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10 ECOLOGICAL IMPACT

10.0.1 As discussed in **Section 3**, various options and combinations of options for the HKBCF and HKLR have been previously investigated, evaluated, assessed and ranked, and the selected option has also been further revised and refined. The ecological impact assessment for the HKBCF and HKLR was based upon the latest layout of the preferred option.

10.1 Legislation and Standards

10.1.1 Ordinances and regulations that are relevant to this study include the following:

- Forests and Countryside Ordinance (Cap. 96) and its subsidiary legislation, the Forestry Regulations;
- Wild Animals Protection Ordinance (Cap. 170);
- Country Parks Ordinance (Cap. 208) and its subsidiary legislation;
- Marine Parks Ordinance (Cap. 476);
- Environmental Impact Assessment Ordinance (Cap. 499) and the associated TM; and
- Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and its subsidiary legislation.

10.1.2 This assessment also makes reference to the following guidelines and standards:

- Hong Kong Planning Standards and Guidelines (HKPSG) Chapter 10, "Conservation";
- PELB Technical Circular 1/97 / Works Branch Technical Circular 4/97, "Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures";
- EIAO Guidance Note No. 6/2002 - Some Observations on Ecological Assessment from the Environmental Impact Assessment Ordinance Perspective;
- EIAO Guidance Note No. 7/2002 – Ecological Baseline Survey for Ecological Assessment;
- EIAO Guidance Note No. 10/2004 – Methodologies for Terrestrial and Freshwater Ecological Baseline Surveys; and
- EIAO Guidance Note No. 11/2004 – Methodologies for Marine Ecological Baseline Surveys.

10.1.3 This assessment also makes reference to the following Mainland legislation:

- List of State Protected Wild Animals, promulgated by the State Council 國家重點保護野生動物名錄.

10.1.4 Other international conventions and guidelines that are relevant to this study include the following:

- Convention on International Trade in Endangered Species of Wild Fauna and Flora ("CITES"). This Convention regulates international trade in animal and plant species considered to be at risk from such trade. Depending on the degree of threat posed by international trade, CITES classifies endangered species of animals and plants into three Appendices. **Appendix I** includes highly endangered species threatened with extinction. Commercial trade in specimens of these species is prohibited. **Appendix II** includes species which are not presently threatened with extinction but may become so unless trade is controlled. Their trade is allowed but subject to licensing controls. **Appendix III** species are species identified by any Party to CITES as requiring cooperation in controlling their trade. Their trade is subject to permits or certificates of origin. Hong Kong's obligations under this Convention are enforced via the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).

- IUCN - The World Conservation Union maintains, through its Species Survival Commission, a "Redlist" of globally threatened species of wild plants and animals (see http://www.iucnredlist.org/static/introduction). The Redlist is considered the authoritative publication to classify species into nine groups as **Extinct** (**EX**) - No individuals remaining; **Extinct in the Wild** (**EW**) - Known only to survive in captivity, or as a naturalized population outside its historic range; **Critically Endangered** (**CR**) - Extremely high risk of extinction in the wild; **Endangered** (**EN**) - Very high risk of extinction in the wild; **Vulnerable** (**VU**) - High risk of extinction in the wild; **Near Threatened** (**NT**) - Likely to become endangered in the near future; **Least Concern** (**LC**) - Lowest risk. Does not qualify for a more at risk category. Widespread and abundant taxa are included in this category; **Data Deficient** (**DD**) - Not enough data to make an assessment of its risk of extinction; **Not Evaluated** (**NE**) - Has not yet been evaluated against the criteria.
- United Nations Convention on Biological Diversity. This convention requires parties to regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use. It also requires parties to promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings. The People's Republic of China (PRC) ratified the Convention on Biological Diversity on 5th January 1993. The HKSAR Government has stated that it is "committed to meeting the environmental objectives" of the Convention (PELB 1996).
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the "Ramsar Convention"), which requires parties to conserve and make wise use of wetlands, particularly those supporting waterfowl populations. The PRC ratified the Ramsar Convention on 31st July 1992, and various wetlands have since been listed as wetlands of international importance (i.e. Ramsar sites). One of these, Mai Po Marshes and Inner Deep Bay Ramsar site in Hong Kong SAR, was listed on 4 September 1995.

10.2 Assessment Area

10.2.1 For HKLR, the alignment covers both marine and terrestrial areas, and there are assessment areas for terrestrial ecology and marine ecology respectively. The assessment area for marine ecology (i.e. aquatic ecology in the EIA Study Brief) is the same as the water quality impact assessment area, i.e. including the following 7 Water Control Zones (WCZ) within HKSAR (**Figure 10.1**) as well as any areas likely to be impacted by the Project.

- Deep Bay WCZ;
- North Western WCZ;
- North Western Supplementary WCZ;
- Victoria Harbour WCZ;
- Western Buffer WCZ;
- Southern WCZ; and
- Second Southern Supplementary WCZ.

10.2.2 The assessment area for terrestrial ecology in HKLR is defined as all areas within 500 m from the site boundary of the land based works areas or the areas likely to be impacted by the Project. Owing to the changes of the alignment, HKLR would go through limited existing land areas, and the terrestrial ecological assessment area (**Figure 10.2**) has significantly reduced in size when compared with the original Study Area during the early stage of the EIA study, which is larger to cover the two conceptual alignment options in the EIA Study Brief No. ESB-110/2003.

10.2.3 For HKBCF, as it is mainly a marine project on new reclamation except some minor connecting slip roads which would involve modifications of the existing road system on Airport Island and most of them have been covered by the HKLR terrestrial ecology assessment area, the assessment area for HKBCF ecology is on marine basis. The marine ecological assessment area for HKBCF is smaller than that of HKLR, and covers the following 4 Water Control Zones (WCZ) within HKSAR as well as any areas likely to be impacted by the Project.

- North Western WCZ;
- North Western Supplementary WCZ;
- Deep Bay WCZ; and
- Western Buffer WCZ.

10.2.4 As the HKBCF marine ecological assessment area is completely covered by the larger HKLR marine ecological assessment area, the present ecological impact assessment (EcoIA) would consider the HKLR marine ecological assessment area.

10.2.5 Key issues of the EcoIA stipulated in the EIA Study Brief ESB-110/2003 and ESB-183/2008 include but are not limited to the following:

Recognized Sites of Conservation Importance

- Tai Ho Stream Site of Special Scientific Interest (SSSI): Tai Ho Stream and inner Tai Ho Wan, important for stream fish, seagrasses, mangroves, and horseshoe crab;
- Lantau North Country Park: a protected area;
- Lantau North (Extension) Country Park: a recently established protected area;
- San Tau Beach Site of Special Scientific Interest (SSSI): with records of seagrasses and mangroves, a horseshoe crab nursery site;
- Sha Chau and Lung Kwu Chau Marine Park: a protected area for the Chinese White Dolphin;
- The proposed marine parks at Fan Lau and Soko Islands; and
- Mai Po Inner Deep Bay Ramsar Site.

Important Habitats

- West Lantau and North Lantau waters (in particular the vicinities along the marine portion of the Project which are frequented by the Chinese White Dolphins);
- Inter-tidal mudflats;
- Mangroves;
- Seagrass beds;
- Horseshoe crab breeding and nursery grounds along the northwest Lantau coastlines including Sham Wat, Hau Hok Wan, San Tau, Tung Chung and Tai Ho Bay;
- Horseshoe crab nursery site at Shui Hau;
- Woodlands;
- Wetlands;

- Natural stream courses and rivers;
- Scenic Hill on Airport Island: supporting a remnant population of the Romer's Tree Frog; and
- Artificial reefs.

Species of Conservation Importance

- Vertebrates: fish, herpetofauna, avifauna, and mammals including bats;
- Macro-invertebrates: butterflies, odonates, crustaceans;
- Inter-tidal and sub-tidal benthic communities;
- Coral communities (including all hard corals, octocorals and black corals);
- Chinese White Dolphin *Sousa chinensis* (CWD);
- Horseshoe crabs and any other notable marine benthic or littoral communities;
- White-green sedge (*Carex leucochlora*); and
- Any other habitats and wildlife groups identified as a special conservation concern by this EIA study.

10.3 Methodology for Baseline Establishment

10.3.1 Introduction

10.3.1.1 The establishment of baseline conditions should include:

- Description of the physical environment;
- Description and quantification of the ecological resources (e.g. wildlife abundance, habitat sizes, food resources); and
- Identification of habitats or locations (e.g. feeding grounds, nursery grounds) that are important to wildlife.

10.3.1.2 Taking account of various factors, the present EIA study covers approximately 6 years (from 2003 – 2009) which is quite long when compared with other EIA studies. The ecological survey programmes for this Project (directly for this EIA or associated with other elements under the Project) were also covered a long time period. Since the commencement of the EIA study for the "Hong Kong – Zhuhai – Macau Bridge and North Lantau Highway Connection" (HZMB/NLHC) (now renamed as Hong Kong Link Road – HKLR) in 2003, ecological baseline data have been continuously collected.

10.3.1.3 To supplement the information obtained from literature reviews, an Ecological Baseline Survey for the HZMB/NLHC Project (i.e. Hong Kong – Zhuhai- Macao Bridge: Hong Kong Section and the North Lantau Highway Connection: Ecological Baseline Survey, hereafter referred as **EBS**) was started in September 2003, prior to the commencement of the EIA study. Based upon the results of an initial literature review, the field surveys of the **EBS** were conducted to provide specific and robust ecological data to prevent data gaps and to establish an ecological profile of its study area. This facilitated, during the early stage of EIA study, the identification, prediction and evaluation of ecological impacts potentially arising from the construction and operation of the Project.

10.3.1.4 The Study Area for the **EBS** covers a large area from Tai Ho to Sham Wat and the southern portion of Airport Island, and the marine waters near North Lantau. (see **Figure 10.3**). This Study Area is large enough to accommodate the two original alignment options shown in the EIA Study Brief ESB-110/2003. The duration of the field surveys is, following the requirements of the EIA Study Brief ESB-110/2003, 9 months covering both wet and dry seasons (September 2003 – May 2004), and the approach and techniques used have made reference to other EIA studies in Lantau (**Appendix 10A**).

10.3.1.5 Since the completion of the **EBS**, the alignment of the HZMB and the NLHC were reviewed and significantly changed due to various considerations including potential ecological impacts on sensitive ecological resources. During this design review stage, field visits (mainly in the eastern and middle part of the study area of **EBS**) and update of literature information (mainly other EIA studies in the area e.g. "Extension of Siu Ho Wan Water Treatment Works – Investigation", and "Feasibility of Lantau Logistics Park") were continued.

10.3.1.6 In mid 2008, when the HKLR alignment (the original HZMB Hong Kong Section and NLHC) was formulated (see **Section 3**), a large-scale Ecological Verification Survey (hereafter referred as **EVS**) was conducted for a duration of 6 months (August 2008 to January 2009) covering wet and dry seasons to verify the validity of the ecological data and information collected in the previous **EBS** as well as from previous literature update and field visits, so as to establish an updated ecological baseline conditions. The items and survey methods applied in this **EVS** followed those in the **EBS,** but the area coverage was shifted to the 500m distance area of the new alignment which mainly follows the airport channel or is located on Airport Island, and would not contact North Lantau landmass.

10.3.1.7 Tuen Mun-Chek Lap Kok Link (TMCLKL), which is interfacing with the HKLR and HKBCF projects, is proposed to provide a traffic link between Tuen Mun and North Lantau. The survey programme for TMCLKL was also commenced in mid 2008, which covers a nine-month period and includes the North Lantau land area near Tai Ho. The area to the east of Tai Ho (e.g. Siu Ho Wan) was also covered by other EIA studies carried out recently, e.g. "Extension of Siu Ho Wan Water Treatment Works – Investigation" approved in end of 2004.

10.3.1.8 In late 2008, the section of HKLR to the east of Airport Island was further revised to reduce the potential visual impacts to Tung Chung Town. As the new alignment of this section would involve additional reclamation on the southeast shore of Airport Island, a Marine Supplementary Survey (hereafter referred as **MSS**) was thus performed to investigate the intertidal and subtidal habitats within the additional reclamation area.

10.3.1.9 All these survey programmes and studies since the commencement of the HKLR EIA study have provided sufficient ecological data over a long time period.

10.3.1.10 The HKBCF EIA study commenced in 2008 after the governments of Hong Kong, Zhuhai and Macau agreed to have separated boundary crossing facilities. Two major issues were considered during the formulation of the methodology for establishing HKBCF ecological baseline. First, the majority of the works of the Project would be limited to the construction and operation of newly reclaimed areas. Direct impacts resulting from these works would mainly be the loss of marine habitats. There would be very limited direct impacts on terrestrial habitats and/or associated fauna.

10.3.1.11 Secondly, there have been many EIA studies and research projects conducted in the vicinity of the Project Site as well as the marine ecological assessment area (particularly North Lantau waters).

10.3.1.12 Available information includes the studies of CT10 at Northwest Lantau, New Contaminated Mud Marine Disposal Facility at Airport East / East Sha Chau Area, Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities, and the ongoing EIA study of TMCLKL, etc.

10.3.1.13 "CT10 (Proposed Port Development at Northwest Lantau)" covered a comprehensive ecological survey programme including a 12-month dolphin survey on the Pearl River Estuary, intertidal survey and horseshoe crab survey in North Lantau area.

10.3.1.14 "New Contaminated Mud Marine Disposal Facility at Airport East / East Sha Chau Area" was an EIA study covering the waters to the north and to the east of Airport Island.

10.3.1.15 "Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities" included two option sites at Black Point and Soko Islands. The study area covered Northwest, West and Southwest Lantau waters.

10.3.1.16 Indirect impacts to habitats and communities within the 500m radius are also anticipated to be limited for the following reasons:

- Areas adjacent to the proposed reclamation site are existing urbanised/disturbed lands (i.e. Airport Island) already subject to high levels of disturbance from road traffic along the coastlines, and therefore of very low ecological value;
- The nearest natural terrestrial habitats (Scenic Hill) are over 500m boundary from the reclamation site and are separated from the reclamation site by urbanised/disturbed lands in between; and
- The only directly affected terrestrial areas would be the existing road system (developed areas) on Airport Island which would require modifications after the reclamation to facilitate road connections (see **Section 3**). The affected areas are located at the eastern Airport Island and are far away from any areas which are recognised of ecological importance.

10.3.1.17 The assessment area for marine ecology in the present EcoIA covers a large sketch of sea areas including 7 water control zones. Besides the four coastal and marine recognised sites of conservation importance in Northwest waters as stipulated in the EIA study brief (i.e. Tai Ho Stream SSSI which also covers the inner Tai Ho Wan, San Tau Beach SSSI, Sha Chau and Lung Kwu Chau Marine Park and the proposed Marine Park at Fan Lau), there are a few others inside the assessment area but far away from the HKLR and HKBCF sites, including Lung Kwu Chau, Tree Island & Sha Chau SSSI, Pak Nai SSSI, Mai Po Inner Deep Bay Ramsar Site, Inner Deep Bay SSSI, Tsim Bei Tsui SSSI, Shui Hau in South Lantau, the proposed marine park in Soko Islands, Sham Wan SSSI in south Lamma, and Cape d'Aguilar Marine Reserve in Hong Kong Island (see **Figure 10.1**). As most of these sites are far away and sheltered from the project site by Lantau Island, they would be unlikely to be impacted by HKLR and HKBCF, as indicated by water quality assessment results (sediment plume would be limited to the vicinity of the reclamation sites, and other water quality criteria would be complied, see **Section 9**). The present EcoIA on marine ecology would thus focus on the North Western Water Control Zone and North Western Supplementary Water Control Zone.

10.3.1.18 Given the above considerations, the best approach for establishing an updated and valid ecological baseline for the Project would be to verify the information collected from previous ecological surveys, recent or ongoing studies/research projects as well as to fill any identified gaps in data coverage by the recent field surveys (i.e. **EVS**, **MSS** and HKBCF field survey programme).

10.3.1.19 Information from literature review and field surveys facilitated the identification, prediction and evaluation of ecological impacts potentially arising from the construction and operation of the Project.

10.3.2 Literature Review Methodology

10.3.2.1 Relevant ecological studies were thoroughly reviewed, including those listed in Appendix E of the EIA Study Brief ESB-110/2003. Other relevant sources, including the Terrestrial Biodiversity Survey conducted by HKU, ongoing Biodiversity Survey conducted by AFCD, ongoing academic research and data-gathering efforts (e.g. HK Bird Watching Society, Hong Kong Lepidopterist's Society) were also reviewed. Species groups of concern were identified based on background information on the study areas, field survey results from **EBS**, **EVS**,

MSS of HKLR and ecological surveys of HKBCF, and consultation with relevant government authorities. Desk-top study and field survey results produced a complete picture of the ecology of the assessment area. Major literature more relevant to the present EIA study included:

- "Population Biology of the Indo-Pacific Hump-backed Dolphin in Hong Kong Waters", *Wildlife Monographs 2000 October No. 144: 1-65*;
- "Distribution and abundance of Finless Porpoises in Hong Kong and adjacent waters of China", *Raffles Bulletin of Zoology (Supplement) 2002 No. 10: 43-55*;
- "Monitoring of Marine Mammals in Hong Kong waters – Data Collection: Final Report (10 April 2008 to 31 March)" (AFCD 2009);
- "Monitoring of Chinese White Dolphin (*Sousa chinensis*) in Hong Kong waters – Biopsy Sampling and Population Data Analysis: Final Report" (AFCD 2007);
- "Habitat use by Hong Kong amphibians: with special reference to the ecology and conservation of *Philautus romeri*" (Lau 1998);
- "Avifauna of Hong Kong" (Carey *et al*. 2001);
- "Consultancy Study on Marine Benthic Communities in Hong Kong" (CCPC 2002);
- "Conservation of Horseshoe Crabs in Hong Kong – Final Report (ECF Project 12/2003)", (Shin *et al*. 2007);
- "Ecological Status and Revised Species Records of Hong Kong's Scleractinian Corals" (AFCD 2004);
- "Field Guide to Hard Corals of Hong Kong" (Chan *et al*. 2005).
- Annual report and other publications of The Hong Kong Bird Watching Society;
- Memoirs of Hong Kong Natural History Society;
- Porcupine! – newsletter of Department of Ecology & Biodiversity of University of Hong Kong;
- Biodiversity – newsletter of AFCD; and
- Other relevant reports from private sectors or Government.

10.3.2.2 Relevant information contained in the above reports was incorporated into this EcoIA.

10.3.2.3 Other relevant EIA studies included:

- The Feasibility Study of Additional Cross-border Links, Stage 2 (Crosslinks Further Study Stage 2);
- Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study;
- Airport EIA study;
- Agreement No. CE 32/96 Study on Tonggu Waterway;
- EIA-040/2000 Northshore Lantau Development Feasibility Study;
- EIA-042/2000 Tai O Sheltered Boat Anchorage;
- EIA-075/2002 Improvement to Tung Chung Road between Lung Tseng Tau and Cheung Sha;
- EIA-082/2002 Shenzhen Western Corridor;
- EIA-077/2002 Permanent Aviation Fuel Facility for Hong Kong International Airport;
- EIA-081/2002 Construction of Lung Kwu Chau Jetty;

- Proposed Port Development at Northwest Lantau (CT10);
- EIA 090/2003 Tung Chung – Ngong Ping Cable Car Project;
- EIA 100/2004 Extension of Siu Ho Wan Water Treatment Works – Investigation (Metcalf & Eddy Ltd. 2004);
- EIA 106/2005 New Contaminated Mud Marine Disposal Facility at Airport East / East Sha Chau Area;
- EIA 125/2006 Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities; and
- EIA study for Feasibility of Lantau Logistics Park.

10.3.2.4 The validity of the information compiled during the literature review was assessed before it had been adopted into the present EIA study and was verified on-site during the ecological field surveys for the present Project (see below).

10.3.3 Identification of Information Gap

10.3.3.1 Surveys on Chinese White Dolphin have been conducted in Hong Kong waters since 1996 and have also been conducted off North Lantau for various EIA studies recently. The territory-wide AFCD dolphin monitoring programme covers 9 zones in Hong Kong waters including Western and North Lantau waters, with vessel survey transects within each zone (AFCD 2009). Further dolphin surveys were conducted in North Lantau waters during the EIA study for TMCLKL and in West Lantau waters during the EIA study for CT10. The information from these recent studies is sufficient for establishing the baseline conditions of CWD within the assessment area in particular in the vicinity of the Project Site. Field surveys for CWD for the Project are therefore not necessary.

10.3.3.2 While for other aspects on ecology, field surveys for the purpose of verifying and updating the information from literature were proposed. The scope of the field surveys covered habitat, vegetation, terrestrial fauna, intertidal fauna, marine benthic communities and corals. Details of the surveys are given in below sections.

10.3.4 Ecological Field Survey Methodology

9-month Ecological Baseline Survey for HZMB / NLHC (EBS)

10.3.4.1 The Study Area for the EBS (the same as the Study Area of the HZMB Project as shown in Appendix H in the Brief for the Project) covers a large area from Tai Ho to Sham Wat and the southern portion of Airport Island, and the marine waters near North Lantau. The duration of the field surveys is 9 months (September 2003 – May 2004) covering both wet and dry seasons.

10.3.4.2 The field surveys of the EBS covered all marine and terrestrial sites, habitats and species of conservation within the study area (**Figure 10.3**), and included the following items:

- Habitat survey and mapping;
- Vegetation survey with special attention on seagrass beds and mangroves;
- Bird survey;
- Terrestrial invertebrate survey;
- Herpetofauna survey;
- Mammal survey;
- Freshwater fish survey;
- Freshwater invertebrate survey;
- Intertidal epifauna survey;
- Horseshoe crab survey;

- Subtidal benthic infauna survey;
- Coral survey; and
- Chinese White Dolphin study based upon literature.

10.3.4.3 Findings of the EBS were incorporated into the baseline description of the study area in the survey report. Readers are referred to the final survey report for the EBS (**Appendix 10A**) for details of survey methods and data.

Ecological Verification Survey (EVS)

10.3.4.4 When the EIA study for the HKLR resumed in 2008, a large-scale and comprehensive Ecological Verification Survey (**EVS**) was planned, to verify the validity of the existing ecological data previously collected and to update the ecological baseline information before the detailed assessment is performed.

10.3.4.5 The items and survey methods applied in this EVS followed those in the EBS, but the area coverage was shifted to the 500m distance area along the new alignment which mainly follows the airport channel or is located on Airport Island, and would not contact the North Lantau landmass.

10.3.4.6 Terrestrial surveys (see below sections) were conducted in all the land areas within 500m from the mid-2008 HKLR alignment (see **Figure 10.3**), on North Lantau and Airport Island for a 6-month duration covering both wet season and dry season (August 2008 to January 2009).

10.3.4.7 It is noted that the eastern part of the mid-2008 HKLR alignment (the sea viaduct offshore to the eastern coast of Airport Island) was revised in late 2008 to an at-grade road along the airport island shoreline on new reclamation, so as to reduce the visual impact to Tung Chung Town. Under the latest alignment, additional land areas on Airport Island would fall within the 500m assessment area. But these additional land areas are all developed area on the Airport Island, and with a significant portion inside restricted area of Airport. The natural habitats within the current 500m assessment area have already completely covered by the EVS study. Given that, the information from the EVS would be sufficient for the ecological assessment purposes.

10.3.4.8 Habitat and vegetation surveys were conducted within in the 500m area. Surveys covered all habitat types. The survey locations are selected prior to the field survey through aerial photographs and data from the baseline survey. During the surveys, the locations of rare or protected plant species were recorded with their number, and photos were taken. Lists of the plant species recorded in wet and dry seasons in each habitat with relative abundance were provided. Plant species which were not reported in the EBS but are found in the EVS were highlighted. A habitat map of suitable scale was provided.

10.3.4.9 Mammal surveys - Traces, tracks and scats of mammals were searched and recorded. Since most mammals are nocturnal, night surveys were also conducted. All mammals were identified to species level and the abundance was recorded. Lists of the mammal species recorded in wet and dry seasons in each habitat with abundance were provided.

10.3.4.10 Reptile and amphibian surveys in the 500m distance area were conducted by active searching in all habitats, with particular attention given to potential shelters sites and hiding places such as litters, streams and watercourses. Special attention was paid on Scenic Hill on Airport Island where Romer’s Tree Frog was previously recorded by AFCD (Chan *et al*. 2005). Frogs and toads were surveyed by auditory as well as visual detection. As most of the amphibian species are more active during night time, night surveys were conducted. All herpetofauna were identified to species level and the abundance was recorded. Lists of the herpetofauna species recorded in wet and dry seasons in each habitat with abundance were provided.

10.3.4.11 Avifauna surveys - Transect count method was used to survey the avifauna present in the 500m distance area. Sampling transects were recorded on map. In addition, night surveys, with binoculars and powerful search lights, were conducted in order to assess the activity of nocturnal species, e.g., owls, nightjars. All birds were identified to species level and the abundance was recorded. List of the bird species recorded in wet and dry seasons in each habitat with abundance was provided.

10.3.4.12 Dragonfly surveys - Dragonflies were surveyed following the same transects used for bird surveys. Dragonflies were identified with the aid of binoculars, and a telescopic hand net was used to capture specimens for identification in the hand (when necessary). All dragonflies were identified to species level and the abundance was recorded. Lists of the dragonfly species recorded in wet and dry seasons in each habitat with abundance were provided.

10.3.4.13 Butterfly surveys were conducted in tandem with the dragonfly surveys, using similar methodology. Potential microhabitats, e.g., ground and canopy of woodland were searched and sweep with a long-handled (5m) butterfly net. All butterflies were identified to species level and the abundance was recorded. Lists of the butterfly species recorded in wet and dry seasons in each habitat with abundance were provided.

10.3.4.14 Stream surveys - Fish and invertebrates present in streams within the 500m distance area were identified and recorded by direct observation, dip-netting and active sampling. All aquatic fauna were identified to species level as far as possible and abundance recorded. Lists of the aquatic species recorded in wet and dry seasons in each stream with abundance were provided.

10.3.4.15 Intertidal surveys were conducted on both hard (including natural and artificial coastlines) and soft shores along the Airport Channel and on Airport Island, during both wet season and dry season (September 2008 and December 2008). All intertidal surveys were conducted during suitable ebbing tides.

10.3.4.16 Horizontal transects (at least 50m in length) at three tidal levels (High, Middle and Low) were established on each of the landing points of HKLR covering natural and artificial coastlines. There were ten 0.5m x 0.5m quadrats on each transect. The epifauna in each quadrat were identified and their numbers/coverage percentages were recorded. Species and abundance of biota in quadrats were reported. Diversity index, evenness index and other statistical analyses were provided for evaluating and ranking the ecological values.

10.3.4.17 Detailed active search surveys along the shores were also conducted to find out the species present and their occurrence in the survey locations in addition to the transect surveys, so as to produce a comprehensive species lists of the survey areas. Photos of the recorded species were taken where possible.

10.3.4.18 The embayments along and in the vicinity of Airport Channel, namely Sham Wat, San Shek Wan, Sha Lo Wan, Hau Hok Wan, San Tau and Tung Chung Bay, were surveyed.

10.3.4.19 In each site, horizontal transects (at least 50m in length) at three tidal levels (High, Middle and Low) were established. There were ten 0.5m x 0.5m quadrats on each transect. The epifauna and infauna (within the top 5cm sediment) in each quadrat were identified and their numbers/coverage percentages were recorded. One core of 10cm diameter x 20cm depth was also collected within each quadrat. The sediments of the cores was sieved with 2mm mesh-size sieve and the biota inside were identified and counted. Species and abundance of biota in both cores and quadrats were reported. Diversity index, evenness index and other statistical analyses were provided for evaluating and ranking the ecological values.

10.3.4.20 Seagrass surveys and horseshoe crab surveys were also conducted at the above soft shore sites. The sites were thoroughly searched for the seagrasses and horseshoe crabs during suitable ebbing tides. The species, number, sizes of horseshoe crabs and the species, area sizes and coverage percentages of seagrasses were recorded, and the locations of horseshoe crabs and the locations and extents of seagrasses were mapped. Photos of seagrasses and horseshoe crabs found during the surveys were taken.

10.3.4.21 Dive surveys for corals and other hard substrate marine organisms were conducted. As spot dives within and outside the Airport Channel had been previously conducted during the 9-month ecological baseline survey, the verification survey concentrated on shallow coastal waters that are potentially subject to direct loss of marine habitats, including the landing points of HKLR at both natural and artificial coastlines along Airport Channel and on Airport Island, and indirect impacts due to change of water quality and hydrodynamic condition, including the coastlines to the east and to the west of Airport Channel.

10.3.4.22 Semi-quantitative Rapid Ecological Assessment (REA) surveys were conducted at each survey location. The REA survey was performed along 100m underwater transects horizontal to the coastlines. Transects perpendicular to the coastline of 50m to 100m (subject to the underwater visibility) was also performed. The depth and substrate along the perpendicular transects for REA were recorded at 3m intervals, or at smaller intervals if the gradient significantly changes along the transects. The benthic cover, taxon abundance, and ecological attributes of the transects were recorded in a swathe of 2m wide, 1m either side of the transects (subject to the underwater visibility), following the Rapid Ecological Assessment (REA) technique. The exact locations and routes of the REA transects were recorded on site by GPS and map. Video footages and photos along the transects and of the surveyed areas were taken during the dive surveys.

10.3.4.23 The purposes of the REA survey are to quantitatively record the habitat types and ecological values of the area by SCUBA diving and the application of Rapid Ecological Assessment (REA) approach. The REA approach (see **Annex A** in **Appendix 10B** for details) will aim at collecting data on the type of substrate and the abundance of marine organisms in particular the occurrence of corals and the extent of the coral distribution from the coastline, for ranking the ecological values. Other parameters to be recorded during the surveys included site condition (e.g. observations regarding the degree of exposure of the sites to wave action), species list of corals and other marine organisms, coral sizes, coral health status, and translocation feasibility of corals.

10.3.4.24 Marine grab samplings on soft substrate seabed for benthic communities were conducted at 9 stations along the mid-2008 HKLR alignment during both wet season and dry seasons (September 2008 and December 2008). Three grab sample replicates of $0.1m^2$ were collected in each of the sampling stations by van Veen Grab (or other sampling devices with equivalent surface area coverage). Collected samples were sieved by 0.5mm mesh-size sieve and then preserved in 5% buffered seawater formalin. Organisms inside the samples were sorted from the sediments by staining with Rose Bengal and then identified to the lowest practicable taxonomic level. Species composition, abundance and biomass were reported. Diversity index, evenness index, Abundance/Biomass Comparison (ABC) plots and other statistical analyses should be provided for evaluating and ranking the ecological values.

HKBCF Ecological Survey

10.3.4.25 HKBCF is a new element for the HZMB after 2008. It would involve large-scale reclamation near the Airport Island, and thus an in-depth marine ecological survey programme was formulated to investigate the proposed reclamation site and its vicinity.

10.3.4.26 Dive surveys for corals and other hard substrate marine organisms were conducted in September 2008. The dive surveys concentrated on shallow coastal waters that would be subject to direct loss of marine habitats or indirect water quality impacts, including both natural and artificial coastlines at the northeast of Airport Island. The methodology used in the present survey followed those adopted in the AFCD territory-wide dive survey conducted in 2001-2002 (AFCD 2004). It consisted of a suite of three standardized “nested” survey methods including spot-check dive reconnaissance dives, Rapid Ecological Assessment (REA) and video transects. In the present study, due to the highly turbid water and the low diversity and coverage of marine fauna, video transect was not performed. The spot-check and REA methods were used and were found sufficient for establishing the ecological profile of the study area.

10.3.4.27 Spot reconnaissance dives were conducted 17 spot-check dives were conducted and covered: 1) along the coastlines of Northeast Airport Island (8 spots), with focus concentrated on the section opposite to the future BCF reclamation area, ; 2) as well as within the future BCF reclamation area covering the entire proposed reclamation site (9 spots). The locations for spot reconnaissance dives are shown in **Figure 10.3** and **Appendix 10D**. Visual reconnaissance was made of the area of each bounce dive point. The purposes of the spot reconnaissance dives are to verify whether corals (including all hard corals, octocorals and black corals) and other marine organisms with conservation importance are present within the areas potentially subject to direct impacts (e.g. the reclamation area and the fire station seawalls) and indirect impacts (e.g. some sections of the Airport Island coastlines). As the underwater visibility is low in North Lantau waters, during the reconnaissance dives circular path at each dive spot was adopted (a continuous route might be difficult under the very low visibility). Besides the biota, the habitat types present within the areas and their approximate proportions/distributions were also recorded. Underwater photographs were also taken.

10.3.4.28 In accordance with the findings from the spot-check dives, a REA was conducted along the seawall which was found to be the only area with hard bottom substrate habitat within the dive survey study area. Semi-quantitative Rapid Ecological Assessment (REA) survey was conducted at the two major locations, i.e. where the BCF connecting on Airport Island, and the Automatic People Mover location. The REA survey at the two major areas was performed along 100m underwater transects horizontal to the coastlines. Transects perpendicular to the coastline up to 50m in length (limited by the low underwater visibility) were also performed. The depth and substrate along the perpendicular transects for REA were recorded. The benthic cover, taxon abundance, and ecological attributes of the transects were recorded in a swathe of 2m wide, 1m either side of the transects, following the Rapid Ecological Assessment (REA) technique. The REA transect locations are shown in **Figure 10.3**. Video footages and photos were taken during the dive surveys.

10.3.4.29 The purposes of the REA survey are to quantitatively record the habitat types and ecological values of the area by SCUBA diving and the application of Rapid Ecological Assessment (REA) approach. The REA approach aims at collecting data on the type of substrate and the abundance of marine organisms in particular the occurrence of corals and the extent of the coral distribution from the coastline, for ranking the ecological values. Other parameters to be recorded during the surveys included site conditions (e.g. observations regarding the degree of exposure of the sites to wave action), species list of corals and other marine organisms, coral sizes, coral health status, and translocation feasibility of corals.

10.3.4.30 Marine grab samplings for benthic communities were conducted at 9 stations within the BCF reclamation area (see **Figure 10.3**) during both wet season and dry season (September and December 2008). Five grab sample replicates of $0.1m^2$ were collected in each of the sampling stations by van Veen Grab. Collected samples were sieved by 0.5mm mesh sieve and then preserved in 5% buffered seawater formalin. Organisms inside the samples were sorted from the sediments by staining with Rose Bengal and then identified to the lowest practicable taxonomic level. Species diversity, abundance and biomass were reported for evaluating and ranking the ecological values.

10.3.4.31 Intertidal surveys for epifauna communities were conducted on both natural and artificial coastlines at the northeast of Airport Island, during both wet season and dry season (August and November 2008).

10.3.4.32 Horizontal transects at three tidal levels (High, Middle and Low) were established on each of the natural and artificial coastlines and cover the landing points of the connecting roads on Airport Island. The locations of the intertidal transects are shown in **Figure 10.3**. There were ten 0.5m x 0.5m quadrats on each transect.

The epifauna in each quadrat were identified and their numbers/coverage percentages were recorded. Species diversity and abundance were reported for evaluating and ranking the ecological values.

10.3.4.33 In addition to the above quantitative surveys, walk-through surveys were also conducted in the survey extent to facilitate the smooth implementation of the ecological survey and to help audit the survey findings. Walk-through survey aimed at to find out the species present and their occurrence and hence facilitate the determination of representative sites for conducting quantitative surveys. Effort spent in walk-through surveys, such as number of surveyors involved and time-spend were recorded.

HKLR Marine Supplementary Survey

10.3.4.34 Intertidal surveys for epifauna communities were conducted at four locations on the southeast shore of Airport Island (**Figure 10.3**), covering both natural and artificial coastlines as well as hard and/or soft (if any) shore habitats, during both wet and dry seasons. The survey frequency of intertidal survey were four (two in dry season and two in wet season, December 2008, February 2009, April 2009 and May 2009), with a view to compensating the relatively short survey period by higher survey efforts. All intertidal surveys were conducted during suitable ebbing tides.

10.3.4.35 In each location, horizontal transects (at least 50m in length) at three tidal levels (High, Middle and Low) were established. There were ten 0.5m x 0.5m quadrats on each transect. For hard shores, the epifauna in each quadrat were identified and their numbers/coverage percentages were recorded. For the soft shores, in addition to the epifauna, the infauna within the top 5cm sediment inside the quadrat as well as from one core (10cm diameter x 20cm depth) collected inside the quadrat were also identified and recorded. Species and abundance of biota in quadrats were reported. Diversity index, evenness index and other statistical analyses were provided for evaluating and ranking the ecological values.

10.3.4.36 In addition to the above quantitative surveys, walk-through surveys were also conducted in the survey extent to facilitate the smooth implementation of the ecological survey and to help audit the survey findings. Undertaking an initial observation along the shore, for example, could find out the species present and their occurrence and hence facilitate the determination of representative sites for conducting more detailed quantitative surveys. A walk-through survey along the transect during or after a quantitative sampling event could also help assess whether the sampling exercise has collected representative data (e.g. the number and type of species encountered) and whether the sampling effort is deemed adequate. Effort spent in such qualitative surveys, such as number of surveyors involved and time spent were recorded.

10.3.4.37 Dive surveys for corals and other hard substrate marine organisms were conducted. The dive surveys focused on shallow coastal waters within the survey extent, i.e. both natural and artificial coastlines at the southeast of Airport Island.

10.3.4.38 Spot reconnaissance dives were conducted along the coastlines of Southeast Airport Island, i.e. within the survey extent. There were eight dive spots within the survey extent. The locations for spot reconnaissance dives are shown in **Figure 10.3**. The purpose of the spot reconnaissance dives is to verify whether corals (including all hard corals, octocorals and black corals) and other marine organisms with conservation importance are present within the areas potentially subject to direct impacts (e.g. the survey extent).

10.3.4.39 Circular paths at each dive spots were adopted during the reconnaissance dives as the underwater visibility is found too low for continuous routes. Besides the biota, the habitat types present within the areas and their approximate proportions/distributions were also recorded. Photos of each spot dive locations, underwater photos, and underwater video footages were taken during the spot dive surveys.

10.3.4.40 In accordance with the findings of the spot dives, semi-quantitative Rapid Ecological Assessment (REA) surveys were conducted in two locations within the survey extent. The REA surveys were performed along 100m underwater transects horizontal to the coastlines. Transects perpendicular to the coastline of 50m to 100m (subject to the underwater visibility) were also performed. The depth and substrate along the perpendicular transects for REA were recorded at 3m intervals. The benthic cover, taxon abundance and ecological attributes of the transects were recorded in a swathe of 2m wide, 1m either side of the transects, following the REA technique. The exact locations and routes of the REA transects were recorded on site by GPS and map. Photos of each REA locations, underwater video footages and underwater photos along the transects and of the surveyed areas were taken during the REA dive surveys.

10.3.4.41 The purposes of the REA survey are to quantitatively record the habitat types and ecological values of the area by SCUBA diving and the application of REA approach. The REA approach aimed at collecting data on the type of substrate and the abundance of marine organisms in particular the occurrence of corals and the extent of the coral distribution from the coastline, for ranking the ecological values. Other parameters to be recorded during the surveys included site condition (e.g. observations regarding the degree of exposure of the sites to wave action), species list of corals and other marine organisms, coral sizes, coral health status, and translocation feasibility of corals. The conservation status of the recorded biota were provided.

10.3.4.42 Marine grab samplings on soft substrate seabed for benthic communities were conducted at eight stations within the survey extent during both wet season and dry season (December 2008 and May 2009). The survey extent and the indicative sampling locations are shown in **Figure 10.3**. Five grab sample replicas of $0.1m^2$ were collected in each of the sampling stations by van Veen Grab (or other sampling devices with equivalent surface area coverage). Collected samples were sieved by 0.5mm mesh-size sieve and then preserved in 5% buffered seawater formalin. Organisms inside the samples were sorted from the sediments by staining with Rose Bengal and then identified to the lowest practicable taxonomic level. Species composition, abundance and biomass were reported. Diversity index, evenness index and Abundance/Biomass Comparison (ABC) plots were provided for evaluating and ranking the ecological values. The conservation status of the recorded biota were provided.

TMCLKL Ecological Survey

10.3.4.43 TMCLKL ecological survey programme covered a 9-month period. Besides the terrestrial surveys conducted in Tuen Mun and Tai Ho (both are outside the current 500m terrestrial assessment area for the present Project), the TMCLKL survey also included marine and intertidal surveys in North Lantau waters which are more relevant to the assessment. The TMCLKL marine and intertidal survey covered dolphin vessel survey (systematic line-transect survey in North Lantau waters), Benthic grab survey, Intertidal flora and fauna survey, and Coral dive survey.

10.3.4.44 Details of the methodology of the ecological surveys for TMCLKL are provided in the separate EIA Report for TMCLKL.

10.4 Baseline Conditions

10.4.1 Terrestrial Ecological Baseline within the EBS Study Area

10.4.1.1 The below **Sections 10.4.1** and **10.4.2** cover fauna and flora in terrestrial habitats including freshwater streams.

Terrestrial Sites of Conservation Importance within the EBS Study Area and the current 500m Assessment Area

10.4.1.2 The original Assessment Area for terrestrial ecological impact assessment of the Project (i.e. the study area for the 9-month **EBS**) is located in North Lantau near the airport, stretching from Sham Wat to Tai Ho Wan. Although this area is located on the coast of north Lantau, which is not considered as important for tourism as southern Lantau and has been a focus of development since the airport project and Tung Chung development, there are still sites of conservation importance, important habitats and species of conservation importance occurring here.

10.4.1.3 The recognised sites of conservation importance within this original assessment area include (**Figure 10.2**):

- Tai Ho Stream SSSI;
- Pok To Yan and Por Kai Shan SSSI;
- Lantau North Country Park;
- San Chau SSSI;
- Lantau North (Extension) Country Park; and
- San Tau Beach SSSI.

10.4.1.4 Other sites in the original assessment area that have been identified during the EIA as of conservation importance include:

- Bat roost in Tai Ho Wan;
- Pak Mong fung shui wood;
- San Tau fung shui wood;
- Sha Lo Wan fung shui wood; and
- The Scenic Hill on Airport Island (which supports a remnant population of the Romer's Tree Frog).

10.4.1.5 However a larger portion of these sites of conservation importance are now outside the current 500m assessment area and far away from the HKLR footprint. Only three of the above sites of conservation importance still fall within the current 500 m assessment area, i.e. Lantau North (Extension) Country Park; San Tau Beach SSSI and Scenic Hill.

10.4.1.6 Lantau North (Extension) Country Park **(Figure 10.2)** covers an area on the slope of Nei Lak Shan just uphill from Sha Lo Wan and the hill slopes to the south of North Lantau Highway between Tai Ho Wan and Siu Ho Wan. It falls within the study area of the 9-month EBS as well as the current 500m assessment area. In addition to the existing 7,800ha of designated Lantau North and South Country Parks, the Lantau North (Extension) Country Park was proposed in the 1999 Policy Address as a positive means to conserve the natural environment of Lantau, gazetted in 2001, and was designated in 2008.

10.4.1.7 Scenic Hill is a small hill at the southeast end of Airport Island. Romer's Tree Frog is endemic to Hong Kong and is protected under the Wild Animals Protection Ordinance (Karsen *et al*. 1998). Ngong Ping is known to support the largest population of this endemic frog (Lau 1998) and has been designated as a Site of Special Scientific Interest (SSSI) for this reason.

10.4.1.8 Before construction of the airport, Chek Lap Kok was one of the few islands on which Romer's Tree Frog was found in Hong Kong. A translocation programme was implemented as a mitigation measure for the PADS project. Though the translocation programme was successful, it is possible that a remnant population still inhabiting the only remaining natural area on the airport island, i.e. the Scenic Hill.

10.4.1.9 San Tau Beach SSSI is a seagrass site and is described in the sections on intertidal ecology below.

<u>Habitats and Vegetations inside the EBS Study Area</u>

10.4.1.10 The habitats recorded within the study area for the EBS include secondary woodland, plantation woodland, tall shrubland, shrubby grassland, cultivated land, mangrove and seagrass, salt marsh, stream, wasteland, and developed area (see **Appendix 10A**). The information of terrestrial habitats is given in the sections below, while intertidal habitats such as mangrove & seagrass and salt marsh are discussed under the sections on intertidal ecology.

Table 10-1 Coverage of Different Habitats within the Study Area for the EBS

Habitat Type	Area (ha)	No. of plant species recorded
Secondary Woodland	302.54	217
Plantation Woodland	6.57	125
Tall Shrubland	22.17	185
Shrubby Grassland	191.8	153
Cultivated Land/Orchard	59.9	126
Mangrove and Seagrass	10.57	85
Salt Marsh	1.63	74
Stream/riparian	5.36	N/A
Wasteland	2.64	159
Developed Area	483.9	129

10.4.1.11 A total of 475 plant species were recorded within the study area (**Appendix 10A**). The description of habitats below follows **Appendix 10A** unless otherwise specified.

Secondary Woodland

10.4.1.12 Notable woodland patches can be found at Tai Ho Wan headland and adjacent to Sha Lo Wan San Tsuen. This habitat is extensive and relatively rich in flora with a total of 217 recorded plant species.

10.4.1.13 Major/dominant plant species included trees *Aporosa dioica*, *Bridelia tomentosa*, *Litsea glutinosa*, *Mallotus paniculata*, *Schefflera octophylla* and *Sterculia lanceolata*. Dominant shrub species included *Litsea rotundifolia*, *Ilex asprella* and *Psychotria rubra*. Of the plant species recorded, only the shrub *Pavetta hongkongensis* was protected under the law but this species in considered common (Xing *et al*. 2000).

10.4.1.14 Woodlands within the study area also consisted of fung shui woods at Tung Chung near the villages of San Tau and Sha Lo Wan.

Plantation Woodland

10.4.1.15 Plantation woodland habitats were mainly located either on the hill slopes or near developed areas. The vegetation was dominated by species with either high amenity value or pioneer species and was comprised of *Acacia confusa, Dimocarpus longan, Ficus hirta, Mallotus paniculata, Microcos paniculata* and *Pinus massoniana*. The understorey shrub consisted of *Ilex asprella, Litsea rotundifolia* and *Vitex negundo* var *negundo*, the climbers, *Lygodium japonicum* and *Embelia laeta*. The understorey shrub communities were not particularly diverse. Fung shui woods at Pak Mong, which lies on the boundary of the eastern study area and was found being heavily modified, is categorised under this habitat type. A total of 125 plant species were present in the plantation woodland habitats. *Aquilaria sinensis* is listed under State Protection (Category II) and is considered “Near Threatened” in the China Plant Red Data Book. However, this species is common in Hong Kong (Xing *et al*., 2000).

Tall Shrubland

10.4.1.16 Tall shrubland occurred along the coast of Tung Chung to Sham Wat and was dominant on the hill-slope of the Tai Ho Wan headland. This habitat type was densely populated with a mix of native tree and shrubby plant species.

10.4.1.17 A total of 185 plant species were recorded in this habitat. Species found commonly in this habitat included trees such as *Acronychia pedunculata*, *Cratoxylum cochinchinense*, *Schefflera octophylla*, *Rhus succedanea* and *Mallotus paniculatum, Sapium discolor*; the shrubs *Eurya japonica, Litsea rotundifolia, Melastoma sanguineum* and *Rhaphiolepis indica,* the climbers *Alyxia sinensis, Lygodium japonicum, Cassytha filiformis, Tetracera asiatica* and *Embelia ribes;* as well as the herbs *Dianella ensifolia* and *Dicranopteris pedata.*

10.4.1.18 *Carex tristachya* is a rare sedge (Xing *et al*. 2000) recorded in this habitat in Hau Hok Wan and patches of the orchid *Eulophia graminea* were found near tall shrubland habitats at Hau Hok Wan and Sha Lo Wan. The locally protected *Pavetta hongkongensis* was also recorded in this habitat.

Shrubland-Grassland Mosaic

10.4.1.19 The shrubby grassland is composed of a range of plant species showing various growth forms (from herbaceous ferns to woody tree species) that are patchily distributed on the hill-slopes and mostly located at higher elevations. Generally, this habitat type is open in structure and has a vegetation height of less than 2m. Moreover, it is believed that part of this mosaic may be disturbed frequently by hill-fire as evidenced by the presence of patches of the fire-resistant fern *Dicranopteris pedata*, especially in the areas behind the burial grounds.

10.4.1.20 153 plant species were recorded in this habitat. Trees were not particularly diverse and most common species included *Ficus variolosa*, *Aporosa dioica* and *Cratoxylum cochinchinense.* However, many shrub species were recorded including *Baeckea frutescens*, *Aster baccharoides*, *Breynia fruticosa*, *Melastoma sanguineum* and *Helicteres angustifolia.* Herbs included *Arundinella setosa*, *Eremochloa ciliaris*, *Eulalia* spp., *Grewia biloba*, *Inula cappa*, *Ischaemum rugosum* together with climbers, *Alyxia sinensis*, *Cassytha filiformis*, *Lygodium japonicum*, *Millettia nitida* and *Morinda umbellata.* Plant species in this habitat were similar to those present in the tall shrubland although fewer tree species were recorded. Three protected orchids *Acampe rigida, Arundina chinensis* and *Cleisostoma simondii* were recorded in this habitat. Although all three species are common in Hong Kong (Siu 2000), all members of the orchid family (Orchidaceae) are protected under the Forestry Regulations in Hong Kong.

Cultivated Field / Orchard

10.4.1.21 Cultivated field/orchards include both active, inactive cultivation and orchards. Cultivated fields are mainly scattered among the village areas and mostly distributed along the coast of the study area. These are planted with fruit trees and ornamental plants such as *Litchi chinensis*, *Dimocarpus longan*, *Clausena lansium*, *Citrus* sp., and some widespread herbs including *Lantana camara*, *Solanum torvum* and *Lygodium japonicum*. A total of 126 plant species were present in this habitat although no rare or protected plant species was recorded.

Stream / Riparian

10.4.1.22 Many stream courses in the EBS study area are seasonal, or of very low base flow. These low base-flow streams are considered of lower ecological value than the permanent streams with reliable discharge to support aquatic life year-round.

10.4.1.23 The streams in the study area pass through various vegetated habitats such as woodlands, grassland-shrubland mosaic and cultivated fields. Riparian vegetation is broadly similar to that of the surrounding habitats, comprising secondary woodland and shrubby grassland.

Wasteland

10.4.1.24 Wasteland is mostly found in heavily disturbed or previously developed areas. This habitat type is poorly represented within the EBS study area.

10.4.1.25 In general, the species diversity of this habitat is poor and its structural complexity is simple. The vegetation on wasteland is dominated by weedy herbaceous ruderal plants; such as the common herbs, *Cynodon dactylon*, *Panicum maximum*, *Lygodium japonicum* and the climbers *Mikania micrantha* and *Pueraria lobata.*

Developed Area

10.4.1.26 The developed area refers to urbanised areas including roads, buildings and villages that can be found in Chek Lap Kok, Tung Chung and some scattered in the western part of the study area. This habitat is man-made.

10.4.1.27 The vegetation is predominantly composed of herbs and climbers, and occasionally with some planted or orchard trees such as *Casuarina equisetifolia*, *Bambusa* sp., *Clausena lansium* and *Averrhoa carambola*. Despite some observations of restricted species, the 129 plant species recorded in the developed areas are common and widespread in Hong Kong. No rare or protected plant species was recorded.

<u>Terrestrial Fauna inside the EBS Study Area</u>

Mammals inside the EBS Study Area

10.4.1.28 Only two species of non-flying mammals were recorded in the EBS study area (Table 5.14 in **Appendix 10A**). These were the Indian Muntjac *Muntiacus muntjak* and Brown Musk Shrew *Suncus murinus*. Both are considered locally common (**Appendix 10A**). Sighting of Indian Muntjacs was made within the terrestrial study area of the EBS at tall shrubland at Sham Shek Tsuen in April 2004. Unidentified insectivorous bats were observed at Tai Ho Wan, Sham Wat and San Shek Wan during night surveys in February, April and May 2004 (*ibid*.).

10.4.1.29 Diversity of medium to large non-flying mammals on Lantau is low. Three species of non-flying mammal, i.e. the Chinese Ferret Badger *Melogale moschata*, Wild Boar *Sus scrofa* and Indian Muntjac were recorded on Lantau Island using camera traps (Shek *et al*. 2007). All are present in low abundance on Lantau (*ibid*.). Chinese Ferret Badger and Indian Muntjac are protected under the Wild Animals Protection Ordinance.

10.4.1.30 A number of rodents, including Sikkim Rat *Rattus sikkimensis*, *R*. *rattus flavipectus*, Norway Rat *R*. *norvegicus* and *Bandicota indica* were recorded at Chek Lap Kok by Chandrasekar-rao (1994). *Rattus r. flavipectus* was recorded at the back of the Tung Chung mangal, near cultivated land in July and August 2002 during the field surveys for the EIA of Tung Chung Cable Car Project (Mott 2003). Several burrows of the species were present in adjacent bunds at the backshore and in adjacent abandoned cultivated land.

10.4.1.31 A Least Horseshoe Bat *Rhinolophus pusillus* roost was found near Pak Mong within the Terrestrial Study Area (Ades 1999). Four bat species were reported in Tung Chung (Lin 2001). These included Leschenault's Rousette Bat *Rousettus leschenaulti*, Rufous Horseshoe Bat *Rhinolophus rouxi*, Lesser Bamboo Bat *Tylonycteris pachypus* and *Hipposideros armiger* (*ibid*.). The Lesser Bamboo Bat was first discovered in Hong Kong in 1996 (Ades 1999). Just above the intertidal zone along the east shore of Tai Ho Bay a cave probably excavated for mineral exploration and subsequently abandoned has been colonised by bats (Mott 1998). The cave is used as a day-time roost by at least three species of insectivorous bats. These were the Fulvous Leaf-nosed Bat *Hipposideros pomona* (approx. 100 individuals), Least's Horseshoe Bat (1 male) and Rufous Horseshoe Bat (1 individual). The mine was a nursery site for Fulvous Leaf-nosed Bat. The 20 females caught were each carrying a single young (approx. 2-3 week old). This species is rare in Hong Kong. The cave was probably also used as a winter hibernaculum.

10.4.1.32 Two species of non-cave dwelling bats were recorded in Tai Ho and nearby areas by AFCD (Shek and Chan 2006). These were Japanese Pipistrelle *Pipistrellus abramus* and Brown Noctule *Nyctalus noctula*. Japanese Pipistrelle is very common and Brown Noctule is common in Hong Kong (*ibid*.). All bats are protected locally under the Wild Animals Protection Ordinance.

Birds inside the EBS Study Area

10.4.1.33 A total of 55 bird species was reported in the **EBS** Study Area by Hong Kong Bird Watching Society between 1993 and 1998 (Carey *et al*. 1998, 1999, 2001, 2002). This included a number of rare/uncommon species (e.g., Crested Kingfisher *Ceryle lugubris*) (Carey *et al*. 2001) and species protected by regional/international regulation/convention (e.g., Pacific Reef Egret *Egretta sacra*, Black Kite *Milvus lineatus*, White-bellied Sea Eagle *Haliaeetus leucogaster*, Osprey *Pandion haliaetus*) (Zheng and Wang 1998). These bird species are inhabitants of terrestrial habitats (e.g., Black Baza *Aviceda leucophotes*, Peregrine Falcon *Falco peregrinus*), e.g., woodland and shrubland, and coastal habitats (e.g., Pacific Reef Egret, White-bellied Sea Eagle, Osprey).

10.4.1.34 A total of 75 species was recorded in Tai Ho Wan during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study" (Mott 1998). Inter-tidal mudflat in Tai Ho Wan provides feeding habitat for a number of bird species (e.g., ardeids, kingfishers, terns, Osprey), but abundance was not high (*ibid*.).

10.4.1.35 A total of 118 bird species were recorded in the EBS study area (**Appendix 10A**). Most of the recorded species are common and widespread in Hong Kong, and 32 species were considered of conservation interest according to Fellowes *et al*. (2002) (Table 5.13 in **Appendix 10A**). This included bird species inhabiting coastal and terrestrial habitats. Locations of the sighting of these species are mapped in Figure 13a of **Appendix 10A**.

10.4.1.36 Bird abundance in secondary woodland, tall shrubland, shrubland-grassland mosaic and cultivated/agricultural land in the EBS study area were ranked very high. Bird abundance in wasteland and developed area were ranked high, while plantation habitat ranked low (Tables 7.1 to 7.8 in **Appendix 10A**).

10.4.1.37 The Project is basically a marine project, while terrestrial habitats to be affected by this Project are mainly developed areas on Airport Island. Avifauna mainly foraging in coastal habitats would be more relevant to the Project. Bird species of conservation importance and foraging in coastal habitats included Little Grebe *Tachybaptus ruficollis*, Grey Heron *Ardea cinerea*, Chinese Pond Heron, Cattle Egret *Bubulcus ibis*, Striated Heron *Butorides striatus*, Swinhoe's Egret *Egretta eulophotes*, Great Egret *E*. *albus*, Little Egret, Intermediate Egret *E*. *intermedia*, Pacific Reef Egret, Black-crowned Night Heron, Grey-tailed Tattler *Heteroscelus brevipes*, Black-winged Stilt *Himantopus himantopus*, Wood Sandpiper *Tringa glareola*, Brown Fish Owl *Ketupa zeylonenis*, White-bellied Sea Eagle, Black Kite, White-throated Kingfisher *Halcyon smyrnensis* and Black-capped Kingfisher *H*. *pileata*. Remarkably high bird abundance in coastal habitats was only recorded at Tung Chung Bay, when about 700 Little Egrets and 773 Cattle Egrets were observed on 24 September 2003 (Fig. 9 in **Appendix 10A**).

10.4.1.38 No ardeid nesting colony or nesting of White-bellied Sea Eagle was recorded within the EBS study area.

10.4.1.39 Black Kite, White-bellied Sea Eagle, Osprey and Brown Fish Owl are Class 2 Protected Animals of PRC and listed in Appendix 2 of CITES (Zheng and Wang 1998). Black Kite is common and widespread in Hong Kong (Carey *et al*. 2001), and occurs in many types of habitats. Black Kites usually soar above and take food from the sea surface. No regular Black Kite roost has been reported in the study area, and the only roost on Lantau Island is found in Tai O (Carey 1996). Brown Fish Owl is a rare resident, and only recorded from a few localities. It usually feeds in undisturbed and unpolluted lowland streams and tidal creeks (Carey *et al*. 2001).

Waters at the mouth of Tai Ho Stream probably provide feeding habitat for this species. Brown Fish Owls were only recorded at Tai Ho during the EBS.

10.4.1.40 Osprey and White-bellied Sea Eagle are mainly maritime (Carey *et al*. 2001). Both are uncommon in Hong Kong. Most records of Osprey come from Inner Deep Bay (*ibid*.). White-bellied Sea Eagle was reported nesting at Pa Tau Kwu near Penny's Bay (Scott Wilson 2000), but not within the Study Area. The estimated local nesting population of this species is about 10 pairs (Carey *et al*. 2001). The home range of White-bellied Sea Eagle is estimated to be 100 km^2, which is one-tenth of total area of Hong Kong (Mooney 1986b in Marchant and Higgins (1993)).

Reptiles inside the EBS Study Area

10.4.1.41 Fourteen species of reptiles were recorded in the EBS study area (Table 5.17 in **Appendix 10A**). Uncommon/rare species included Blue-tailed Skink *Eumeces quadrilineatus*, Four-clawed Gecko *Gehyra mutilata*, Tokay Gecko *Gekko gecko*, Chinese Cobra *Naja naja* and Taiwan Kukri *Oligodon formosanus*. Locations of the sightings of these species were shown in Figure 13a of **Appendix 10A**.

10.4.1.42 Tokay Gecko is locally rare and is Class 2 Protected Animal of China (Zhao 1998). It is mainly found in thick bush and forest (Karsen *et al*. 1998). Chinese Cobra can be found in many types of habitats throughout Hong Kong, and is listed in Appendix 2 of CITES (Zhao 1998). Taiwan Kukri is uncommon and can be found in many types of habitats (Karsen *et al*. 1998).

10.4.1.43 Abundance of herpetofauna (reptiles and amphibians) was ranked high in secondary woodland, tall shrubland, shrubland-grassland mosaic and developed area, medium in wasteland and cultivated/agricultural land of the EBS study area (Tables 7.1 to 7.8 in **Appendix 10A**).

10.4.1.44 During the EIA study of the Tung Chung – Ngong Ping Cable Car Project, Buff-striped Keelback was recorded at Tung Chung (Mott 2003). This species is common and widespread in Hong Kong (Karsen *et al*. 1998). Buff-striped Keelback mainly occur in low altitude wetlands (*ibid*.). Mangrove Water Snake *Enhydris bennettii* was recorded at the mangroves near Hau Wong Temple at Tung Chung during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study" (Mott 1998). This species was first recorded in Hong Kong in 1954, and is mainly a muddy coastal habitat species (Karsen *et al*. 1998) and threatened by destruction of habitats and pollution (Zhao 1998).

10.4.1.45 Reptiles observed near Tung Chung Valley area included Buff-striped Keelback *Amphiesma stolata*, Large-spotted Cat Snake *Boiga multimaculata* , King Cobra *Ophiophagus hannah* and Greater Green Snake *Ophedrys major* (Ridley 2001). Buff-striped Keelback and Greater Green Snake are common in Hong Kong and occur in many types of habitats (Karsen *et al*. 1998). Large-spotted Cat Snake is rather uncommon, widespread throughout Hong Kong and primarily occurs in shrubland and woodland (*ibid*.). King Cobra is a very uncommon snake in Hong Kong that occurs in many types of habitats (*ibid*.). It is listed in Appendix 2 of CITES (Zhao 1998). Chinese Cobra was recorded at Shek Mun Kap during the EIA Study of Tung Chung Road Improvement (Mouchel 2002).

Amphibians inside the EBS Study Area

10.4.1.46 Seven species of amphibian were recorded within in the EBS study area (**Appendix 10A**). Lesser Spiny Frog was the only species of conservation concern according to Fellowes *et al*. (2002), and individuals were found in streams at two locations within in the EBS study area (Figure 13a of **Appendix 10A**). This species is the most common of the Hong Kong hill stream frogs (Karsen *et al*. 1998). Abundance throughout its distribution range may have declined (Fellowes *et al*. 2002). The other amphibian species recorded within the terrestrial study area during the EBS are all common and widespread in Hong Kong.

10.4.1.47 Gunther's Frog *Rana guentheri* and Three-striped Grass Frog *R*. *microdactyla* were recorded at abandoned cultivated land in Tai Ho Wan during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility

Study" (Mott 1998). Both are common and widespread in Hong Kong (Lau and Dudgeon 1999).

10.4.1.48 Ten amphibian species were reported from the EBS study area by Lau and Dudgeon (1999). These were Asian Common Toad *Bufo melanostictus*, Gunther's Frog, Paddy Frog *Rana limnocharis*, Three-striped Grass Frog *R. macrodactyla*, Chinese Bullfrog *R. rugulosa*, Romer's Tree Frog *Philautus romeri*, Brown Tree Frog *Polypedates megacephalus*, Asiatic Painted Frog *Kaloula pulchra*, Ornate Pigmy Frog *Microhyla ornata* and Marbled Pigmy Frog *M. pulchra*. All except Chinese Bullfrog are common and widespread in Hong Kong (Lau and Dudgeon 1999). Chinese Bullfrog is a Class 2 Protected Animal of China (Zhao 1998). Romer's Tree Frog is an endemic species protected under the Wild Animals Protection Ordinance.

10.4.1.49 Short-legged Toad *Megophrys brachykolos* was recorded at Tung Chung Stream during the EIA Study of Tung Chung Road Improvement (Mouchel 2002b). This species is considered endemic to Hong Kong (Karsen *et al*. 1998). Short-legged Toad is mainly found in forested mountain stream (*ibid*.). A locally common species Three-striped Grass Frog was reported near Sham Wat stream (Ridley 2001). This species is mainly found in wet abandoned cultivated land (Karsen *et al*. 1998).

10.4.1.50 Romer's Tree Frog was not recorded during the **EBS** study. However, several individuals and tadpoles were reported from Scenic Hill in the summer of 2004 by AFCD (Chan *et al*. 2005b).

Butterflies inside the EBS Study Area

10.4.1.51 Ninety species of butterfly were recorded within the EBS study area (Table 5.16 in **Appendix 10A**). Most are common and widespread in Hong Kong (**Appendix 10A**). Six species are considered of conservation concern according to Fellowes *et al*. (2002). These were Common Albatross *Appias albina*, Burmese Bush Blue *Arhopala bimana*, Small Grass Yellow *Eurema brigitta*, Danaid Eggfly *Hypolimnas misippus*, White Dragontail *Lamproptera curius* and Falcate Oak Blue *Mahathala ameria*. Locations of the sighting of these species are mapped on Figure 13a of **Appendix 10A**. Apart from Danaid Eggfly (found in shrubby-grassland in Scenic Hill), all were recorded in North Lantau and away from the HKLR alignment.

10.4.1.52 Abundance of butterfly was ranked very high in secondary woodland, tall shrubland, shrubland-grassland mosaic, cultivated/agricultural land and developed area, high in wasteland (Tables 7.1 to 7.8 in **Appendix 10A**).

10.4.1.53 60 species of butterfly were recorded at Tung Chung during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study" (Mott 1998). This included 13 uncommon and five rare species. Uncommon species included Yellow Pansy *Junonia hierta*, Blue Pansy *J. orithya*, Plain Tiger *Danaus chrysippus*, Common Cerulean *Jamides celeno*, Quaker *Neopithecops zalmora*, Albocaerulean *Udara albocaerules*, Yellow Orange Tip *Ixias pyrene*, Common Jay *Graphium doson*, Swallowtail *Papilio xuthus*, Common Birdwing *Troides helena*, Bush Hopper *Ampittia dioscorides*, Tree Flitter *Hyarotis adrastus* and Yellow Band Dart *Potanthus parva*. Rare species included Red Lacewing *Cethosia biblis*, Forget-me-not *Catochrysops strabo*, Painted Jezebel *Delias hyparete*, Common Brownie *Miletus chinensis* and Common Pierrot *Castalius rosimon*.

10.4.1.54 Tree Flitter, Swallowtail, Common Jay, Bush Hopper, Plain Tiger, Yellow Band Dart, Lesser Band Dart, Common Pierrot and Yellow Orange Tip are found in abandoned cultivated lands (Bascombe *et al*. 1999, Yiu 2004). Red Lacewing, Yellow Pansy, Blue Pansy, Painted Jezebel, Common Birdwing, Albocaerulean, Quaker, Common Brownie and Common Cerulean are found in forest (Yiu 2004). Forget-me-not is found in low shrub and secondary growth (Bascombe *et al*. 1999).

10.4.1.55 A total of 40 species of butterfly were recorded at Tai Ho Wan during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study" (Mott 1998). Forest in Tai Ho Wan provided habitats for four uncommon species, which included Baron *Euthalia aconthea*, Striped Blue Crow

Euploea mulciber, Common Birdwing *Troides helena* and Painted Jezebel *Delias hyparete*.

Dragonflies inside the EBS Study Area

10.4.1.56 Twenty-four species of dragonfly were recorded in the EBS study area (**Appendix 10A**). All are common and widespread in Hong Kong. Dragonfly species considered of local concern by Fellowes *et al*. (2002) included Elegant Clubtail *Leptogomphus elegans* (recorded at Tai Ho Wan) and Sapphire Flutterer *Rhyothemis triangularis* (Tung Chung Bay). These two species were also recorded near the terrestrial study area in a previous EIA study for Tung Chung Road improvement (Mouchel 2002b). Elegant Clubtail mainly occurs in wooded streams while Sapphire Flutterer is usually found in weedy ponds (Wilson 2004).

10.4.1.57 Dragonfly abundance is ranked high in secondary woodland and shrubland-grassland mosaic, medium in tall shrubland, wasteland and developed area, low in cultivated/agricultural land in the EBS study area (Tables 7.1 to 7.8 in **Appendix 10A**).

10.4.1.58 19 species of dragonfly were recorded at Tung Chung during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study" (Mott 1998). Three species of dragonfly were recorded at Tung Chung by Wilson (1997). These included Chinese Greenwing *Neurobasis chinensis*, Fiery Emperor *Anax immaculifrons*, and Small Clubtail *Stylogomphus chunliuae*. Chinese Greenwing and Fiery Emperor are common in Hong Kong (Wilson 2004). Small Clubtail is uncommon in Hong Kong (*ibid*.). This species inhabits streams with steep gradient and boulder substrate.

10.4.1.59 A total of 15 species of dragonfly were recorded in streams and agricultural lands in Tai Ho Wan during the field surveys for "Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study" (Mott 1998). Two uncommon species of damselfly were recorded at abandoned cultivated lands in Ngau Kwu Long (*ibid*.). These were Milky Midget *Agriocnemis lacteola* and Chinese Mountain Damsel *Calicnemia sinensis*. Milky Midget is found in abandoned cultivated lands, while Chinese Mountain Damsel inhabits small forested spate streams in low altitude (Wilson 2004).

Stream Fishes inside the EBS Study Area

10.4.1.60 Approximately 160 species of freshwater fish have been recorded in Hong Kong (Lee *et al*. 2004). The first comprehensive listing of species present in Hong Kong was the checklist produced by Chong and Dudgeon (1992) which provides details of 96 indigenous fish species, including information on distribution and conservation status. A brief review of local freshwater fish ecology is provided in Dudgeon and Corlett (1994). Lee *et al*. (2004) in "Freshwater Fish in Hong Kong" provides information on identification of common species and the distribution and conservation status of the 160 predominantly freshwater fish species recorded locally.

10.4.1.61 Lowland freshwater streams are considered one of the most endangered habitats in Hong Kong. The freshwater streams present on north Lantau are generally unaffected by pollution and support comparatively diverse aquatic communities (Chong and Dudgeon, 1992; EPD, 2000; Mouchel, 2002b).

10.4.1.62 Freshwater fish have been relatively well-studied in the north Lantau area. Chong and Dudgeon (1992) reported that the Tai Ho (46 species recorded between 1980-1991) and Tung Chung (23 species recorded between 1980-1991) streams rank first and second in terms of species-richness of all streams in Hong Kong. The locally rare Ayu *Plecoglossus altivilis* was first recorded in Hong Kong from the Tai Ho stream (Chong and Dudgeon, 1992). The catadromous Giant Mottled Eel *Anguilla marmorata* has also been recorded in Tai Ho stream (Chong and Dudgeon, 1992). Both species are listed in the China Red Data Book of Endangered Animals. Owing to the high diversity of fish, the Tai Ho stream has been designated an SSSI.

10.4.1.63 67 fish species were recorded during the EBS field surveys. Details are presented in the final EBS report (**Appendix 10A**). Survey results confirmed that the Tai Ho, Tung Chung and Sham Wat streams support high fish diversity and species of conservation interest. It should be noted, however, that only the estuaries of these three streams fall within the study area for the **EBS**, while the stream courses themselves are located outside the study area for the **EBS**.

10.4.1.64 Fish species of conservation concern recorded in the streams include the *Acrossocheilus beijiangensis* (in Tung Chung Stream), *Anguilia marmorata* (in Sham Wat Stream and Tai Ho Stream), *Channa asiatica* (in Pak Mong Stream, Sha Lo Stream, Sham Wat Stream, Tai Ho Stream and Tung Chung Stream), *Oryzias curvinotus* (in Tung Chung Stream), *Plecoglossus altivelis* (in Tai Ho Stream), *Takifugu ocellatus* (in Pak Mong Stream, San Tau Stream, Sham Wat Stream, Tai Ho Stream and Tung Chung Stream). Among these, *Acrossocheilus beijiangensis*, *Anguilia marmorata* and *Oryzias curvinotus* are of global concern and the remaining two species are considered locally/regionally restricted.

10.4.1.65 During the May 2004 survey, the Ayu *Plecoglossus altivelis* was recorded in the Tai Ho Stream. Declining populations of this species were reported locally, regionally and globally. This species is considered to be of immediate regional conservation concern (Fellowes *et al*., 2002) and only recorded once during the course of the surveys.

10.4.1.66 The Giant Mottled eel *Anguilla marmorata* was recorded in Sham Wat and Tai Ho during the surveys conducted in December 2003 and May 2004. The population of *Anguilla marmorata* was reported to be in marked decline locally and considered a species threatened globally by Fellowes *et al*. (2002) but is not included in the IUCN World Conservation Union Redlist. This species is also listed in the China Red Data Book.

Stream Invertebrates inside the EBS Study Area

10.4.1.67 The streams of Hong Kong are known to support a diverse group of freshwater macroinvertebrates some which are endemics (e.g. certain odonates and water beetles). The streams on north Lantau are generally unaffected by pollution inputs and support comparatively diverse aquatic communities (Chong and Dudgeon 1992; EPD 2000; Mouchel 2002b). The recently published China Water Beetle Trilogy (Jach and Ji 1995, 1998, 2003) reported that some of the water beetles in Hong Kong are probably endemic as they have not yet been recorded in other parts of Mainland China. These include *Sinonychus lantau* (Elmidae) from Ngau Kwu Long near to Tai Ho. Wilson (1995) and Mouchel (2002b) also reported the presence of several endemic odonates on Lantau and their larval stages are completed in uncontaminated freshwater. A species of sesarminae crab, *Sesarma (Holometopus) tangi* Rathbun was also recorded in Tai Ho stream (Lee & Leung 1999). This species of crab has a very limited distribution in Hong Kong. Tai Ho Stream is one of the two local sites of occurrence for this species, the other being Mai Po.

10.4.1.68 A total of twelve freshwater macroinvertebrate families/suborders consisting of 83 individuals were recorded during the EBS macroinvertebrate stream surveys conducted between September 2003 and January 2004 (**Appendix 10A**). The number of macrofauna species recorded in each stream was generally low except in the stream at San Shek Wan (**Appendix 10A**). The generally low species richness was probably caused by the lower water flow during the dry season.

10.4.1.69 It was found that the water levels in stream courses with significant flows in wet season became much lower in dry season, while many of the courses with low water flows in wet season completely dried out during the dry season. This seasonal variation, however, is typical of streams in Hong Kong (Dudgeon and Corlett, 1994).

10.4.1.70 In order to determine the relative quality of each stream course, a BMWP (Biological Monitoring Working Party) biotic index was calculated for each stream. The BMWP biotic index for Pak Mong, Hau Hok Wan, Sha Lo Wan and San Shek

Wan are 8, 0, 2 and 34, respectively. The biotic index indicated that there were large variations in the habitat quality of the streams within the study area. This, however, could be a reflection of stream flow variability and the percentage of taxa that does not have a score rather than pollution/disturbance.

10.4.2 Terrestrial Ecological Baseline within the 500m Assessment Area

Terrestrial Sites of Conservation Importance within the 500m Assessment Area

10.4.2.1 A larger portion of the sites of conservation importance listed in Section 10.4.1 is now outside the current 500m assessment area and far away from the HKLR footprint. Only three of the above sites of conservation importance still fall within the current 500 m assessment area, i.e. Lantau North (Extension) Country Park; San Tau Beach SSSI and Scenic Hill.

- Lantau North (Extension) Country Park;
- San Tau Beach SSSI; and
- The Scenic Hill on Airport Island (which supports a remnant population of the Romer's Tree Frog).

10.4.2.2 Lantau North (Extension) Country Park **(Figure 10.2)** covers an area on the slope of Nei Lak Shan just uphill from Sha Lo Wan and the hill slopes to the south of North Lantau Highway between Tai Ho Wan and Siu Ho Wan. It falls within the study area of the 9-month EBS as well as the current 500m assessment area. In addition to the existing 7,800ha of designated Lantau North and South Country Parks, the Lantau North (Extension) Country Park was proposed in the 1999 Policy Address as a positive means to conserve the natural environment of Lantau, gazetted in 2001, and was designated in 2008.

10.4.2.3 Scenic Hill is a small hill at the southeast end of Airport Island. Romer's Tree Frog is endemic to Hong Kong and is protected under the Wild Animals Protected Ordinance (Karsen *et al*. 1998). Ngong Ping is known to support the largest population of this endemic frog (Lau 1998) and has been designated as a Site of Special Scientific Interest (SSSI) for this reason.

10.4.2.4 Before construction of the airport, Chek Lap Kok was one of the few islands on which Romer's Tree Frog was found in Hong Kong. A translocation programme was implemented as a mitigation measure for the PADS project. Though the translocation programme was successful, it is possible that a remnant population still inhabiting the only remaining natural area on the airport island, i.e. the Scenic Hill.

10.4.2.5 San Tau Beach SSSI is a seagrass site and is described in the sections on intertidal ecology below.

Vegetation and Habitats within the 500m Assessment Area

10.4.2.6 The coastal areas between inner Tung Chung Bay and San Tau, and the southeast end of Airport Island including Scenic Hill, were surveyed during the EIA study for Tung Chung Cable Car project (Mott 2003). Habitats identified included Developed Area on Airport Island; Grassland on Scenic Hill; Plantation; Woodland; and Tall Shrub.

10.4.2.7 The vast expanse of terrestrial habitats (1,087 ha) between Siu Ho to Sham Wat, covering Tai Ho, Tung Chung, San Tau, Sha Lo Wan, San Shek Wan, Airport Island and Scenic Hill, were surveyed between September 2003 to May 2004 in the **EBS**. Habitats recorded included developed area (e.g. North Lantau Highway, Airport Island), wasteland, shrubby grassland and woodland.

10.4.2.8 A large portion of the current 500m Terrestrial Assessment Area (about 1600 ha) is currently sea area (about 1,100 ha) (**Figures 10.4a-c & 10.5 & 10.6**). Terrestrial habitats within the elongated 500m assessment area are located in the middle to eastern parts on Airport Island and along the North Lantau shore from San Tau to

Sha Lo Wan. Habitats recorded in previous studies were reviewed and renamed in the **EVS** study. As it was found during the field surveys, and from the review of aerial photos of the last few years and the habitat maps prepared by those previous studies, the land use within the 500m Assessment Area was similar with that in the time of the previous studies, with minor changes in the boundaries at certain locations. For example, some grassland habitat at Scenic Hill has been replaced by the Angle Station of Tung Chung Cable Car. But these changes were minor and did not significantly change the ecological profiles of the area. Other than the Cable Car project which has small footprints on non-developed areas, there was no major development implemented within the 500m assessment area in the last few years. The information provided by the previous studies such as **EBS** should therefore still be valid in general.

10.4.2.9 A total of 14 habitat types were identified in the current 500m assessment area. Terrestrial habitats recorded included woodland, shrubland, grassland, stream/channel, plantation, and developed area (**Figures 10.4a-c & 10.5 & 10.6**). Among these habitats, developed area on Airport Island is the predominant habitat type (over 350 ha), while tall shrubland also contribute a significant proportion (42.7 ha). Other habitat types (Grassland/shrubland, Secondary woodland and Plantation etc.) with a much lower area size.

Table 10-2 Coverage of Different Habitats within the 500m Assessment Area

Habitat Type	Area (ha)	No. of plant species recorded
Active Dry Agriculture	0.05	NA
Associated Mangrove	0.80	20
Developed Area	About 350	111
Grassland	0.40	19
Grassland/ Shrubland	15.22	96
Mangrove	0.14	18
Plantation	15.37	67
Mudflat	0.14	NA
Seasonally Wet Grassland	0.64	85
Secondary Woodland	17.73	90
Shrubland	10.50	Included by grassland/shrubland
Stream	1.35	50
Tall Shrubland	42.70	123
Young Woodland	3.84	49

10.4.2.10 A total of 307 plant species were identified within the current 500m assessment area. Tall shrubland, secondary woodland, grassland/shrubland and developed area support higher plant species diversities, with 123, 90, 96 and 111 plant species respectively, than other coastal and riparian habitats.

10.4.2.11 Low numbers (3-5 individuals) of the tree *Pavetta hongkongensis* were identified in tall shrubland close to Hau Hok Wan. This species is protected under the Forestry Regulations (Cap. 96A) but it is a common tree species found in tall shrubland and young woodland in Hong Kong (Xing *et al*. 2000).

10.4.2.12 The insectivorous herb *Drosera indica* was identified on the rock surface of a stream at Hau Hok Wan. Approximately 40 individuals of *D. indica* were identified in both dry and wet season surveys. This herbaceous plant is identified as a very rare plant only found in Tung Chung (Xing *et al*. 2000) but receives no protection by law in Hong Kong (South China Institute of Botany & AFCD 2003). It has been listed as "Least Concern" in China.

10.4.2.13 Around six individuals of orchid *Eulophia graminea* were identified within the stone crevices along a stream at Hau Hok Wan. This orchid species is a restricted terrestrial herb found in the grassland and highly disturbed areas (Siu 2000, Xing *et al*. 2000). All wild native orchid species are protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and the Forestry Regulations (Cap. 96A) in Hong Kong. It is also classified as a restricted species by Siu (2000).

10.4.2.14 Several tree specimens and seedlings of *Aquilaria sinensis* were identified along the footpath near the tall shrubland from Hau Hok Wan to Sha Lo Wan and within the secondary woodland of the Scenic Hill in Chek Lap Kok Island. Due to potential threats of habitat destruction and over-exploitation in China, this tree species is regarded as "Near Threatened" in the China Plant Red Data Book and the Illustrations of Rare & Endangered Plants in Guangdong Province. It is listed as a Category II nationally protected species in China (South China Institute of Botany & AFCD 2003). This species is, however, common in lowland forest and Fung Shui woodlands (Xing *et al*. 2000) and currently is protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).

10.4.2.15 Numerous individuals of tree *Thespesia populnea* were identified along the coastal and associated mangrove habitats of the Study Area. This is a tree species restricted to coastal habitats (Xing et al. 2000) and is regarded as a rare associate mangrove species (present in only nine of 43 mangrove stands) in a territory-wide mangrove study by Tam and Wong (1997). However, T. populnea has no protection by law in Hong Kong.

10.4.2.16 An individual of shrub/small tree *Drosera viscosa* was recorded near the tall shrubland close to the coastline at Sha Lo Wan. This is regarded as a rare species only found in Ham Tin and Tung Chung (Xing *et al.* 2000), but it is not protected by law in Hong Kong.

10.4.2.17 Two seagrass species, *Halophila* sp. and *Zostera japonica* were recorded along the mangrove fringe within the San Tau Beach SSSI. The seagrass bed at San Tau mudflat and mangrove stands is regarded to be of high conservation value and its locality is designated as San Tau Beach SSSI for better protection by law (South China Institute of Botany & AFCD 2003). In addition, all established seagrass beds are considered to be an important habitat under the Environmental Impact Assessment Ordinances and any potential developmental disturbances and/or impacts should be avoided or minimized (Kwok *et al*. 2005).

10.4.2.18 Three natural habitats are of particular concerns, i.e. the young woodland in Sha Lo Wan headland, on which the viaduct will span over, the grassland/shrubland habitat on Scenic Hill where direct impact from the latest alignment is anticipated, and the secondary woodland on Scenic Hill, where remnant population of Romer's Tree Frog was recorded previously and is potentially subject to direct impacts under some earlier alignment options.

10.4.2.19 The headland at Sha Lo Wan is young woodland habitat. Under natural succession, this young woodland has evolved from tall shrubland by developing a denser and more complex canopy coverage and structure. The young woodland is dominated by the trees *Sterculia lanceolata*, *Microcos paniculata*, *Ardisia quinquegona*, *Myrsine seguinii*, *Schefflera heptaphylla* and *Garcinia oblongifolia*, with the understorey containing shrubs such as *Psychotria asiatica*, *Desmos chinensis*, *Ardisia crenata*, *Ilex asprella*, *Ilex pubescens* and seedlings of tree species including *Daphniphyllum calycinum*, *Archidendron clypearia* and *Archidendron lucidum*.

10.4.2.20 The majority of the grassland/shrubland habitat within the 500m Assessment Area is on North Lantau, and typically dominated by grasses *Panicum maximum*, *Imperata koenigii*, *Ischaemum* spp., *Rhynchelytrum repens* and *Neyraudia reynaudiana*, herbs *Bidens alba*, *Eupatorium catarium*, *Mimosa pudica*, *Aster* *baccharoides*, *Inula cappa*, isolated shrubs *Melastoma candidum*, *Rhaphiolepis indica*, *Rhodomyrtus tomentosa*, *Ilex asprella*, *Osbeckia chinensis*, *Clerodendrum fortunatum*, *Baeckea frutescens*, *Breynia fruticosa* and *Eurya chinensis* and trees *Zanthoxylum avicennae*, *Litsea rotundifolia* var. *oblongifolia*, *Schefflera heptaphylla*, *Aporusa dioica*, *Ficus hirta*, *Ficus variolosa* and *Itea chinensis*. The grassland/shrubland habitat on North Lantau is adjacent with other natural habitats, and might undergo further succession in time. This habitat type is also found on the western and southeast of Scenic Hill on Airport Island. Scenic Hill however is isolated from other natural habitat and surrounded by developed areas and sea area. The secondary woodland in Scenic Hill is typical of other woodlands in Hong Kong. It is dominated by *Sterculia lanceolata*, *Schefflera heptaphylla*, *Celtis sinensis*, *Tetradium glabrifolium* and *Microcos paniculata* as the overstorey (8 – 10 m high). Its understorey is dominated by common and widespread shade-tolerant species including shrubs and small tree species such as *Psychotria asiatica*, *Litsea rotundifolia* var. *oblongifolia*, *Melicope pteleifolia*, *Sarcandra glabra*, *Bredelia tomentosa*, *Zanthoxylum avicennae* and *Uvaria macrophylla*. Seedlings of the trees *Archidendron clypearia* and *Aquilaria sinensis* were found occasionally in the understorey.

10.4.2.21 Besides the above, there were also intertidal habitats (including artificial seawall, natural shore, mangrove and intertidal mudflat), marine waters, and other terrestrial habitats (agricultural land) recorded within the 500m boundary or inside Tai Ho area. These habitats would be covered in the later sections on intertidal ecology, marine ecology, and Tai Ho area.

Terrestrial Fauna within the 500m Assessment Area

10.4.2.22 The surveyed terrestrial habitats within the 500m Assessment Area were urbanised/disturbed (including artificial coastlines), stream/channel, woodland, grassland, and shrubland. The recorded fauna were typical of disturbance tolerant, due to the high disturbance level within the Assessment Area. More than 60% of the terrestrial habitats within the 500m Assessment Area are Developed Area, which is under high level of human disturbance. Grassland/shrubland made up 4.55% of total area of terrestrial habitats. Fauna diversity in this type of habitat is generally low (Dudgeon and Corlett 1994, 2004). Plantations of exotic species made up only 4.59% of total area of terrestrial habitats. This type of habitat, particularly young ones, generally supports low fauna diversity (Dudgeon and Corlett 1994, 2004). Woodland and tall shrubland exist as small isolated patches in the Assessment Area, and mainly support disturbance tolerant species or habitat generalists.

Birds within the 500m Assessment Area

10.4.2.23 A total of 77 species was reported from Chek Lap Kok airport (Carey *et al*. 1998, 1999, 2002). This high species richness was at least partially attributed to the fact that birds are more visible at the airport, but does not indicate the ecological importance of the Chek Lap Kok airport as a bird habitat. A total of 136 bird species was recorded in the Kai Tak Airport (Melville 1979), but it was concluded that most of the bird species were grounded by adverse weather, and would leave once their condition recovered. The former Kai Tak Airport provided little food for birds (*ibid*.). The situation on Chek Lap Kok airport is likely to be similar.

10.4.2.24 Use of inter-tidal mudflats near San Tau by ardeids (e.g., Reef Egret, Little Egret) was reported in the EIA study of the Tung Chung – Ngong Ping Cable Car Project (Mott 2003).

10.4.2.25 A total of 61 bird species was recorded during the **EVS** study. Of these 61 species, 14 are listed by Fellowes *et al*. (2002) as species of conservation concern; 10 of the 14 species of conservation concern are also wetland dependant species, and were observed on the shoreline of northern Lantau and the artificial seawall of Chek Lap Kok. These species included Grey Heron, Great Egret, Little Egret, Pacific Reef Egret, Straited Heron, Black-crowned Night Heron, Little Ringed Plover, Whimbrel, and Grey-tailed Tattler. Birds utilizing coastal habitats should be of higher concern in the present Project as the majority of terrestrial habitats to be affected are the coastal areas along the Airport Channel and Airport eastern shore.

10.4.2.26 Apart from Pacific Reef Egret, all are common and widespread in Hong Kong (Carey *et al.* 2001). Bird abundance and species richness were low in all surveyed habitats. The low diversity in developed area, and artificial coastline was related to the high human disturbance and low food abundance. Grassland and plantations of exotic species generally support low diversity of bird (Kwok and Corlett 2000, Kwok and Dahmer 2002), due to low food abundance and simple habitat structure. Woodland and shrubland exist as small isolated patches, and support bird species basically similar to those in surrounding habitats (developed area, grassland).

10.4.2.27 Bird species that are locally rare or regional/global protected were considered of conservation concern. Among the water-dependent birds, only Pacific Reef Egret *Egretta garzetta* is Class 2 Protected Animals of PRC (Zheng and Wang 1998). Pacific Reef Egret is mainly found in rocky coastlines of widespread localities (Carey *et al.* 2001).

Mammals within the 500m Assessment Area

10.4.2.28 During the EIA study of the Tung Chung – Ngong Ping Cable Car Project, Indian Muntjac was observed in tall coastal shrub/ woodland off the coastal path near Hau Hok Wan in May 2002, and in woodland of the San Tau Valley and Ngau Au Area in early October 2002 (Mott 2003). Scats of Ferret Badger or civet were found near San Tau Valley (*ibid*.). Indian Muntjacs were recorded in tall shrubland of Sha Lo Wan in September 2003 and April 2004 during the EBS study. The common rat *Rattus norvegicus* was observed around San Tau village during the course of the survey during the field surveys for the EIA of Tung Chung Cable Car Project (Mott 2003).

10.4.2.29 Only three species of mammal were recorded during the **EVS** study. A Red Muntjac *Muntiacus muntjac* was seen in the village section of San Tau stream. In addition, footprints of Muntjac deer, presumably Red Muntjac, were observed in the soft sand at the beach close to the mouth of a stream at San Tau. Red Muntjac (as Indian Muntjac) is listed as being of Potential Regional Concern following Fellowes *et al*. (2002) and is protected under the Wild Animals Protection Ordinance (WAPO). This small deer is widespread in Hong Kong (Shek and Chan 2006).

10.4.2.30 The skull of a Eurasian Wild Pig *Sus scrofa* was found on the beach at Sha Lo Wan. This species has a widespread distribution in Hong Kong (Shek and Chan 2006). The third mammal is unconfirmed rat species (*Rattus* sp.) near San Tau and Hau Hok Wan.

10.4.2.31 Four species of non-cave dwelling bats were recorded in San Tau and nearby areas by AFCD (Shek and Chan 2006). These were Japanese Pipistrelle *Pipistrellus abramus*, Short-nosed Fruit Bat *Cynopterus sphinx*, Lesser Yellow Bat *Scoptophilus kuhlii* and Whiskered Myotis *Myotis muricola*. Both Japanese Pipistrelle and Short-nosed Fruit Bat are very common in Hong Kong. Lesser Yellow Bat is uncommon while Whiskered Myotis is rare in Hong Kong. Yellow House Bat often roosts in the attics of houses, but it also roosts under the modified fronds of palm trees next to the Short-nosed Fruit Bat, holes in walls or even in an abandoned bird nest (Lin *et al*. 2005 in Shek and Chan 2006). Whiskered Myotis is reported to roost in the central curled leaves of banana trees, and occasionally in caves in Thailand (Lekagul and McNeely 1988 in Shek and Chan 2006).

Reptiles within the 500m Assessment Area

10.4.2.32 Seven species of reptiles, all common and widespread in Hong Kong (Karsen et al. 1998) and not of conservation concern, were seen across wet and dry season surveys of the **EVS** (**Appendix 10B**). Two species of gecko, Chinese Gecko *Gekko chinensis* and Bowring's Gecko *Hemidactylus bowringii*, were recorded in villages, particularly the abandoned village houses on Scenic Hill. Three species of skink (Chinese Skink *Eumeces chinensis*, Long-tailed Skink *Mabuya longicaudata* and Reeves' Smooth Skink *Scincella reevesii*) were recorded primarily on woodland/shrubland edges. Juvenile Long-tailed Skinks were also common amongst the leaf-litter of the abandoned village on Scenic Hill. Changeable Lizard *Calotes versicolor* was seen in waste ground on the edge of Sha Lo Wan. There was also one exotic species of terrapin, Red-eared Slider *Trachemys scripta*. No snakes were seen during any of the surveys.

10.4.2.33 During the EIA study of the Tung Chung – Ngong Ping Cable Car Project, Long-tailed Skink *Mabuya longicaudata* and Copperhead Racer *Elaphe radiata* were recorded in San Tau (Mott 2003). Both are common and widespread in Hong Kong (Karsen *et al*. 1998). Long-tailed Skink and Copperhead Racer occur in many types of habitats (*ibid*.).

10.4.2.34 Checkered Keelback *Xenochrophis piscator* was recorded at mangroves near San Tau (Mott 1998). This species is common and widespread in lowland wetlands in Hong Kong (Karsen *et al*. 1998).

10.4.2.35 Two species of snakes were reported from the Airport island (Chan *et al*. 2006a). These were Large-spotted Cat Sanke *Boiga multomaculata* and Chinese Cobra *Naja atra*. Both are common and widespread in Hong Kong. Chinese Cobra is considered to be of Potential Regional Concern (Fellowes *et al*. 2002). This species occurs in various types of habitats, including woodlands, shrublands, grasslands and mangroves. The Airport island is mostly developed and of high level of disturbance and is not considered optimal habitat of Chinese Cobra.

10.4.2.36 Chinese Gecko *Gekko chinensis* and Bowring's Gecko *Hemidactylus bowringii* were reported from the Airport island and San Tau respectively (Chan *et al*. 2006b). Both species are very common in Hong Kong.

Amphibians within the 500m Assessment Area

10.4.2.37 Four species of amphibians were recorded during the EVS in the 500m Assessment Area (**Appendix 10B**), Chinese Bullfrog *Hoplobatrachus chinensis*, Lesser Spiny Frog *Paa exilispinosa*, Asian Common Toad *Bufo melanostictus* and Asian Painted Frog *Kaloula pulchra*. Chinese Bullfrog is a Class II Protected Animal in China and is considered to be of Potential Regional Concern in Hong Kong owing to depletion of wild populations for the food trade (Fellowes *et al*. 2002, Chan *et al*. 2005a). An adult Chinese Bullfrog was seen in a drain at Scenic Hill. The species has previously been recorded on Chek Lap Kok (Chan *et al*. 2005a).

10.4.2.38 Tadpoles of Lesser Spiny Frog were observed in the streams between San Tau and Hau Hok Wan. This species is regarded as Vulnerable by IUCN Redlist (2009) and is considered to be of Global Concern (Fellowes *et al*. 2002), although it is widely distributed and common in suitable habitat in Hong Kong (Chan et al. 2005a). The remaining two species are common and widespread in Hong Kong (Karsen *et al*. 1998, Chan *et al*. 2005a).

10.4.2.39 Romer's Tree Frog was not recorded during the **EBS** study or the **EVS** study. The endemic Romer's Tree Frog was discovered on Lamma Island in 1952 (Lau and Dudgeon 1999). The other locations with records of this species included Chek Lap Kok, Lantau and Po Toi (Karsen *et al*. 1998). This species is protected under the Wild Animals Protection Ordinance, Cap. 170. The habitat characteristics of Romer's Tree Frog were studied in details by Lau (1998). Romer's Tree Frog lives on forest floor and breed in shaded, slow-flowing or stagnant waters including man-made structure. The diet of this species consists of small forest litter invertebrates (Lau 1998). Ngong Ping is known to support the largest population of this endemic frog (*ibid*.) and has been designated as a Site of Special Scientific Interest (SSSI). Given its small size, predation pressure from larger amphibians and limited mobility, Romer's Tree Frog is very sensitive to habitat fragmentation.

10.4.2.40 Prior to the construction of Chek Lap Kok International Airport, populations of Romer's Tree Frog on Chek Lap Kok were collected, captive bred and translocated to localities with suitable local habitats (Lau 1998) as a mitigation measure for the PADS project. Breeding of translocated populations was monitored between 1994 and 1997 (*ibid*.). Regular breeding was recorded at half of the translocated sites (*ibid*.).

10.4.2.41 While it was believed that the population on Chek Lap Kok would be exterminated by the construction of the new airport, a single specimen was caught at the abandoned village on the south side of the former island in July 2000 (Lynch 2001). The presence of old water tubs and pitchers maintain pools of rain water, which provide breeding habitats for Romer's Tree Frog. This enabled survival of a small population.

10.4.2.42 Indeed Romer's Tree Frog has demonstrated a high adaptability elsewhere in Hong Kong. For example at Lamma Island a population was found in a patch of grassland receiving seepage flow from an adjacent engineered slope (Halcrow China Ltd. 2002). A number of tadpoles of Romer's Tree Frog were also found in seasonal streams at Ngong Ping (Arup 2002). In addition, this species can also breed in artificial breeding sites (e.g., pots) (Lau 1998).

10.4.2.43 Besides the **EBS** study and the **EVS** study, night survey conducted for Cable Car EIA study at Scenic Hill aimed at verifying Lynch's finding also failed to find any evidence of Romer's Tree Frog (Mott 2003). The general environment and topography of Scenic Hill have not changed significantly since the discovery of the frog in 2000. Breeding habitat of Romer's Tree Frog is also present on Scenic Hill (e.g., streams, old water tubs and pitchers). Tadpoles of this species were seen earlier in 2008 as part of the on-going monitoring by AFCD (**Appendix 10B**). Therefore it is reasonable to adopt a precautionary approach assuming that some individuals still survive in the area. This makes Scenic Hill the only location on Airport Island supporting Romer's Tree Frogs that are descended from the original Chek Lap Kok population.

10.4.2.44 Some amphibian species were recorded in the Airport island by AFCD (Chan *et al*. 2005b). These included Asian Common Toad *Bufo melanostictus*, Short-legged Toad *Xenophrys brachykolos*, Asiatic Painted Frog *Kaloula pulchra*, Butler's Pygmy Frog *Microhyla butleri*, Paddy Frog *Fejervarya limnocharis*, Chinese Bullfrog *Hoplobatrachus chinensis*, Three-striped Grass Frog *Rana macrodactyla* and Brown Tree Frog *Polypedates megacephalus*. All are common and widespread in Hong Kong. Chinese Bullfrog is a Class 2 Protected Animal of PRC. Short-legged Toad is potentially endemic to Hong Kong, and is considered of "Potential Global Concern (Fellowes *et al*. 2002).

Dragonflies within the 500m Assessment Area

10.4.2.45 A common damselfly species Marsh Dancer *Onychargia atrocyana* was reported in Sha Lo Wan (Wilson 2004). This species occurs in wet abandoned cultivated lands (*ibid*.).

10.4.2.46 The dragonfly species, Small Hooktail *Melliogomphus moluamis*, which is considered globally threatened by Fellowes *et al*. (2002) was recorded at San Tau during the EBS (**Appendix 10A**). Very little is known about the habitat requirements of this species (Wilson 2004).

10.4.2.47 Only seven dragonfly species were recorded during the **EVS** study, none of which are considered to be of conservation concern. By far the most numerous and widespread species recorded was the Wandering Glider *Pantala flavescens*, with many hundreds seen across the site over all habitats. This is the most common species in Hong Kong (Wilson 2004). Other than Wandering Glider, all other species were recorded only outside the proposed HKLR alignment, within the limits of stream and/or irrigation ditches across the 500m assessment area. Both abundance and species richness of dragonfly were low in all habitats within the Assessment Area. The low diversity of dragonfly within the Assessment Area was related to the paucity of natural freshwater habitats.

Butterflies within the 500m Assessment Area

10.4.2.48 Danaid Eggfly *Hypolimnas misippus*, considered of conservation concern according to Fellowes *et al*. (2002), was found in shrubby-grassland in Scenic Hill during the EBS study.

10.4.2.49 A total of 58 butterfly species was recorded during the **EVS** study. Most species occur in shrubland (32) with 24 species recorded in woodland and 15 species recorded from village habitats. Few records of butterflies were made from the intertidal habitats (i.e. soft shore, hard shore and mangrove), as would be expected from the paucity of suitable food plants in this habitat. Common Mormon *Papilio polytes* was the most widespread species, occurring in various habitat types. This species is very common and widespread in Hong Kong (Lo & Hui 2005). Among the species recorded, only White Dragontail *Lamproptera curius* recorded at a stream in San Tau stream is considered to be of conservation concern (Local Concern in Fellowes *et al*. 2002).

10.4.2.50 The hillside along the coastline from Tung Chung to Tai O is a recommended butterfly watching route by the Lepidopterist's Society (Young and Yiu 2002). Rare species such as Hainan Palm Dart *Telicota besta* and Common Awl *Hasora badra* are reported from this trail (*ibid*.).

10.4.2.51 Two locations within the Study Area – San Tau and Sha Lo Wan – have been identified as important sites for butterflies in Hong Kong (Young and Yiu 2002).

10.4.2.52 A total of 89 species of butterfly have been recorded in San Tau (Yiu 2004). Uncommon/rare butterfly species reported in this location include Golden Birdwing *Troides aeacus*, White Dragontail *Lamproptera curius*, Plain Cupid *Chilades pandava*, Falcate Oak Blue *Mahathala ameria*, Red Lacewing, White-edged Blue Baron *Euthalia phemius* (*ibid*.). Important butterfly habitats identified in San Tau include ravine woodland, *fung shui* forest and orchard (*ibid*.).

10.4.2.53 A total of 81 species of butterfly have been recorded in Sha Lo Wan (Yiu 2004). Uncommon/rare butterfly species reported in this location included Swallowtail, Red Lacewing, Yellow Orange Tip, Cornelian *Deudorix epijarbus*, Silver Streak Blue *Iraota timoleon*, Dark Blue Tiger *Tirumala septentrions* (*ibid*.). Important butterfly habitats in Sha Lo Wan include *fung shui* forest and abandoned cultivated land (*ibid*.).

Stream Fish within the 500m Assessment Area

10.4.2.54 Several species of conservation interest were recorded in streams within the 500m assessment area, including Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis*, Dark-margined Flagtail *Kuhlia marginata*, Rice Fish *Oryzias curvinotus*, the Indo-Pacific Tropical Sand Goby *Favonigobius reichei*.

10.4.2.55 Beijiang Thick-lipped Barb is a rare species and only appears in several locations including streams on Lantau Island (Lee *et al.* 2004) and it is also considered to be of Global Concern (Fellowes *et al*. 2002). One individual was observed in the midstream section of a stream near San Tau (i.e. ST9).

10.4.2.56 Dark-margined Flagtail *Kuhlia marginata* was observed at the same stream. This species was regarded as locally endangered in a recent EIA Study Report (DSD 2005). It is regarded to be of Regional Concern by Fellowes *et al*. (2002), but its status was not evaluated by Lee *et al*. (2004) or AFCD (2009). Since freshwater streams are important nursery habitats for this catadromous species (Oka & Tachihara 2008), ST9 is considered to have potential to be a nursery habitat for this species.

10.4.2.57 Rice Fish *Oryzias curvinotus* was found at three stream sites and is a species considered to be of Global Concern (Fellowes *et al*. 2002) which is uncommon in the wild in Hong Kong (Lee et al. 2004). Although it is generally considered to be a freshwater species, it can inhabit brackish environments (Froses & Pauly 2008) and a large population was seen in the mangrove area of Tung Chung Bay (**Appendix 10B**). a small population of Rice Fish was observed in the lower reaches of ST9, and only single individuals of this species were seen in the lower sections of the other two stream sites near Hau Hok Wan (HH3 and HH5).

10.4.2.58 Predaceous Chub *Parazacco spilurus* is common and widespread in Hong Kong (Lee et al. 2004), but is regarded as a vulnerable species in Mainland China (Yue & Chan 1998, CSIS 2008).

10.4.2.59 Populations of over 100 individuals of this species were seen in the middle sections of ST9 and SL3. The Indo-Pacific Tropical Sand Goby Favonigobius reichei, which is regarded as "Lower Risk/ Near Threatened" by IUCN (2009), was found in the lower sections of several streams surveyed. Whilst it is regarded globally as Near Threatened, this species is common and widespread in the intertidal area in Hong Kong (Lee et al. 2004, Nip 2005).

Stream Invertebrates within the 500m Assessment Area

10.4.2.60 The Sesarmine Crab species Chiromantes sereni was found in the lower sections of HH3 and SL3. This species was first recorded in Hong Kong by Soh (1978) and is reported to be endemic (Kwok & Tang 2005). Although its conservation status is not fully understood, it was only found at four sites in a recent territory-wide Sesarmine Crab survey (Kwok & Tang 2005).

10.4.2.61 *Somanniathelphusa zanklon*, another endemic crab species, was also found in the Current Study. Although this species has been found to be quite abundant in Lantau and other places in Hong Kong (DSD 2002, EPD 2007), it is regarded as an endangered species by IUCN due to its restricted distribution (IUCN Redlist 2009). Two juveniles of this species were recorded in ST12. This small stream has potential to provide a nursery habitat for this endangered species.

10.4.2.62 Greasyback Shrimp *Metapenaeus ensis* juveniles were recorded in the lower section of the streams ST9 and SL3. Shrimps belonging to the genus Metapenaeus are commercially important and were extensively cultured in the Gei Wai of Mai Po in the past. They are common in mangrove and estuarine areas in Hong Kong (Leung 1999, Vance 1999). Due to over-exploitation, all four *Metapenaeus* species found in Hong Kong (including *M. ensis*) are considered to be Vulnerable in China (CSIS 2008). Shallow estuarine areas in Hong Kong have the potential to provide nursery habitats for these species.

10.4.3 Marine and Intertidal Ecological Baseline

<u>Marine Recognized Sites of Conservation Importance and important habitats</u>

10.4.3.1 Recognised Sites of Conservation Importance at intertidal zone are divided into two groups, i.e. those within the North Western and North Western Supplementary WCZs, and those within the marine ecological assessment area for the EIA Study.

Within the North Western and North Western Supplementary Water Control Zones

10.4.3.2 There are several Recognised Sites of Conservation Importance and important habitats located Within the North Western Water Control Zone:

- Site of Special Scientific Interest (SSSI) at San Tau Beach;
- Horseshoe crab nursery sites at Sham Wat, Hau Hok Wan, San Tau, Tung Chung Bay, Tai Ho Wan;
- Tai Ho Stream SSSI;
- Seagrass site at Yam O;
- Artificial reefs;
- Sha Chau and Lung Kwu Chau Marine Park;
- The proposed Marine Park at Fan Lau; and
- Marine waters in North and West Lantau waters as dolphin habitats (in particular dolphin hotspots).

Within the Marine Ecological Assessment Area of the EIA Study

10.4.3.3 There are further Recognised Sites of Conservation Importance and important habitats located at intertidal and subtidal zones within the marine ecological assessment area as follows:

- The proposed Marine Park at Soko Islands;
- Horseshoe crab nursery site at Shui Hau: Shui Hau, which is the third identified horseshoe crab nursery sites in Hong Kong (Chiu & Morton 1999);
- Pak Nai SSSI: Pak Nai SSSI was designated in 1980 for its function as roost site for gulls and terns in the Deep Bay area;
- Seagrass beds and Horseshoe crab nursery site in Pak Nai: Pak Nai is one of the three confirmed horseshoe crab nursery site (Chiu and Morton 1999) and also harbours the largest seagrass beds in Hong Kong (Fong 1998);
- Mai Po and Inner Deep Bay Ramsar Site;
- Inner Deep Bay SSSI; and
- Tsim Bei Tsui SSSI.

10.4.3.4 The coastal areas of the southeast shore of Airport Island, southward to the Marine Cargo Terminal, are zoned as "Coastal Protection Area" (CPA) in the outline zoning plan for Chek Lap Kok.

10.4.3.5 In addition to the above recognised sites, another SSSI, i.e. The Lung Kwu Chau, Tree Island and Sha Chau SSSI, designated as Site of Special Scientific Interest on 20 September 1979, is also located within the study area. Pak Chau (Tree Island), a small island located closed to the western boundary of Sha Chau and Lung Kwu Chau Marine Park, is an important night-time roosting site for wintering Cormorants *Phalacrocorax carbo* in Hong Kong. This SSSI, however, is not included in the present assessment as the Lung Kwu Chau, Tree Island and Sha Chau SSSI only covers the land areas of the islands within the Marine Park.

San Tau Beach SSSI

10.4.3.6 Tung Chung Bay is the largest lowland and river mouth habitat on North Lantau, as well as within the marine ecological assessment area except inner Deep Bay, and has extensive mudflats. San Tau Beach SSSI, designated in 1994, is a shallow sheltering beach of about 2.7 ha with fine sand and silt at the west coast of Tung Chung Wan. San Tau harbours the largest seagrass area on Lantau. Two species of seagrasses, *Zostera japonica* and *Halophila ovalis*, were recorded at San Tau Beach. San Tau is the only site located in western waters among the three known sites in Hong Kong where *Zostera japonica* is found. This species of seagrass was previously thought to be limited to the temperate regions, and is thus of special interest to plant biogeography. In the site, there are also trees of the mangrove species *Bruguiera gymnorrhiza*, which was previously thought to be rare but is now considered locally uncommon. Besides seagrass beds, it is also one of the three recognized horseshoe crab nursery sites Hong Kong (Huang *et al*. 1999; Chiu and Morton 1999, Shin et al. 2007).

Horseshoe Crabs and Horseshoe Crab Nursery Sites at Sham Wat, Hau Hok Wan, San Tau, Tung Chung Bay, Tai Ho Wan.

10.4.3.7 Horseshoe crabs are an ancient and taxonomically isolated group (class Merostomata, sub-class Xiphosura) related to spiders, ticks and mites. Though not presently protected under local law, Horseshoe crabs have been identified as a species of conservation importance in Hong Kong. Three species have been reported in HKSAR waters: *Tachypleus tridentatus*, *T. gigas* and *Carcinoscorpius rotundicauda* (Chiu & Morton 1999). These represent all species known from the South China Sea, and three of four species known worldwide. All three species appear to be undergoing rapid population declines and are thought to be under severe pressure in the South China Sea, including Hong Kong waters, due to habitat loss, pollution and over exploitation (Huang 1997; Chiu and Morton 1999, 2003; Chiu 2003; Morton and Lee 2003). Information on abundance of these species is limited, but Liang and Zhou (1987) note that in surveys in Beibu Bay, Guangxi/Guangdong, *T. tridentatus* made up 90% of the catch and the other two species together made up only 10%.

10.4.3.8 In an extensive study of the distribution of horseshoe crabs in Hong Kong conducted between March 1995 and June 1998 *Tachypleus gigas* was not recorded and its local status is uncertain (Chiu and Morton 1999.) It is likely that only two species of horseshoe crab (*T. tridentatus* and *C. rotundicauda*) are currently widely distributed in Hong Kong as no recent records of *T. gigas* are available (Chiu and Morton 1999; Mouchel 2002c). Liao et al. (2001) also did not record *T. gigas* in their extensive surveys (September 1994 to June 1998) of the South China Sea (from Hainan to Xiamen). All three species of Indo-Pacific horseshoe crabs appear to be in population decline and are thought to be under severe pressure in the South China Sea, including HKSAR waters, due to habitat loss and overexploitation (Huang 1997). The most critical habitat is the sandy shore and sandy backshore where adult horseshoe crabs mate and lay eggs. Horseshoe crabs have been identified as species of conservation importance in the HKSAR, and regarded as Vulnerable by CSIS (2008).

10.4.3.9 Horseshoe crabs, most commonly *T. tridentatus*, have been recorded in the HKSAR at Tap Shek Kok, Sha Chau, Tai Po and Peng Chau, though there are no recent records from any of these sites (Huang 1997). *C. rotundicauda* was recorded in 1997 from Ma Wan Chung, Lantau, at a site that would be lost to development of the Tung Chung New Town (*ibid*.). The other areas where horseshoe crabs have been recorded in the HKSAR are on the shores of Outer Deep Bay and the waters around Black Point-Tap Shek Kok.

10.4.3.10 Horseshoe crabs are currently more often found in western waters of Hong Kong, though they were once thrived on many beaches in Hong Kong including Tolo Harbour (Huang 1997; Huang *et al*. 1999).

10.4.3.11 During the Crosslinks 2 study, horseshoe crabs were reported to have been recorded from trawl surveys at Tap Shek Kok, and beaches at Lung Kwu Sheung Tan and Lung Kwu Tan were thought once to be breeding grounds for horseshoe crabs, based upon information from the residents in Lung Kwu Tan (Mouchel 1999). It was also reported that spawning of horseshoe crabs was seen in Lung Kwu Sheung Tan many years ago (Huang *et al*. 1999).

10.4.3.12 Confirmed nursery sites for horseshoe crabs in recent years included Pak Nai, San Tau and Shui Hau (Huang *et al*. 1999), together with Tai Ho Wan (Fong 1999). Some other beaches on Lantau, including Tai O, Yi O, Sham Wat Wan, Sha Lo Wan and Tung Chung, are considered of high possibility due to the records that adult horseshoe crabs were frequently fished offshore (Huang *et al*. 1999).

10.4.3.13 At a territory-wide study, three locations, i.e. Pak Nai in Deep Bay, San Tau near Tung Chung, and Shui Hau at south Lantau, are identified as important horseshoe crab nursery sites, all of which are located at western waters (Chiu & Morton 1999). San Tau is identified as one of the key ecological issues for the present study.

10.4.3.14 Two species of horseshoe crab, *Tachypleus gigas* and *Tachypleus tridentatus*, have been recorded from trawl surveys at Tap Shek Kok just south of Lung Kwu Tan, and the beaches at Lung Kwu Sheung Tan and Lung Kwu Tan have been identified as potential breeding sites for *T. gigas* (ERL 1993, ERM 1996). Juvenile horseshoe crabs are seen by fishermen in the intertidal zone from Sheung Pak Nai to Ngau Hom Shek, but adults are seldom seen.

10.4.3.15 In Deep Bay the preferred habitat was identified as sandy to muddy intertidal zones, which appear to provide habitats for mating and egg laying, and for juveniles. Currently, Ha Pak Nai in Deep Bay, together with San Tau near Tung Chung and Shui Hau in South Lantau, are regarded as nursery sites for horseshoe crabs (Chiu & Morton 1999).

10.4.3.16 *T. tridentatus* and *C. rotundicauda* have been recorded at Tai Ho Wan, Tung Chung Wan, San Tau and Sha Lo Wan and Sham Wat (Huang 1997; Chiu and Morton 1999; Fong 1999; Mouchel 2000 2002c; Mott 2003). Specimens of horseshoe crabs were also collected in north Lantau waters (ERM 1997; Chiu and Morton 1999).

Tai Ho Stream SSSI

10.4.3.17 The Tai Ho Stream SSSI is about 5ha in area and comprises two main components: Tai Ho Stream and the inner part of Tai Ho Wan. "Tai Ho Stream" includes several tributaries that lie to the south and east of Tai Ho Wan, passing Tin Liu, Tai Ho San Tsuen, and merging just below Ngau Kwu Long, and entering Tai Ho Wan at its southern end. Tai Ho Stream is one of the most ecologically valuable fresh water streams in Hong Kong. Chong and Dudgeon (1992) recorded the salmonid fish Ayu ("sweetfish") *Plecoglossus altivelis* at Tai Ho Stream, the first record and the only site of occurrence of this species for Hong Kong or Guangdong (Dudgeon 1993). This species requires unobstructed passage between salt and fresh water to breed. The high water quality and natural state of Tai Ho Stream are likely very important to this species.

10.4.3.18 The importance of Tai Ho Stream to Hong Kong's freshwater fish fauna, and the linkages to other ecologically important intertidal habitats in Tai Ho Wan, qualify Tai Ho Stream as a habitat of high ecological value. Conservation and prevention of damage to the stream channel and riparian zone is essential. The Tai Ho Stream and part of its estuarine zone were designated as an SSSI in 1999 in recognition of the ecological importance of the stream and its fish fauna.

Seagrass site at Yam O

10.4.3.19 Seagrasses were recorded in Yam O (Sunny Bay) during a territory-wide seagrass survey conducted by AFCD (Kwok *et al*. 2004). About 0.75 ha of *Halophila ovalis* was found at this location and made it a new seagrass locality (*ibid*). *H. minor* was also reported in this site (Yip and Lai 2006).

Artificial Reefs

10.4.3.20 Artificial Reefs were deployed near the northeast corner of Airport Island within Marine Exclusion Zone 3 and at Sha Chau and Lung Kwu Chau Marine Park. Both ARs were deployed in 2000, with a footprint of 1,200 m^2 (3,600 m^3 in terms of volume) in the Marine Exclusion Zone, and a footprint of 3,660 m^2 (3,600 m^3 in terms of volume) in the Marine Park.

Sha Chau and Lung Kwu Chau Marine Park

10.4.3.21 North Lantau waters also contain Sha Chau and Lung Kwu Chau Marine Park which was designated for the conservation of Chinese White Dolphin (**Figure 10.1**). Sha Chau and Lung Kwu Chau Marine Park, a marine area of 12 km2 (1,200 hectares), lies adjacent to the Urmston Road shipping channel. It is the only marine park in Hong Kong western waters. The Marine Park was designated on 22 November 1996 with the primary objective of protecting Chinese White Dolphin and its habitat. Some human activities are controlled in the Marine Park in order to provide a safe haven for CWD. Bottom trawling is prohibited, and speed limits are placed on vessel traffic to decrease the risk of collisions. The boundary is demarcated by yellow light buoys deployed at the corners of the marine park. The landward boundary follows the high water mark along the coastline of the islands. The marine environment of Sha Chau and Lung Kwu Chau Marine Park is greatly influenced by the Pearl River freshwater run-off, with high organic loading and sediment loading. Marine organisms found in this region are adapted to a low salinity and high turbidity marine environment. Sha Chau and Lung Kwu Chau Marine Park has rich fisheries resources. Fishes of the Engrulidae, Scieanidae and Clupeidae families are important food for Chinese White Dolphin. It therefore provides an important feeding ground for Chinese White Dolphin.

Proposed Marine Park at Fan Lau

10.4.3.22 The waters off the southwest coast of Lantau (i.e. Fan Lau) is considered a proposed Marine Park for the protection of cetaceans (**Figure 10.1**). A feasibility study was completed in 1999 (Tsang & Milicich 1999). One of the marine ecological resources in this area is the cetaceans, in particular Chinese White Dolphin which are abundant in West Lantau waters.

10.4.3.23 West Lantau and North Lantau waters which are the most important dolphin habitats in Hong Kong. Chinese White Dolphin is present commonly year-round in the waters north and west of Lantau, and are found only seasonally or rarely in other places of Hong Kong.

Other recognized sites of conservation importance/ important habitats

10.4.3.24 The proposed Marine Park at Soko Islands was also proposed for the protection of cetaceans.

10.4.3.25 Horseshoe crab nursery site at Shui Hau: Shui Hau, which is the third identified horseshoe crab nursery sites in Hong Kong (Chiu & Morton 1999).

10.4.3.26 Pak Nai SSSI was designated in 1980 for its function as roost site for gulls and terns in the Deep Bay area (Anon. 1995).

10.4.3.27 Seagrass beds and Horseshoe crab nursery site in Pak Nai: Pak Nai is one of the three confirmed horseshoe crab nursery site (Chiu and Morton 1999) and also harbours the largest seagrass beds in Hong Kong (Fong 1998).

10.4.3.28 Mai Po and Inner Deep Bay Ramsar Site is the only Ramsar Site in Hong Kong and important for several thousands of waterbirds during winter.

10.4.3.29 Inner Deep Bay SSSI is designated in 1986. It covers 2,300 ha of intertidal mudflats and mangroves at the inner most part of inner Deep Bay, between Hong Kong and Shenzhen.

10.4.3.30 Tsim Bei Tsui SSSI is also located in inner Deep Bay, but covers a much smaller area of 2.1 ha. It is a mature mangrove community at a seafront location just below Tsim Bei Tsui Police Post. Designated in 1985, it was at that time considered the only known habitat in Hong Kong for the snail *Ellobium polita*.

<u>Intertidal Ecological Baseline for the North Western Water Control Zone</u>

10.4.3.31 Similar with the terrestrial habitats, intertidal habitats relevant to the ecological impact assessment are located in two main areas, i.e. the North Lantau coastlines near the Airport Channel and the shores on Airport Island. These two areas are separated by Airport Channel which is a 200m wide sea channel separating the New Town from the Airport Island and giving each a distinct waterfront.

10.4.3.32 The North Lantau coastlines near the Airport Channel are mainly natural intertidal habitats, including undisturbed rocky shores and intertidal sandflats/mudflats, while all the original coastlines in Tung Chung New Town (the eastern end of the present project's study area) have been lost to reclamation.

10.4.3.33 The coastlines of Airport Island are predominately artificial seawalls, but the northeast and southeast shores of Airport Island contain some remnant shores of the original Chek Lap Kok Island. All the other original coastlines of Chek Lap Kok have been lost during reclamation for the Airport.

Artificial Seawalls

10.4.3.34 The dominant intertidal habitat type within the 500m distance of the HKLR alignment was sloping boulder-form artificial seawall.

10.4.3.35 All the coastlines on the southern shore of Airport Island (along the Airport Channel), and some sections in the southeastern shore (e.g. the most southern end) and northeast shore (e.g. the marine cargo terminal) of Airport Island are artificial shores. The artificial coastlines on Airport Island, at least 10km meters in total, are seawalls of reclamation for the Airport. The age, design, homogeneity, orientation and lack of habitat niches of the seawall are, however, likely to limit faunal numbers and diversity here.

10.4.3.36 The intertidal habitats on the artificial seawalls of Airport Island were studied during the field survey programme for the **EVS** (see **Appendix 10B**). The number of species and the diversity and evenness indices of artificial seawalls were in general slightly lower than other natural rocky shores inside the 500m assessment area. Sessile organisms such as Purplish Bifurcate Mussel, Rock Oyster and Striped Barnacle were the dominant species of all these sites. Other abundant species observed were Bearded Ark Shell, Limpets, *Nerita yoldii* and Periwinkles. The dominant species found are common and widespread in Hong Kong rocky shores (Williams 2003, Lai *et al*. 2006). None of the species recorded are considered to be rare or of conservation importance.

10.4.3.37 The sloping seawalls in the Northeast of Airport Island, where direct impacts on intertidal zone from the HKBCF reclamation are anticipated, were also surveyed during the HKBCF ecological survey programme. The artificial seawalls were colonised by intertidal fauna, but the abundance and diversity were low. The species recorded were all common in Hong Kong, including Acorn Barnacle *Tetraclita squamosa*, Rock oyster *Saccostrea cucullata*, False limpet *Siphonaria japonica*, Limpet *Patelloida pygmaea* & *P. saccharina*, and Nerite snails. No fauna of special conservation interest was found.

Rocky Shores

10.4.3.38 The remaining intertidal habitats within the 500m assessment area of the HKLR, except those inside embayments as explained in the next section, are rocky shores including 1) remnant rocky shores along the southeast coast and a small section at the northeast end of Airport Island, and 2) undisturbed natural rocky shores on North Lantau coastlines from Tung Chung Bay to Sham Wat.

10.4.3.39 Rocky shores are not rare in Hong Kong, and are not characterised by high productivity, species richness or diversity as are intertidal mudflats. Various studies of the coastal areas of Northern Lantau have revealed that the intertidal fauna and flora present in rocky shore habitat are typical of other locations in Hong Kong

10.4.3.40 During the intertidal survey for the **EBS** between September 2003 to May 2004, all recorded species on hard intertidal shore are common and widespread in Hong Kong, such as rock oyster *Saccostrea cucullata* and littorinid gastropod *Littoraria articulata*.

10.4.3.41 Their survey results revealed that only common intertidal species such as freshwater nerite (*Clithon cf. faba*), top shell (*Monodonta labio*), nerite (*Nerita spp.*), rock oyster (*Saccostrea cucullata*), the littorinid gastropod (*Littoraria articulata and Nodilittorina radiata*), common whelk (*Thais clavigera*), and acorn barnacle (*Balanus* sp.) were recorded on the rocky shores. In addition, a few small shore crabs (*Hemigrapsus sanguineus*) and one hermit crab were seen on pebbles or rocky bottom. All hard-bottom intertidal species recorded are common and characteristic of intertidal habitats throughout Hong Kong. These results were consistent with the findings from other previous literatures.

10.4.3.42 The undisturbed natural coastlines on North Lantau would not be impacted by the Project. Three natural rocky shores, including those on the western and eastern sides of Sha Lo Wan headland, and near the Sha Lo Wan Pier, were surveyed during the **EVS** study. A total of 54 species was recorded in the hard shore habitats (including natural rocky shore on North Lantau and artificial seawalls on Airport Island). None of the recorded species are listed as being of conservation importance (IUCN 2009, CSIS 2009). During the quantitative survey, 45 species were recorded. The number of species and the diversity and evenness indices of natural rocky shores were in general slightly higher than those of the two artificial hard shores.

10.4.3.43 The remnant coastlines at the southeast shore of Airport Island, which are originated from the old Chek Lap Kok Island, were surveyed during the Marine Supplementary Survey (**MSS**) for the HKLR. Four locations were investigated following the same hard shore methodology applied in the **EVS** and the HKBCF survey programme. Although not being completely converted to artificial coastlines, these coastlines have been subject to disturbance and modification of various extents, including the elimination of backshores and conversion to seawalls, and thus should not be considered as natural coastlines. It was also isolated from other natural shores. Only 26 taxa were recorded from both quantitative and wall-through survey during wet and dry seasons. All the species found are common and widespread intertidal fauna in Hong Kong. The abundance of the intertidal fauna was generally low, especially in areas with isolated sandy substrates.

Intertidal Sandflats/Mudflats

10.4.3.44 The intertidal habitats from Tung Chung Bay to Sham Wat are characterized by mudflats/sandflats, seagrass beds and mangroves.

10.4.3.45 Intertidal mudflats, together with the mangroves and seagrasses, were found to be the most ecologically important intertidal habitats for the present EIA. Ecological functions provided by these communities include energy cycling, coastal stabilisation, and habitat for wildlife such as coastal birds and horseshoe crabs. Tung Chung Bay is the largest embayment on North Lantau, and has extensive mudflats. Mudflats are important not only because they provide a habitat to infauna which are in turn the prey items of many waterfowls, but also they are the suitable substrate for the colonization of mangroves and seagrasses, both are important habitat types in Hong Kong. The seagrass beds are also an important nursery and feeding ground of horseshoe crabs. The structures of the mudflat habitat would be diversified by the colonizing vegetation. A large variety of microhabitat types may contribute to a diverse intertidal fauna. The high species richness of crabs in Mai Po, where 32 species of crabs were recorded, was also attributed to the large variety of microhabitats there (Lee & Leung 1999).

10.4.3.46 Important species such as horseshoe crabs and seagrasses are present within certain intertidal sandflats/mudflats in the study area (ERM 2001; Mouchel, 2000, 2002b; Tam and Wong, 2000; Mott, 2003).

10.4.3.47 During the **EBS** study, soft shores were surveyed, and quantitative transect survey were performed in selected locations including Tung Chung Bay. All the species recorded were typical soft shore intertidal fauna and can be found in similar habitats throughout Hong Kong. Mud snails (Cerithidea diadjariensis) were common representatives on the sandflats of Tung Chung Bay.

10.4.3.48 In the **EVS** study, six soft shore locations (Sham Wat (SW), Sha Lo Wan (SLW), Hau Hok Wan (HHW), Tung Chung Bay (TCB), San Tau (ST) and San Shek Wan (SSW)) along the northern coast of Lantau (The locations of these soft shore locations are shown in **Appendix 10B**) were surveyed to cover wet and dry seasons.

10.4.3.49 A total of 155 species from several faunal groups, including echinoderms (sea cucumber), arthropods (shrimp, crab and horseshoe crab), molluscs (bivalve, gastropod and tusk shell), annelids (segmented worm), sipunculids (peanut worm), nemerteans (ribbon worm), cnidarians (sea anemone) and poriferans (sponge), were recorded from these soft shore sites. Of these six sites, the highest species number was recorded at San Tau and Tung Chung Bay (76), and the lowest number was recorded at Sham Wat (57). Species numbers recorded at San Shek Wan, Sha Lo Wan and Hau Hok Wan were 69, 72 and 75, respectively.

10.4.3.50 During the transect and quadrat surveys, a total of 26,627 individuals belonging to 104 species were recorded, including a single horseshoe crab individual. A total of 1,019 individuals belonging to 56 fauna species were found in the core samples. Findings of quantitative surveys are summarized in the table below.

Table 10-3 Species number, numerical abundance, Pielou's evenness index (J') and Shannon diversity index (H', Log e) recorded at soft shore sites

	SW	SSW	SLW	HHW	ST	TCB
Epifauna						
Number of Species	29	42	44	49	55	50
Abundance	1259	4147	5079	3899	4222	8021
J'	0.46	0.49	0.47	0.53	0.55	0.43
H' (Log_e)	1.56	1.82	1.79	2.07	2.20	1.67
Infauna						
Number of Species	12	20	17	18	19	24
Abundance	164	265	83	56	115	336
J'	0.45	0.52	0.74	0.86	0.81	0.48
H' (Log_e)	1.11	1.56	2.10	2.47	2.38	1.51

10.4.3.51 Most species found during these surveys are common and widespread in Hong Kong. Six species considered of international or regional (China) conservation importance were recorded (**Table 10-4**), details of which are given in the following paragraphs.

Table 10-4 Species of international or regional conservation importance found in soft shore habitats

Species	SW	SSW	SLW	HHW	ST	TCB
Indo-Pacific Tropical Sand Goby *Favonigobius reichei*	+	+	+	+	+	+
Snowy Puffer *Takifugu niphobles*				+	+	
Predaceous Chub *Parazacco spilurus*		+				
Sea Cucumber *Holothuria leucospilota*	+					
Horseshoe Crab *Tachypleus tridentatus*	+				+	+
Greasyback Shrimp *Metapenaeus ensis*	+		+	+	+	

10.4.3.52 The Indo-Pacific Tropical Sand Goby *Favonigobius reichei*, which has been regarded as “Lower Risk/Near Threatened” by IUCN (2009), was found to be very common at all the study sites. Although it is regarded globally as Lower Risk/Near Threatened, this species is common and widespread in intertidal areas in Hong Kong (Lee *et al*. 2004, Nip 2005).

10.4.3.53 Another fish species observed, Snowy Puffer *Takifugu niphobles*, is regarded as “Data Deficient” by IUCN (2009). This fish is, however, considered to be common in Hong Kong (Nip 2005, AFCD 2009b).

10.4.3.54 Two Predaceous Chub *Parazacco spilurus* were observed in a freshwater creek running across the shore in SSW. This species is considered to be Vulnerable in Mainland China (Yue & Chen 1998, CSIS 2008). This is primarily a freshwater species, however, and is not known to tolerate saline conditions; its presence on the surveys probably resulted from upstream populations having been washed into the lower reaches of the stream.

10.4.3.55 The Horseshoe Crab *Tachypleus tridentatus* was recorded at two of the soft shore sites, TCB and ST. Two records from TCB included a juvenile (max. width of prosoma = 40mm) and one dead subadult (max. width of prosoma = 150mm). The single crab at ST was one tiny juvenile (max. width of prosoma = 5mm). This Horseshoe Crab species is regarded as Vulnerable by CSIS (2008).

10.4.3.56 The Sea Cucumber *Holothuria leucospilota* was found on the shore of SW. This species is usually found in the low tide/subtidal zone of boulder shores (Morton & Morton 1983) and the soft shore at SW is not optimal habitat for this species. It is the most common holothuroid in Hong Kong (Lai *et al*. 2006) but is regarded as Endangered in Mainland China due to over-exploitation (CSIS 2008).

10.4.3.57 Although *Metapenaeus* spp. are common in mangrove and estuarine areas in Hong Kong (Leung 1999, Vance 1999), all four species found in Hong Kong (including *M. ensis*) are considered to be Vulnerable in Mainland China due to over-exploitation (CSIS 2009). In the Current Study, individuals of *M. ensis* were found in SW, SLW, HHW and ST.

10.4.3.58 All of the species recorded were typical soft shore intertidal fauna and can be found in similar habitats throughout Hong Kong. Mud snails (*Cerithidea diadjariensis*) were common representatives on the sand-flats of Tung Chung Bay. Survey results obtained at Tai Ho Wan also revealed that the mud snail (*C. diadjariensis*) was dominant. Common species including acorn barnacle (*Balanus* sp.), small shore crab (*Hemigrapsus sanguineus*) and the nerite (*Nerita polita*) were abundant on hard surfaces such as rocks and boulders present on the soft shores of the entire coastal study area. Species abundance was similar in wet and dry seasons. Besides the sandflats/mudflats, there are some patchy sandy beaches on the southeast shore of Airport Island. These patcthy sandy beaches are of very low abundance of intertidal fauna as recorded during the MSS, and no infauna was recorded in the sediment in these sandy beaches (see **Appendix 10C**).

10.4.3.59 Tai Ho Wan is located in the estuarine area and harbours intertidal mudflats and mangroves. It has been partly cut off from the sea by the construction of the North Lantau Highway. A culvert at the western end of the bay maintains tidal exchange within the bay. The southern end of the bay is dominated by mangroves and extensive mudflats where Tai Ho Stream enters the bay. Mudflats of this size are uncommon outside Deep Bay area and are becoming more and more scarce in the territory.

10.4.3.60 The intertidal habitats inside the embayment at Tai Ho Wan are dominated by intertidal mudflats, with patches of seagrass beds and mangroves along the coastline.

10.4.3.61 Intertidal mudflats, together with the mangroves and seagrasses, were ecologically important intertidal habitats. Ecological functions provided by these communities include energy cycling, coastal stabilisation, and habitat for wildlife such as coastal birds. Tai Ho Wan has extensive mudflats. Mudflats are important not only because they provide a habitat to infauna which are in turn the prey items of many waterfowls, but also they are the suitable substrate for the colonization of mangroves and seagrasses, both are important habitat types in Hong Kong. The seagrass beds are also an important nursery and feeding ground of horseshoe crabs (Fong 1999). AFCD recorded 20 *C. rotundicauda* individuals at Tai Ho Wan December 2003 (**Appendix 10A**). The structures of the mudflat habitat would be diversified by the colonizing vegetation. A large variety of microhabitat types may contribute to a diverse intertidal fauna. The high species richness of crabs in Mai Po, where 32 species of crabs were recorded, was also attributed to the large variety of microhabitats there (Lee & Leung 1999).

10.4.3.62 Tai Ho Wan provides an ecological linkage between marine habitats and freshwater habitats (Tai Ho Stream) of conservation importance. It is a movement corridor for anadromous and catadromous fishes moving between streams and the sea. The bay also provides additional habitat for the marine vagrant fish species recorded in Tai Ho Stream.

10.4.3.63 The Tai Ho area is notable for the fact that the hydrological system of streams, estuary and bay remains intact and little modified by human activity. Horseshoe crabs are known to prefer undisturbed beaches (Botton *et al*. 1998 in Chiu and Morton 1999). Chong and Dudgeon (1992) attributed the exceptional fish fauna they recorded in Tai Ho Stream to the relatively unaltered condition of the area. Tai Ho provides an example of a well-interlinked ecological landscape, dominated by sheltered bay, wetlands, woodlands and streams, that support a high diversity of plant and animal communities.

Mangrove Habitats

10.4.3.64 Mangrove communities are under threat from urbanisation and reclamation, and because many stands have been destroyed in Hong Kong they are considered to be a conservation priority (Tam and Wong, 2000). There is a large body of data on the mangal and seagrass habitats present in the **EBS** study area (e.g., Mouchel 2000; Tam and Wong 2000).

10.4.3.65 During the EBS study, mangroves in San Tau to Tung Chung Bay were surveyed. The Tung Chung and San Tau mangrove habitats have also been well studied previously (Tam and Wong 2000; Mott 2003). The mangrove habitat at San Tau is considered to be of particular ecological importance because of its size and seagrass beds. This habitat is dominated by the mangroves *Aeigceras corniculatum*, *Kandelia candel* and *Bruguiera gymnorrhiza* (which was previously thought to be rare but is now considered locally uncommon). Other mangroves *Avicennia marina* and *Acanthus ilicifolius* are also well represented.

10.4.3.66 During the **EVS**, mangrove was identified within the San Tau Beach SSSI, while two patches of associated mangrove were found along the coastlines of Tin Sam (just to the north of San Tau) and Hau Hok Wan. The mangrove habitat is dominated by a number of mangrove species, especially *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Kandelia obovata* and *Acanthus ilicifolius*. The associated mangrove habitats are dominated by herb *Limonium sinense*, shrubs *Clerodendrum inerme*, *Suaeda australis*, *Scaevola sericea* and *Pandanus tectorius* and trees *Cerbera manghas*, *Hibiscus tiliaceus* and *Thespesia populnea*.

10.4.3.67 There are also mangroves in Tai Ho Wan and Sham Wat. Mangroves in Sham Wat were also surveyed during the EBS, and different from the mangrove stands in Tung Chung Bay or Tai Ho, there were only small areas of mangroves fringing the eastern and western shores of Sham Wat, and no species of special concern were recorded.

10.4.3.68 Tam and Wong (1997) surveyed the main mangrove stand in Tai Ho Wan. They found this 1.86 ha stand to be the third largest mangrove on Lantau, after Tung Chung and San Tau. The Tai Ho Bay mangroves harboured all of Hong Kong's mangrove species except *Lumnitzera racemosa* and the extremely restricted *Heritiera littoralis* (*ibid*.). Tai Ho Wan also had the densest mangrove stand encountered in the study.

10.4.3.69 During the **EBS**, the number of floral species recorded in Tai Ho was fairly high. There were six true mangrove species including *Lumnitzera racemosa, Kandelia candel, Bruguiera gymnorrhiza, Avicennia marina, Aegiceras corniculatum* and *Acanthus ilicifolius*. In addition to these true mangrove species, a number of mangal-associated flora, such as *Limonium sinense, Clerodendrum inerme* and *Acrostichum aureum* were also recorded. Other common species recorded within the coastal or mangrove communities included *Zoysia sinica, Suaeda maritime* and *Vitex rotundifolia*.

10.4.3.70 During a field visit in 2005, it was verified that the mudflat in Tai Ho Wan consisted of isolated patches of mangrove stands at the estuary of Tai Ho Stream and some inlet. 13 mangrove and mangrove associate species were recorded.

Seagrass Beds

10.4.3.71 North Lantau harbours a few locations of seagrasses including Tung Chung Bay, San Tau, Tai Ho Wan and Yam O. Tung Chung Bay is the largest lowland and river mouth habitat on North Lantau, and has an extensive mudflat. San Tau, at the northwest of Tung Chung Bay mudflat, harbours the largest seagrass area on Lantau. Two species of seagrasses, *Zostera japonica* and *Halophila ovalis* (previously described as *H. ovata*), were recorded in San Tau Beach, and an area of 2.7 ha was designated a SSSI in 1994.

10.4.3.72 Both *Zostera japonica* and *Halophila ovalis* (previously described as *H. ovata*) are considered rare locally (Xing *et al*, 2000). *Zostera japonica* and *Halophila ovata* are usually found co-habiting the seaward margins of mangrove stands (AFCD 2003). San Tau is the only site in western waters among the five known sites in Hong Kong where *Zostera japonica* can be found (i.e. Lai Chi Wo, So Lo Pun, Siu Tan, Sheung Sze Wan and San Tau, see Kwok *et al*. 2005). *Zostera japonica* was previously thought to be limited to the temperate regions and is thus of special interest to plant biogeography.

10.4.3.73 *Halophila ovalis* is also considered to be of special scientific interest because it is one of the few marine flowering plants in Hong Kong (AFCD 2003). Apart from San Tau, *Halophila ovalis* (described as *Halophila ovata*) has been previously recorded in Tai Tam Bay, Ho Chung, Hoi Ha Wan, Wu Shek Kok and Lai Chi Wo (AFCD 2003). More localities for this species have been found in a territory-wide search of seagrass sites in Hong Kong, including Ham Tin, Kai Kuk Shue Ha, Nam Chung, Nim Shue Wan, Sheung Sze Wan, Siu Tan, To Kwa Peng, Tsam Chuk Wan and Yam O (Kwok *et al*. 2004).

10.4.3.74 These two seagrass species at San Tau were surveyed during some previous studies and was found that much of the seagrass beds lied outside the SSSI (Mott 1998).

10.4.3.75 During the **EBS** study, the field surveys for seagrass beds were undertaken between 2003-2004. Field survey results confirmed that the seagrass bed at San Tau Beach SSSI still supported the two seagrass species, *Halophila ovalis* (described as *H. ovata* in the **EBS** study) and *Zostera japonica.* (**Appendix 10A**).

10.4.3.76 It should be noted that the seagrass bed at San Tau has been subject to impacts associated with the reclamation works for the airport at Chek Lap Kok. The seagrass has, however, recovered since the works were completed.

10.4.3.77 During the field survey for TMCLKL in July 2008, however, no seagrass beds were found on the mudflat in Tung Chung Bay (Maunsell 2009). During the **EVS** study, a third species of seagrass, *Halophila minor*, was recorded in San Tau. *Halophila minor* was also previously recorded at Sunny Bay (previously called Yam O) in North Lantau (Yip & Lai 2006).

10.4.3.78 Patches of the seagrass *Halophila beccarii* were also recorded in Tai Ho Wan (Wu and Lee 1998, Fong 1998) and at the stream mouth within Tai Ho Stream SSSI (Mott 1998; Mouchel 2000). *H. beccarii* is widespread along the coast of various Southeast Asian countries (Hodgkiss and Morton 1978). *H. beccarii* was first recorded in Hong Kong at Tsim Bei Tsui in Deep Bay (*ibid*.). Besides Tsim Bei Tsui and Tai Ho, other sites where this species of seagrass was recorded included Starling Inlet (Wong 1998), Black Point (Xing *et al.* 2000), Sheung Pak Nai, Sha Kong Tsuen and Nam Chung Yeung Uk. (Kwok et al. 2005, with the largest *H. beccarii* bed in Ha Pak Nai (Fong 1999).). This seagrass species is considered locally rare (Xing *et al.* 2000). The seagrass beds are also an important nursery and feeding ground of horseshoe crabs. During the April 2004 survey, the seagrass *Halophila beccarii* habitat was found during low tide at Tai Ho Wan and supported more than 20 colonies each approximately 30cm X 30 cm in area. During the field survey for TMCLKL, however, no seagrass beds were found on the mudflat in Tai Ho Wan (Maunsell 2009). The Tai Ho seagrass beds are of importance due to the presence of a locally restricted seagrass species and also it is a horseshoe crab nursery site while horseshoe crabs are threatened by habitat loss in Hong Kong.

Horseshoe Crab

10.4.3.79 Horseshoe crabs are considered of conservation importance in Hong Kong. Three species have been reported in HKSAR waters: *Tachypleus tridentatus, T. gigas* and *Carcinoscorpius rotundicauda* (Chiu & Morton 1999). These represent all species known from the South China Sea, and three of four species known worldwide. All three species appear to be undergoing rapid population declines and are thought to be under severe pressure in the South China Sea, including Hong Kong waters, due to habitat loss, pollution and over exploitation (Huang 1997; Chiu and Morton 1999).

10.4.3.80 In an extensive study of the distribution of horseshoe crabs in Hong Kong conducted between March 1995 and June 1998, *Tachypleus gigas* was not recorded and its local status is uncertain (Chiu and Morton 1999.) It is likely that only two species of horseshoe crab (*T. tridentatus* and *C. rotundicauda*) are currently widely distributed in Hong Kong as no recent records of *T. gigas* are available (Chiu and Morton 1999; Mouchel 2002c).

10.4.3.81 Horseshoe crabs are currently more often found in western waters of Hong Kong, though they were once thrived on many beaches in Hong Kong including Tolo Harbour (Huang 1997; Huang *et al.* 1999). Conformed nursery sites for horseshoe crabs in recent years included Pak Nai, San Tau and Shui Hau (Huang *et al.* 1999), together with Tai Ho Wan (Fong 1999). Some other beaches on Lantau, including Tai O, Yi O, Sham Wat Wan, Sha Lo Wan and Tung Chung, are considered of high possibility due to the records that adult horseshoe crabs were frequently fished offshore (Huang *et al.* 1999). At a territory-wide study, three locations, i.e. Pak Nai in Deep Bay, San Tau near Tung Chung, and Shui Hau at south Lantau, are identified as important horseshoe crab nursery sites, all of which are located at western waters (Chiu & Morton 1999).

10.4.3.82 Horseshoe crabs are known to be sparsely distributed along the coastline of Lantau Island and most survey effort of the **EBS** was expended at bays within the study area where suitable microhabitats were present (typically well-aerated sediment substrates near to seagrass beds; substratum adjacent to streams). These areas included Hau Hok Wan, Pak Mong, San Shek Wan, San Tau, Sha Lo Wan, Sham Wat, Tai Ho Wan and Tung Chung Bay. Several embayments with confirmed records of horseshoe crab juveniles including Tai Ho Wan, San Tau, Hau Hok Wan, Sha Lo Wan, and Sham Wat were considered as ecological sensitive receivers in the present EcoIA (see **Figures 10.1 & 10.2**).

10.4.3.83 During the field surveys of the **EBS**, horseshoe crab juveniles were recorded in Tai Ho Wan and Pak Mong (fourteen live and three molts of *Carcinoscorpius rotundicauda*), San Tau (10 *Tachypleus tridentatus* and 1 *Carcinoscorpius rotundicauda*), Tung Chung Bay (26 *Tachypleus tridentatus*), Hau Hok Wan (Two *T. tridentatus* and one *C. rotundicauda*), and Sham Wat (one live and three molts of *Tachypleus tridentatus*). During the **EVS** study, Horseshoe Crab *Tachypleus tridentatus* was recorded at two of the soft shore sites, Tung Chung Bay and San Tau. Two records from Tung Chung Bay included a juvenile (max. width of prosoma = 40mm) and one dead subadult (max. width of prosoma = 150mm). The single crab at San Tau was one tiny juvenile (max. width of prosoma = 5mm). Besides seagrass beds, it is also one of the three recognized horseshoe crab nursery sites Hong Kong (Huang *et al*. 1999 ;Chiu and Morton 1999). During the TMCLKL study, two *Tachypleus tridentatus* and three *Carcinoscorpius rotundicauda* were recorded at San Tau in July 2008. In addition, two *Carcinoscorpius rotundicauda* were recorded at Tung Chung Bay.

Subtidal Ecological Baseline for the North Western Water Control Zone

Marine waters

10.4.3.84 The assessment area for marine ecology in the present EIA covers a large sketch of sea areas including 7 water control zones. As the areas outside North Lantau waters are far away and sheltered from the project site by Lantau Island, they would be unlikely to be impacted by the project. The present EcoIA would thus focus on North Lantau waters.

10.4.3.85 The HKLR alignment goes through the waters in Hong Kong western boundaries while the proposed reclamation site for HKLR is adjacent to the southeast shore of Airport Island and that for HKBCF is located near the Northeast corner of Airport Island, and are all surrounded by North Lantau waters. Water depths off the North

Lantau reclamation range up to 20m, with the deepest waters in the swift tidal channel of Urmston Road. Water depths in the area just off the NLH are shallower, generally less than 5 m.

10.4.3.86 North Lantau waters also receive effluent from the Urmston Road, Pillar Point and Siu Ho Wan marine discharge outfalls as well as numerous small-scale outfalls. Quantities of effluent from all three major outfalls are predicted to rise continuously (Smith-Evans and Dawes 1996, Maunsell 1997).

10.4.3.87 The North Lantau waters between Tuen Mun and Airport Island are a spawning/nursery grounds for fish and shrimp (ERM 1998). The North and West Lantau waters are important habitats for Chinese White Dolphin in Hong Kong (detailed in below sections on Chinese White Dolphin).

Chinese White Dolphin

10.4.3.88 There are sixteen recorded cetacean species from Hong Kong waters (Jefferson and Hung 2007). And recently in March 2009, a humpback whale was reported in Hong Kong. This made the number of recorded cetacean to seventeen species. Only two of these recorded species, the Chinese White Dolphin (CWD in short form, also commonly known as Indo-Pacific humpback dolphin, *Sousa chinensis*) and Finless porpoise (*Neophocaena phocaenoides*) are resident. Chinese White Dolphin is present in the coastal and inshore waters throughout the Indo-pacific, from Australia and China in the east to South Africa in the west (Jefferson and Karczmarski 2001). Off the coast of south China, at least seven separate populations were identified from Guangxi up to the mouth of the Yangtze River, and all coincide with the presence of river mouths (Jefferson and Hung 2004).

10.4.3.89 One population of Chinese White Dolphin lives in the estuary of the Pearl River, where they inhabit waters of the Hong Kong SAR, Macau SAR and Guangdong Province of the People's Republic of China (Zhou *et al*. 1995; Jefferson and Hung 2004). In Hong Kong, Chinese White Dolphin is also concentrated in the more estuarine-influenced waters, i.e. all the waters of western Hong Kong. They are present commonly year-round in the waters north and west of Lantau, and also occur seasonally or in small numbers to the south and east of Lantau Island, as well as in southern Deep Bay and to the west of Lamma Island (Jefferson 2000, Jefferson & Hung 2004). They are not present in the waters to the east of Lamma Island, except for occasional wanderings.

10.4.3.90 From September 1995 through November 1998, the Hong Kong Airport Authority and the Agriculture, Fisheries and Conservation Department (the then AFD) funded several studies on the biology of the population of Chinese White Dolphin in Hong Kong waters. The results of these early studies indicated that the dolphin population shared with mainland China (Pearl River Estuary) and probably Macao, was much larger than originally estimated, and was probably viable in the long term if appropriate conservation measures were taken (Jefferson 1998, 2000).

10.4.3.91 Chinese White Dolphin is also present in the rest of the Pearl River Estuary outside (to the west) of Hong Kong. Before systematic surveys for the Tonggu Waterway study began in late 1997, there were only sporadic and opportunistic records of CWD from Mainland waters of the Pearl River Estuary (Yang and Chen 1996). From the Tonggu systematic surveys as well as additional systematic surveys conducted in 1999-2000, it has been confirmed that the distribution of Chinese White Dolphin extends throughout the entire Pearl River Estuary from Hu Men in the north to Guishan Dao and Dong'ao Dao in the south (Jefferson & Hung 2004).

10.4.3.92 Through investigation on CWD individual movements and ranging patterns (Hung 2000; Hung & Jefferson 2004), it is confirmed that many identified CWD had ranges that spanned across the Hong Kong/Mainland boundary. A single population of CWD is therefore involved in Hong Kong and Pearl River Estuary, and the population size has been estimated using line-transect methods to be about 1300 – 1500 individuals, with roughly 200 individuals using Hong Kong waters on a regular basis (AFCD 2007).

10.4.3.93 There appears to be seasonal shifts of CWD occurrence with the extent of river influence, moving farther south and east from the Pearl River in the wet season, and farther into the estuary proper in the dry season (Jefferson 2000).

10.4.3.94 Calving seasonality was determined by computing an estimated birth date for each neonate and fetus in the sample, based on the average length at birth, along with fetal and early neonatal growth rates from the literature (Jefferson 2005). Breeding appears to occur throughout the entire year, but there is a peak in the occurrence of births between the months of March and August (Jefferson 2005).

10.4.3.95 Western and Northern Lantau waters are the most important range of the Chinese White Dolphin in SAR waters. This has been concluded from systematic boat surveys for *Sousa chinensis* in Hong Kong waters since 1996 (AFCD 2008). Several hotspots were consistently used by CWD since 2002, including the waters around Lung Kwu Chau, near Black Point, around the Brothers Islands, and the entire stretch of West Lantau waters from Tai O Peninsula to Fan Lau. These hotspots can be considered as the prime dolphin habitats in recent years in Hong Kong. The coast of West Lantau area is of particularly high dolphin density (with densities even higher than in the North Lantau area and around the Sha Chau and Lung Kwu Chau Marine Park), and there are also frequent sightings of young calves in this area.

10.4.3.96 West Lantau waters are currently the most important area in Hong Kong for dolphin conservation as the highest encounter rate of CWD as well as juveniles and calves were recorded in that area. A quantitative grid analysis was developed and has been applied to AFCD long-term monitoring programme to examine fine-scale habitat use by CWD (Hung 2008). According to the results from the long-term AFCD marine mammal monitoring surveys (AFCD 2009), dolphin usage was the highest west of Lantau Island, where most grids (each of 1 km^2) had moderate to high dolphin densities. Densities of CWD engaged in feeding and socializing activities, as well as densities of mother-calf pairs, were particularly high in West Lantau and east of Lung Kwu Chau, indicating the importance of these sites. Chinese White Dolphin frequently uses the whole stretch of the West Lantau waters between Fan Lau to Sham Wat, and some of the sightings of juvenile CWD were even beyond Sham Wat. This finding has been further supported by an additional AFCD land-based dolphin survey in 2004-2005 on the shore between Tai O to Sham Wat, specifically for facilitating the assessment of HZMB on CWD in the West Lantau waters (AFCD 2005).

10.4.3.97 There are also frequent sightings of young calves and juveniles in the coast of West Lantau area (**Figures 10.9 & 10.10 & 10.11**). Most of the sightings of calves and unspotted juveniles in the 2008-2009 monitoring programme were made in the coastal waters of West Lantau (between Tai O to Fan Lau), following by the waters near Lung Kwu Chau, while only a few other sightings were made in waters around the Brothers Islands (only two sightings during 2008-2009, see AFCD 2009) and Soko Islands. To locate the important habitats for nursing activities, the data on unspotted calves and unspotted juveniles from 2002-08 were processed. It was found that both the mean DPSE of unspotted calves and that of unspotted juveniles in West Lantau were much higher those in other areas in Lantau (*ibid*). With the high occurrence of young animals found along the stretch of coastal waters in West Lantau, West Lantau can be considered important nursing area for Chinese White Dolphin in Hong Kong during 2002-08. In view of the importance of this area for CWD, a marine park has been proposed at the coastal waters near Fan Lau.

10.4.3.98 Besides West Lantau waters, the waters around Lung Kwu Chau are also a dolphin hotspot in Hong Kong, and having high densities of unspotted calves. Also in North Lantau waters, Sha Chau and Lung Kwu Chau Marine Park, a marine area of 12 km^2, was designated in November 1996 with the primary objective of protecting *S. chinensis* and its habitat. Two set of artificial reefs were also deployed by government at the marine park and the northeast corner of Airport Island to enhance the food resources for CWD (**Figure 10.1**). The waters offshore the North Lantau Expressway between the Airport Island and Tai Ho Wan are an area of relatively lower dolphin density, compared to other areas in North Lantau (Jefferson

2000) (**Figures 10.8**). Examination of individual range use through photo-ID technique revealed that most CWD had very specific preferences for sites within their home ranges, which acted as core area(s) receiving greater intensity of use (Hung 2008). Several core areas used intensively by many individuals of CWD were identified, including the Sha Chau and Lung Kwu Chau Marine Park, the Brothers Islands, and the stretch of waters from Tai O and Fan Lau in West Lantau (*ibid*). These core areas were considered important habitats for Hong Kong CWD. Among the 62 individuals having higher sighting frequency (over 15 times), the Brothers Islands were the core area for 22 individuals (the second highest number). Furthermore, 12 out of these 22 individuals had exclusive core area use in the Brothers Islands. This implies that many individuals that used the Brothers Islands as their core areas strongly relied on this area with very intensive use (AFCD 2009). On the other hand, the photo-identification works in 2008-09 found an increase of individuals expanding their range use from Northwest Lantau to West Lantau areas or vice versa.

10.4.3.99 Vessel dolphin surveys were conducted for the EIA study on Liquefied Natural Gas receiving terminal in Northwest Lantau waters and Deep Bay between July 2005 and May 2006. 109 sightings of Chinese White Dolphin were recorded in West Lantau waters, 79 in Southwest Lantau waters, 62 in Northwest Lantau waters, while only 25 sightings were made in Deep Bay. In Northwest Lantau waters, the encounter rate in autumn and winter are higher than those in spring and summer.

10.4.3.100 A systematic Chinese White Dolphin line-transect survey in the Pearl River Estuary and Hong Kong waters (covering all of Hong Kong's waters and Pearl River Estuary from Hu Men in the north to Aizhou Dao (隘洲島) in the southeast and Sanzao Dao (三灶島) in the southwest) was conducted between February 2006 to January 2007 for the study on "Proposed Port Development at Northwest Lantau". It covered the entire known range of the Chinese White Dolphin population in the Pearl River Estuary, and the waters at the exit of Modaomen(磨刀門), in order to calculate abundance and density in a 12-month period. In Hong Kong waters of the Pearl River Estuary, individuals of Chinese White Dolphin were frequently sighted along the narrow strip of coastal waters west of Lantau waters. Most sightings were made near Tai O Peninsula (大澳半島), Kai Kung Shan (雞公山), Peaked Hill (雞翼角) and Fan Lau (分流). The frequency of dolphin occurrence was slightly higher along the inshore transect lines than the offshore ones. The dense distribution of dolphin sightings throughout West Lantau was in accordance with results from AFCD's long-term monitoring studies.

10.4.3.101 18 systematic line-transect dolphin vessel surveys were conducted from July 2008 to March 2009 for TMCLKL study. The survey area covered the central portion of North Lantau waters between Pillar Point and Brothers Islands. 30 groups of CWD numbering 100 individuals were sighted, with most sightings (22 sightings) made in the western section of Northeast Lantau survey area (the transect covering the Brothers Islands), while another eight sightings were made in the eastern section of Northwest Lantau survey area.

10.4.3.102 The waters to the east of Airport Island and the waters to the west of Airport Island were the potential areas for locating HKBCF during the early stage of the HKBCF EIA study. To facilitate the ranking of the options, a desk-top study on the dolphin use of both areas was conducted. Both the potential HKBCF locations at the eastern and western Airport were covered by dolphin vessel survey transect adopted for AFCD regular annual dolphin monitoring programme. The dolphin monitoring data thus provided relevant information for assessing the dolphin use in these two locations. Dolphin sightings in North and West Lantau waters during 2002-2008 were reviewed. Positions of on-effort sightings of Chinese White Dolphin from 2002-08 were retrieved from the long-term sighting database and then plotted onto 1 km^2 grids in the waters around Lantau Island. It was found that during the 2,857 dolphin groups (or 11,189 individuals) sighted during vessel and helicopter surveys in North and West Lantau waters between year 2002 and 2008, only a few dolphin sightings overlapped with the potential location to the east of Airport, while more sightings overlapped with the potential location to the west of

Airport. Moreover, for the section of transect to the south of the options, only a handful of sightings were made to the south of the eastern Airport option (the waters immediately to the east of Airport), while CWD were frequently sighted immediately south of the western Airport option. Furthermore, for the coastal waters, dolphin sightings were densely distributed along the coastal waters from Shum Wat to Tai O, while there are very limited sightings on Tung Chung coastlines except the waters around the Brothers Islands and Sham Shui Kok. For seasonal pattern, dolphin sightings were only recorded in the eastern Airport option during autumn months, while the sightings were made during all four seasons in the western Airport option though fewer sightings were made in spring months. The overall abundance of Chinese White Dolphin at several survey areas was estimated by Jefferson (2007), using line-transect analysis with vessel survey data collected during 2004-06. It was found that the area with highest dolphin density was the West Lantau waters, with exceptionally high densities in all four seasons of 159-219 individuals/100 km^2. Moreover, dolphin density at Northwest Lantau was quite high with 52-107 individuals/100 km^2, and the one at Northeast Lantau was relatively low with 6-34 individuals/100 km^2 (Jefferson 2007). Since dolphin densities were much higher in West and Northwest Lantau than in Northeast Lantau among all four seasons, it appeared that dolphin usage at the western Airport option (which lies in between the Northwest Lantau and West Lantau survey areas) should be much higher than the one at the eastern Airport option (which lies in between the Northwest Lantau and Northeast Lantau survey areas).

10.4.3.103 Ranging patterns of 54 individuals of CWD re-sighted 10-123 times since 1995 and with their ranges spanning the Northeast, Northwest and West Lantau survey areas were examined. Of these 54 individuals, 49 of them (90.7%) had their ranges overlapped with the western Airport option, and 37 individuals (68.5%) had their ranges overlapped with the eastern Airport option. The eastern Airport option is thus preferred and has become the present proposed HKBCF.

10.4.3.104 Although the HKBCF lies within the range of dolphin activities and sightings, few sightings were made in the HKBCF reclamation site. Based upon the data from the AFCD dolphin surveys between 2002 and 2008, the mean SPSE values per grid of all 356 grids around Lantau Island was 4.1 ± 6.12, while the mean DPSE values per grid was 16.0 ± 25.77. A total of four grids in Northeast Lantau survey area overlapped with the HKBCF reclamation, and the mean SPSE and DPSE values among these four grids were 2.8 and 10.9 respectively, which were both below the overall means of all grids around Lantau.

10.4.3.105 For the HKLR, its reclamation along the southeast shore of Airport Island and the part of viaduct inside the Airport Channel are within areas with no dolphin sighting records. The waters to the east of Airport Island and offshore Tung Chung are rarely used by the Chinese White Dolphin. Even though a transect line (i.e. the westernmost transect line in Northeast Lantau) run through the area of HKBCF site extending toward Tung Chung, it is found from the desk-top study that only two dolphin sightings were made in this area (between Tung Chung and Airport eastern shore) from 2002-08.

10.4.3.106 The sections of viaduct between Sham Wat to the HKSAR boundary are (i.e. the HKLR marine section open sea part in the below impact assessment) in waters of various levels of dolphin densities, ranging from 0.1-20.0 DPSE to 61.0 – 80.0 DPSE. Only a section of viaduct offshore to Tai O Peninsula gets close to a grid cell with higher DPSE value (61.0-80.0 DPSE) at its northeast corner and this grid cell is the only one with relatively high dolphin density among all grid cells along the HKLR alignment.

10.4.3.107 In the vicinity of the proposed HKBCF reclamation site, the records of calves and juveniles were low in comparison with Lung Kwu Chau and West Lantau. During 2002-08, only two sightings of unspotted juveniles were made within the HKBCF reclamation footprint, while none for unspotted calves (**Figures 10.9 & 10.10**). During the 2008-2009 dolphin monitoring programme, no sighting of calves or unspotted juvenile was made inside or near the HKBCF reclamation footprint

(**Figure 10.11**). The nearest sightings of calves and unspotted juveniles were made in the waters around the Brothers Islands,

10.4.3.108 For the HKLR alignment, as mentioned in above sections that its reclamation and viaduct inside the Airport Channel are not within dolphin habitats (areas with no dolphin sighting including adult and juvenile). During 2002-08, though only two sightings of unspotted calves were made on the HKLR alignment open sea part, there were over 11 sightings of unspotted juveniles along this section of alignment (**Figures 10.9 & 10.10**). There are three unspotted calves and unspotted juvenile sightings lie on or are very close to the HKLR alignment between Sham Wat to Tai O Peninsula during 2008-09 (**Figure 10.11**).

10.4.3.109 There was no frequent feeding activity of Chinese White Dolphin in the HKBCF reclamation site. During 2008-2009, no record of dolphin feeding behaviours was made in the site and its vicinity. While for HKLR, one feeding activity record and four socializing activity records were made on or close to its alignment offshore to Sham Wat.

10.4.3.110 It is noted that the waters around Brothers Islands (to the east of the HKBCF reclamation site) are considered as one of the dolphin hotspots in recent years. Although the HKBCF reclamation is located outside the waters around Brothers Islands with higher dolphin density (between 20.1- 60.0 DPSE, see **Figure 10.8**), this location is still near the dolphin hotspot. The HKBCF site option desk-top study also revealed that more dolphin groups were sighted near the northeast corner of the airport (north of the HKBCF site) and near the Brothers Islands. The HKBCF location is to the west of the hotspot and immediately adjacent to the existing Airport artificial seawall, where the dolphin density is much lower. The DPSE values in the majority of the reclamation site range from 0.1-20.0 DPSE only (see **Figure 10.8**), with only a small fraction inside the area with relatively higher dolphin density (20.1-40.0 DPSE). The habitat use of this area by dolphin is relatively low when compared with other dolphin hotspots in North Lantau.

10.4.3.111 The ecological values of marine waters in western Hong Kong could largely relate to the habitat use of Chinese White Dolphin which is the most significant species of conservation importance in this habitat, and would vary in accordance with the levels of usage by CWD. The West Lantau waters and the waters near Lung Kwu Chau would be of high ecological value due to the high dolphin density and the functions as dolphin nursery grounds. Other dolphin hotspots such as the Brothers Islands would be of moderate to high ecological value. Areas without dolphin sightings or of very limited dolphin use such as Airport Channel and the waters immediately to the east of Airport Island would be of low ecological value. But under some certain circumstances, the ecological value of low dolphin usage areas would escalate to low to moderate if they are adjacent to high use areas (such as Northeast Airport where is close to the Brothers Islands), or even to moderate if they are on potential corridors between high use areas (such as the waters to the west of Airport Island).

Finless Porpoise

10.4.3.112 Within Hong Kong Finless Porpoises occur in the waters to the south and east of Lantau Island, but have never been sighted north or west of Lantau. In addition, they occur in Hong Kong's eastern waters, south of Lamma Island, Hong Kong Island, and in the Po Toi, Ninepins, Sai Kung, and Mirs Bay areas (Parsons *et al.* 1995; Jefferson & Braulik 1999; Jefferson *et al.* 2002a).

10.4.3.113 The total size of the local Finless Porpoise population is not known, but based on line transect analyses, there are estimated to be between 55 (the low season in autumn) and 152 (the peak season in spring) porpoises in Hong Kong's waters in different seasons, and up to 217 finless porpoises occur in the area of Hong Kong plus Mainland waters immediately to the southwest that have been surveyed (Jefferson *et al.* 2002a). The minimum estimate of the population size is thus about 220 porpoises, although the true size of the population is likely to be much larger.

Breeding is strongly seasonal, and although some may be born at other times of year, most calves are born from October to January (Jefferson *et al.* 2002b).

10.4.3.114 Nothing is known of ranging patterns for individual finless porpoises, as individual specimens cannot be identified at sea, and no tagging or marking studies have been done. Feeding habits are known only from examination of stomachs of dead, stranded specimens (Barros *et al.* 2002). Porpoise prey includes many different species of fish, several types of cephalopods and at least one kind of shrimp. Porpoises prey on reef-associated organisms, but these are not primary constituents of the Finless Porpoise diet. Although field observation is currently lacking, there is some indication from stomach contents that porpoises may also feed in association with fishing vessels.

10.4.3.115 Finless porpoises do not occur in North Lantau waters, and within Hong Kong waters, finless porpoise are widely distributed in the southern and eastern waters (Jefferson *et al.* 2002a). There was also no porpoise recorded within the proposed HKBCF reclamation area and its vicinity or the HKLR alignment during the AFCD regular marine mammal monitoring as well as the land-based cetacean survey mentioned above.

Soft substrate seabed

10.4.3.116 Seabed sediments in North Lantau waters display a range of types: those in deeper and swifter-moving waters such as Urmston Road are dominated by coarse material, while those in areas with slower-moving currents are dominated by mud, silt and clay (Greiner Maunsell 1991). This variety of benthic substrates was found to foster a diversity of burrowing infauna in grab samples conducted in 1990 (Greiner Maunsell 1991).

Benthos

10.4.3.117 There is no known macrofauna species of conservation interest in Hong Kong, other than the cephalochordate *Branchiostoma belcheri*. The species is regarded as living fossil link in the evolution of marine invertebrates to vertebrates and is, therefore, considered a potentially important species. The species, however, is typically recorded in the eastern waters of Hong Kong (CCPC 2002) and recently to the south of Cheung Chau (Mouchel, 2003). No species of conservation importance were recorded in the Western waters stratum.

10.4.3.118 Parts of the seabed off North Lantau (beyond the project footprint of the present project) have been used as marine borrow and spoil dumping sites. Contaminated spoil is dumped at the East Sha Chau dumping grounds, where benthic grab samples indicate a fauna low in species diversity, and highly variable due to natural and human disturbance (ERM 1996). More recent monitoring results in the mud pits also revealed similar conditions in the benthic and demersal communities (Mouchel 2002a).

10.4.3.119 Surveys of benthic fauna had been conducted off North Lantau for various studies. In a territory-wide benthic survey commissioned by AFCD (CCPC 2002), up-to-date information on the subtidal benthic communities, with respect to spatial distribution, abundance, and species composition, was collected at 120 sampling stations over the territorial waters of Hong Kong which was divided into 5 strata (regions). One of the strata, Western waters with 29 sampling stations, covers Urmston Road, Deep Bay and North Lantau, and is more relevant with the works areas of the Project. Station 18 is more relevant with the Project as this station is located in the vicinity of the Project footprint (**Figure 10.7**).

10.4.3.120 Station 18 is located in to the north of Airport Northeast corner. The water depth of Station 18 is 8m, and in summer the mean Total Organic Matter TOM was 3.64%, lower than the average in Hong Kong (6.04%). The species richness index (*d*) was 5.62, the species, individual and biomass density were 38 species, 1,444 individuals, and 1,347.68 g/m^2 respectively. The diversity index, H', was 1.52 and evenness, J, was 0.42. Common species in the group of stations covering Station

18 included annelids of *Mediomastus* sp., *Aglaophamus distranchis* and *Apionsoma trichocephalus*.

10.4.3.121 In winter, the mean TOM in Station 18 was 4.39%, lower than the average in Hong Kong (5.45%). A species richness (*d*) of 8.06 was recorded and the density of species, abundance and biomass were 52, 1,120 individual/m^2 and 263.38 g/m^2 respectively. *H'* was 2.14 and *J* was 0.54. Common species in the group of stations covering Station 18 included annelids of *Prionospio ehlersi*, *Mediomastus* sp., *Apionsoma trichocephalus, Aglaophamus distranchis* and *Neoxenophthalmus obscurus*.

10.4.3.122 Species richness, diversity and evenness indices are inter-related. A diversity index integrates two components: the total number of species and the distribution of individuals among species, into a single number (*H'*). H' is usually high (e.g. >3 or 4) in environmentally undisturbed benthic communities, and low (e.g. <1) in highly disturbed communities (Gray 1989). Values for richness, diversity, and evenness would be high, with *d*>10, *H'*>3 and *J* (evenness) >0.8 for a diverse community structure. In benthic habitats where organic matter is concentrated or dissolved oxygen is low, such values are low, with *d*<5, *H'*<2, and *J*<0.5. Results in above paragraphs show that Station 18 is of moderate species richness, low diversity, and low evenness in both summer and winter seasons. No species of conservation importance was recorded. The only known benthic macrofauna species of conservation interest in Hong Kong, the cephalochordate *Branchiostoma belcheri* was not found in this station. This area is therefore not of special conservation importance in terms of benthic communities.

10.4.3.123 The diversity and abundance of benthic infauna in North Lantau display a high level spatial variation. Among the four CCPC sampling stations around Airport Island (i.e. Station 18 at the northeast Airport Island described above, Station 19 at the Northwest of Airport Island, Station 20 to the east of Airport Island at Brothers Islands, and Station 21 to the west of Airport Island, the density of benthos in summer varied from 218 no./m^2 (Station 20) to 1,444 no./m^2 (Station 18), and the biomass varied from 11.52 g/m^2 (Station 21) to 1,347.68 g/m^2 (Station 18). During winter, similar spatial variations are observed, with the density of benthos varied from 36 no./m^2 (Station 20) to 1,120 no./m^2 (Station 18), and the biomass varied from 15.12 g/m^2 (Station 19) to 263.38 g/m^2 (Station 18).

Table 10-5 The number of species, density and biomass of benthic infauna from four CCPC benthic stations near Airport

Station	Summer			Winter		
	No. of species (0.5m^2)	No. of Individual (m^2)	Wet weight (g/m^2)	No. of species (0.5m^2)	No. of Individual (m^2)	Wet weight (g/m^2)
18	38	1444	1347.68	52	1120	263.38
19	41	650	77.80	54	664	15.12
20	27	218	38.58	13	36	18.38
21	38	460	11.52	37	296	38.62

10.4.3.124 Grab sampling were conducted at 15 sampling stations in North Lantau inshore waters at both wet and dry seasons during the **EBS** study. 15 sampling stations were sampled from three zones, i.e. HKS (to the west of Airport Island), NLHC (within Airport Channel) and THW (to the east of Airport Island). In the wet season, species abundance and diversity was higher outside (32.6 individuals and 4.2 taxa grab-1) than inside Airport Channel (9.2 individuals and 2.4 taxa grab-1). In the dry season, conversely, species abundance and diversity was higher inside (46.2 individuals and 9.8 taxa grab-1) than outside (23 individuals and 5.6 taxa grab-1) Airport Channel (**Appendix 10A**). The marine benthic macrofauna was comprised of a high diversity of polychaete species, in which *Sigambra hanaokai* was the dominant species in the wet season, while *Eunice indica* and *Prionospio* sp. dominated in the dry season. Species diversity of other taxa (mainly crustaceans, echinoderms and molluscs) and the overall biomass were, however, low, which is typical in the North-western waters of Hong Kong (ERM 2000; CPCC 2002; Mouchel 2002). All the species recorded occur frequently in Hong Kong and no rare species were observed (CPCC 2002). The biotic index of ~ 2 – 3 and the dominant species recorded implies the community is slightly disturbed.

10.4.3.125 During wet season, the recorded benthic species number in THW Area was 23 taxa including annelid (with the dominant families of Spionidae, Pilargiidae, Poecilochaetidae, and Capitellidae) and crustacean (with the most abundant group of amphipod Corophiidae), the individual number was 163, the density of benthos was 32.6 individual/grab (or 326 individual/m^2), and the biomass was 0.76 g/grab (or 7.6 g/m^2)

10.4.3.126 In dry season (winter), the recorded benthic species number in THW Area was 28 taxa also including annelid (with the dominant families of Spionidae and Capitellidae) and crustacean (with the most abundant group of amphipod Corophiidae), the individual number was 115, the density of benthos was 23.0 individual/grab (or 230 individual/m^2), and the biomass was 0.54 g/grab (or 5.4 g/m^2)

10.4.3.127 Infauna diversity to the east of Airport Channel was relatively low (H' at THW = 0.97) compared to other areas in Hong Kong. The impoverished assemblages present is likely due to the proximity of Pearl River Estuary (estuarine areas are often less diverse owing to their highly dynamic physical and chemical nature) and possibly due to the predominantly silt-clay composition of the seabed that tends not to support high diversity (Shin 1998; Mouchel 2002b; CCPC 2002).

10.4.3.128 The major conclusion from other previous work in the North-western waters as summarised in Mouchel (2002b) was that benthic macrofauna present are impoverished and relatively similar throughout the North-western waters and are representative of the general study area.

10.4.3.129 Marine grab samplings of **EVS** study were conducted for benthic communities in soft substrate seabed at 9 stations along the mid 2008 HKLR alignment during both wet season and dry seasons (September 2008 and December 2008). The mid-2008 HKLR alignment and the sampling locations are shown in **Figure 10.3** and Figure A1.1.3 in **Appendix 10B**. Three grab sample replicates of 0.1m^2 were collected at each of the sampling stations by van Veen-type Grab and collected samples were sieved using a 0.5mm mesh-size sieve and then preserved in 70% ethanol. Organisms inside the samples were sorted from the sediments by staining with Rose Bengal and then identified to the lowest practicable taxonomic level. Species composition, abundance and biomass were reported and statistical analyses (Diversity index, evenness index and Abundance/Biomass Comparison (ABC) plots), were provided for evaluation and ranking of ecological values.

10.4.3.130 A total of 985 macro-faunal specimens, comprising 90 species from 59 families in 9 phyla (Annelida, Arthropoda, Branchiopoda, Chordata, Cnidaria, Echinodermata, Mollusca, Nemertea and Platyhelminthes), were recorded in the wet season. In the dry season, a total of 383 macro-faunal specimens comprising 58 species from 44 families in 6 phyla (Annelida, Arthropoda, Coelenterata, Echinodermata, Mollusca and Nemertea) were recorded. Only 28 species were found in both seasons. Polychaetes (Annelida) were collected at all stations and represented the highest species richness and abundance in both seasons.

10.4.3.131 The bivalves *Donax* sp. and *Theora lata* and the brittle star *Macrophiothrix longipeda* were the commonest species recorded in the wet season, whilst the polychaetes *Notomastus latericens* and *Euclymene* sp. and the pea crab *Xenophthalmus* sp. were the most abundant species recorded in the dry season. Detailed data are presented in **Appendix 10B**.

10.4.3.132 Species abundance and richness were higher in the wet season than in the dry season (using two-way ANOVA, $p < 0.001$), except in Station 7 where the species abundance and richness remained constant. The overall patterns were, however, similar in both seasons: higher in open waters (Stations 1-3, 8 & 9) and declining gradually towards the Airport Channel. In the wet season, Stations 2 and 3 possessed the highest species abundance and Station 1 had the highest species richness. The lowest species richness and abundance occurred in Station 7. In the dry season, the species abundance and richness were highest in Stations 2 and 3 and were lowest in Stations 5 and 6.

10.4.3.133 The Pielou's Index was similar between seasons and stations (wet season: 0.75 – 0.93, dry season: 0.79 – 0.99). The Shannon-Wiener Diversity Index was slightly higher in the wet season than in the dry season, but the variation between stations is slight (wet season 2.68 – 3.37, dry season: 1.84 – 2.57).

10.4.3.134 The overall biomass was higher in the dry season than in the wet season (using two-way ANOVA, $p < 0.05$). The values in both seasons were, however, variable between stations and no general patterns could be deduced. Total biomass in the wet season was 30.94 g and was mainly due to the relatively high mass of molluscs (22.1 g) and arthropods (5.5 g). Juveniles (~1 – 5 mm length) of bivalves and gastropods were recorded. Total biomass in the dry season was 131.53 g and was mainly due to the relatively high mass of molluscs (67.92 g), echinoderms (40.77 g) and arthropods (20.77 g). The biomass of other taxa in both seasons was low because of their small sizes and/or low abundance. Detailed biomass data are presented in **Appendix 10B**.

10.4.3.135 The W statistics for the 9 stations during the wet season were all positive and generally similar (0.225 – 0.411), although Station 7 possessed the lowest value of 0.11 and Station 9 had the highest value of 0.556. The W-statistics for the 9 stations during the dry season were also positive and the values were higher than those recorded in the wet season (0.264 – 0.739).

10.4.3.136 In both wet and dry seasons, none of the species are mentioned in the IUCN Red List (IUCN 2009). One species is listed in the China Species Red List (CSIS 2008): the Greasyback Shrimp *Metapenaeus ensis* is listed as Vulnerable due to over-exploitation in China. This species indeed is commercially important in many Asian countries (Leung *et al*. 2004). In Hong Kong, *Metapenaeus ensis* is a common fisheries species, and is also one of the major species cultured in the tidal shrimp ponds "Gei Wais" in Mai Po, and commonly known as "Gei Wai Shrimp" in the local market.

10.4.3.137 The marine benthic macrofauna in North Lantau was composed of a high diversity of polychaete species and a low diversity of other taxa, which is characteristic in the North-western waters of Hong Kong (ERM 2000; Shin, 2002; Mouchel, 2002). There was, however, a distinct spatial and temporal pattern, suggesting the benthic macrofauna are sensitive as a biological indicator to reflect changes in environmental conditions (Shin, 2002).

10.4.3.138 Spatially, species abundance and richness were higher outside than inside the Airport Channel. The large error bars indicate that species abundance and richness varied considerably within sites.

10.4.3.139 Temporally, species abundance, richness and diversity (Shannon-Wiener Diversity Index) were higher in the wet season than in the dry season. The small individual sizes observed and the low biomass recorded in the wet season may suggest that the majority of the benthic macrofauna recruit during this time period. The decrease in species abundance and richness in the dry season is possibly an indication of post-recruitment mortality of the benthic macrofauna. The similarity in the Pielou's Evenness between seasons and stations indicates the species evenness was constant over time alike among the 9 stations.

10.4.3.140 Infauna diversity in the North Lantau waters is relatively low when compared to other areas in Hong Kong. The impoverished assemblages present is likely due to the proximity of the Pearl River Estuary, leading to low salinity and possibly due to the predominantly silt-clay composition of the seabed which does not lend itself to supporting high diversity (Shin 1998). All the species recorded occur frequently in Hong Kong and no rare species were observed (Shin 2002).

10.4.3.141 The benthic communities in the waters offshore to the southeast coast of Airport Island were also investigated in the **MSS** study. From the 8 sampling stations, a total of 917 organisms from 83 taxa were identified from the dry season survey. The most diverse group was polychaetes (46 species). In terms of number of individuals, 43% of collected organisms were polychaetes, followed by crustaceans (35%).

10.4.3.142 During the dry season benthic survey under the **MSS** study, 345 organisms were identified from the sediment samples collected. In wet season, 58%, 15%, 12%, 8% and 7% of organisms collected were polychaetes, molluscs, crustaceans, echinoderms and other phyla, respectively. The total biomass was 130.87 g, in which 52%, 27%, 15% and 6% of total biomass were accounted by echinoderms, molluscs, crustaceans and other phyla, respectively.

10.4.3.143 The benthic communities inside the footprints of HKBCF reclamation (the waters offshore to the northeast coast of Airport Island) were also investigated in the HKBCF survey programme. 559 organisms from 80 taxa (210 individuals weighted 264.28g and 349 individuals weighted 179.73g from dry season survey) were collected from 9 sampling stations within the HKBCF reclamation area. Detailed results are presented in **Appendix 10D**. No species of special conservation importance was found. The results are basically similar with those from the grab sampling surveys of **EVS** and **MSS**.

10.4.3.144 During the TMCLKL study, benthic samplings were conducted at 8 stations along the alignment in October 2008 and February 2009. 917 individuals from 50 families comprising 8 different phyla. The total recorded biomass was 58.0 g due to the high mass of molluscs, echinodermata, annelida and arthropoda. The infauna density was 382 individuals/m^2, and the average biomass was 24.2g/m^2. The dry seasons survey collected 1,579 individuals from 50 families comprising 7 different phyla. The total recorded biomass was 73.1g. The density was 658 individuals/m^2 and the average biomass was 30.46 g/m^2.

10.4.3.145 The soft substrate seabed of the vast Hong Kong western waters also provides a habitat for adult horseshoe crab. Though the available habitats are abundant, but the density of the adult horseshoe crabs is not high as this species is not a regular fishing catch. Adult horseshoe crabs are only occasionally collected during bottom trawling.

Hard substrate seabed

Corals

10.4.3.146 Recent information on coral ecology in North Lantau waters is provided by several studies as well as field survey programmes including the **EBS**, **EVS**, **MSS**, and the HKBCF.

10.4.3.147 Hard corals are protected in Hong Kong by the Protection of Endangered Species of Animals and Plants Ordinance (Cap 586) which includes the protection of all stony (hard) corals. Established coral communities of any size are regarded as important habitat types in Hong Kong as defined in Annex 8 of EIAO-TM.

10.4.3.148 Corals in Hong Kong exhibit strong gradients in distribution, species diversity and abundance. Hard corals are more vulnerable to water quality such as salinity and suspended solid and prefer clear oceanic water, and their geographical distribution in Hong Kong is affected by the salinity of the water. Hard coral coverage and diversity decrease from east to west, toward the influence of the Pearl River (Scott 1984). The estuarine environment of the western Hong Kong waters was thought unsuitable for the existence of scleractinians (reef-building corals)(Scott 1984). A later study demonstrated that water quality, particularly elevated freshwater and suspended sediment levels which are characteristic of estuarine environment, prevent substantial hard coral growth (Hodgson and Yau 1997). The vertical distribution of hermatypic corals is largely controlled by the requirements of their photosynthesising zooxanthellae which require strong light and hence shallower water, whereas many of the soft corals that do not possess symbiotic algae can survive at greater depths (Morton and Morton 1983; Morton 1994).

10.4.3.149 The North Lantau waters are within the estuarine western waters. In contrast to the oceanic eastern waters, the abundance and diversity of corals are low in western Hong Kong waters (in particular North-western waters which are closer to Pearl River Estuary). North Lantau waters are thus characterized by domination of gorgonian and soft corals. Soft corals, sea pens and gorgonian corals (sea fans) were reported to be present throughout the North-western waters (Mouchel 2002b, 2004).

10.4.3.150 AFCD commissioned intensive underwater surveys in 2001-2002 to survey corals at 240 sites covering about 70 km of coastline in territorial waters (AFCD 2004). Hard corals were found in western waters of Hong Kong, but in southern Lantau waters (Tong Fuk, Soko Islands) and eastern (Cheung Chau, Hei Ling Chau) Lantau waters, and only sparse colonies or low-coverage communities, composed of extremely tolerant and hardy species were found.

10.4.3.151 The coverage of corals in this region is very low (less than 5%, and usually < 1%, the lowest compared with other regions in Hong Kong). The “near-total or complete absence” of reef-building hard corals was considered attributable to the high turbidity and low salinity.

10.4.3.152 A dive survey targeting on corals was conducted along the coastline from Sham Wat to Kei Tau Kok (to the east of Tung Chung near Tai Ho) during the EBS. No hermatypic hard coral was found at any of the 27 dive sites. Although ahermatypic corals were recorded, but they were concentrated in sites to the west of the airport island. The only widespread and common coral recorded in the survey was one species of gorgonians *Echinomuricea* sp. which was found both to the east and to the west of the airport island, but not inside the Airport Channel. The species composition at the dive sites near the HKLR reclamation for the at-grade road (the southeast coast of Airport Island, Dive site 22 and 23) consisted of gorgonian soft corals and ahermatypic corals, and their coverage were found all below 5% (**Appendix 10A**). The gorgonian soft corals near Airport Island suffered high levels of partial mortality. The findings are consistent with that recorded in western water during the AFCD study.

10.4.3.153 A dive survey was conducted at the artificial seawalls near MTR depot at Siu Ho during the LLP EIA study. The survey site is basically facing to the Brothers in North Lantau waters. It is to the east of the outlet of Tai Ho Wan. Freshwater input from Tai Ho Stream is discharged into the nearby waters through this only outlet of Tai Ho Wan with the open sea.

10.4.3.154 It was found from the LLP dive survey that the topography of the subtidal habitats within the proposed LLP site is generally flat. The coastline is all sloping boulder artificial seawall.

10.4.3.155 The horizontal transect covered the seawall adjacent to the MTR depot. Along the transect the seabed composition was all boulders. The boulders on the seawalls were also heavily covered by fine sediment.

10.4.3.156 Though no alive or dead hard corals, colonies of gorgonian were found on the boulders of the artificial seawalls. They were all of small sizes (less than 10 cm in length) and scattered on the boulders, resulting in a low coverage (<1%). Partially mortality was also observed in many colonies, which indicated that these gorgonians were under stress. Other marine fauna species found during the survey included Fan Shell, Green Mussel, and Oyster, and they were common and of no special conservation importance in Hong Kong. The results from the present dive survey were basically consistent with those from the EBS dive survey, in particular the coral composition and coverage.

10.4.3.157 Dive surveys were conducted at seven dive survey sites (with DS1 near Sham Wat, DS2 at the western shore of Sha Lo Wan headland, 3 sites DS3, DS4, DS5 inside the Airport Channel, DS6 on the southeast shore of Airport Island, and DS7 on Tung Chung New Town) in 2008 during the **EVS** study. The results revealed that no coral was found within the Channel while the diversity and abundance of hard and soft corals outside the Airport channel were low. Most hard substrates were dominated by barnacles, mussels and rock oysters. At the western shore of Sha Lo Wan headland, i.e. DS2, the subtidal hard substrate extends less than 10m from the shore.

10.4.3.158 Only one genus of ahermatypic cup coral *Balanophyllia* (Dendrophylliidae) and one genus of octocoral, *Echinomuricea* sp. (Plexauridae) were recorded from two (DS1 and DS2) and four (DS1, DS2, DS6 and DS7) of the seven survey sites, respectively. Both the hard and soft corals were only present outside the Airport Channel. No coral was found within the Channel (i.e. DS3, DS4 and DS5).

10.4.3.159 No other taxa of high conservation interest were recorded in the seven survey sites. Full details of substrate type and fauna recorded are shown in **Appendix 10B**.

10.4.3.160 Compared with the **EBS** study, the spot dive in 2003 generated similar qualitative data as the **EVS** study. In the **EBS** study, the ahermatypic cup coral *Balanophyllia* sp. was only recorded outside the Airport Channel at site SD5 (DS1 in the **EVS** study), SD9 (DS2 in the **EVS** study) and SD22 (DS6 in the **EVS** study). In the **EVS** study, this cup coral was also recorded in DS1 and DS2 but not in DS6, which is probably due to the very low abundance and patchy distribution of the coral within same area. For the octocoral *Echinomuricea* sp., the results in the **EVS** study agree with the finding in the **EBS** study.

10.4.3.161 In Hong Kong context, the low salinity and murky water at the western Hong Kong limit the development of hard coral to few thriving species such as *ahermatypic* cup corals, *Oulastrea crispata*, *Plesiastrea versipora* and selected *Favia* species. At north and northwest Lantau, only *Oulastrea crispata* and *ahermatypic* cup corals have been reported. The low diversity and low abundance of corals in the present survey is typical for the western Hong Kong waters.

10.4.3.162 During the **MSS** study, 8 locations along the southeast shore of Airport Island were investigated by spot dive and two of them were further surveyed with REA technique. In the HKBCF survey programme, dive surveys were conducted at 7 locations along the northeast shore of Airport Island and 9 locations within the HKBCF reclamation site, with two shore locations where direct impacts are anticipated further studied by REA technique.

10.4.3.163 Only 2 out of the 8 dive locations in the **MSS** study had records of gorgonian coral *Echinomuricea* sp., and both sites (D1 and D8) are sloping boulder seawalls. The percentage cover of the gorgonian recorded was less than 1% and the gorgonians were of fair condition. The seabed within the HKBCF reclamation site was quite homogeneous, of all muddy seabeds, lacking the hard bottom substrate required for coral colonization and thus was not a habitat for corals. The sediment was very fine and no demersal fauna was sighted. As no hard substrate in these locations, no coral (both hard and soft) was found in the seabed within the reclamation site. The only hard bottom substrate in the area was the artificial seawalls which laid along the Airport Island shoreline, to the west of the HKBCF reclamation site. No hermatypic hard corals were found, but sparsely distributed small-sized gorgonian colonies (*Echinomuricea* sp.) were found at all seawall bounce dive points. The existing artificial sloping seawalls is comprised of both vertical (at Marine Cargo Terminal and Sky Pier) and sloping seawalls (Fire station and to the south of MCT). The vertical seawalls had no hard corals and very little soft corals, but with more common epifauna such as rock oysters. The seawall surveyed by REA was sloping boulder form. To further investigate the epifauna fauna on the seawall which was the only hard bottom substrate habitat in the area, two sections of 100m seawall was surveyed by REA in a horizontal transect pattern. The slope of the sloping artificial seawall maintained the gradient (about 45 degree gradient) in the subtidal zone and extended till it met the seabed. The boulders of the sloping seawalls were all irregular in shape and the largest ones were close to 1m in size. On the boulders of the sloping seawalls, there was no hermatypic hard coral, but a low coverage percentage of small-sized gorgonian colonies (*Echinomuricea* sp.) which is common in Hong Kong western waters and not of special conservation importance. Furthermore, partially mortality was observed on some branches of the gorgonian colonies, demonstrating the poor conditions of the gorgonians. Very low coverage of ahermatypic cup corals *Balanophyllia* sp. was found at the Northern REA transect at the Fire Station sloping seawall. Other epifauna on the boulders were mainly sessile bivalves including Green mussel *Perna viridis* and Oyster *Ostrea* sp., and predatory snail *Thais* sp. except the boulders at the seawalls, the seabed in the area was almost solely muddy substrate. Other fauna recorded on both the muddy seabed and the boulders of the seawall were also of low conservation importance including green mussels and oysters.

10.4.3.164 The hard substrate seabed along North Lantau coastlines were also surveyed during the dive survey of TMCLKL study. Low coverage of populations of soft coral *Guaiagorgia* sp. (< 10%) and ahermatypic coral *Paracyathus rotundatus* (< 5%) were found along the seawalls. Partial mortality (about 20%) of the population of *Guaiagorgia* sp. was recorded during the REA survey at this coastline. Other organisms recorded were common in Hong Kong, such as sponges, barnacles, oysters, coralline algae. No taxa of high conservation interest were recorded. It is expected that the salinity in the HKBCF site is diluted by the flow from Pearl River as in other locations in North Lantau waters, and it might explain the absence of hard corals in the HKBCF site. This might also explain the similarity in the results from the present study and those from EVS and MSS in which many dive sites near Tung Chung Bay which is the outlet of Tung Chung River and Wong Lung Hang Stream.

10.4.3.165 Basically, the marine communities showed no particular trend within the several study areas of different surveys in terms of diversity and abundance. The northeast and southeast coastlines of Airport Island are exposed to the open sea and no hermatypic coral coverage was found there. These results matched the results from the EBS during 2003-04. From the information presented in the previous sections, it is clear that the hard substrate subtidal habitats in the area can be considered as of low ecological value due to the absence of hermatypic coral, the low coverage and the small sizes of gorgonian and ahermatypic corals, and their poor conditions (with partial mortality on the branches of gorgonians).

Artificial Reefs

10.4.3.166 Artificial Reefs were deployed near the northeast corner of Airport Island within Marine Exclusion Zone 3 and at Sha Chau and Lung Kwu Chau Marine Park. Both ARs were deployed in 2000, with a footprint of 1,200 m^2 (3,600 m^3 in terms of volume) in the Marine Exclusion Zone, and a footprint of 3,660 m^2 (3,600 m^3 in terms of volume) in the Marine Park. The artificial reef units in the Marine Exclusion Zone comprised Ferro-cement vessels (build-up river barge) and natural materials (quarry rock), while the units in the Marine Park comprised Ferro-cement vessels (river barge) and concrete-coated materials (Steel Container). Primarily postulated as feeding stations for Chinese White Dolphin, these artificial reefs also help to enhance habitat quality and marine resources. As both sites are restricted, for either fishing or marine traffic, the undisturbed environment should facilitate a better development of the reef community and enhancement functions. The enhancement functions of artificial reefs deployed in Eastern waters were demonstrated by monitoring surveys, and it was recorded that juvenile fish were found to have settled after artificial reef vessels were deployed (Wilson 2003). While the ARs in the Marine Park is quite distant (approximately 7 km from HKBCF), the ARs in Marine Exclusion Zone is the nearest marine ecological sensitive receiver and is approximately 300m from the HKBCF reclamation and 1.5km from HKLR reclamation.

10.4.4 Evaluation of Ecological Importance of Habitats

10.4.4.1 The ecological importance of different parts of the assessment areas are evaluated based primarily on the criteria set forth in Table 2, Annex 8 of the EIAO-TM:

- naturalness;
- size;
- diversity;
- rarity;
- re-creatability;
- fragmentation;
- ecological linkage;
- potential value;
- nursery/breeding ground;
- age; and
- abundance/richness of wildlife.

Table 10-6a Ecological value of different habitats along HKLR and HKBCF

Criteria	Terrestrial			
	Woodland	Shrubland	Plantation	Agricultural
Naturalness	Semi-natural	Semi- natural	Artificial	Artificial
Size	About 22 ha	About 67 ha	23.5 ha	About 0.05 ha
Diversity	Moderate	Moderate	Moderate	Low
Rarity	Common habitat in Hong Kong	Common habitat in Hong Kong	Common habitat in Hong Kong	Common habitat in Hong Kong
Re-creatability	Creatable through planting	Creatable through planting	Creatable through planting	Readily creatable
Fragmentation	Unfragmented, except the woodland in Scenic Hill.	Unfragmented, except the shrubland in Scenic Hill..	Unfragmented.	Fragmented to a certain extent by paths and houses.
Ecological linkage	Generally linked with adjacent natural habitats except the woodland in Scenic Hill.	Generally linked with adjacent natural habitats except the shrubland in Scenic Hill.	No significant linkage	Generally linked with adjacent natural habitats
Potential value	Low. Already a natural habitat.	Low.	Low.	Low
Nursery/breeding ground	No special nursery/breeding ground function observed	No special nursery/breeding ground function observed	No special nursery/breeding ground function observed	No special nursery/breeding ground function observed
Age	N/A	N/A	N/A	N/A
Abundance/Richness of wildlife	Moderate	Moderate	Low	Low
Overall Ecological value	High for Scenic Hill; Moderate –high for other woodlands Low-moderate for young woodland	Moderate-high for tall shrubland and shrubland; moderate for grassland /shrubland; low for grassland/shrubland on Scenic Hill	Low-moderate	Low-moderate

Table 10-6b Ecological value of different habitats along HKLR and HKBCF

Criteria	Terrestrial		
	Grassland/Seasonally wet grassland	Developed area	Streams
Naturalness	Natural.	Artificial	Basically natural.
Size	About 1 ha	Over 300 ha	NA
Diversity	Low	Low	Moderate
Rarity	Common habitat in Hong Kong	Common and abundant in Hong Kong	Common habitat in Hong Kong
Re-creatability	Re-creatable.	Re-creatable.	Difficult to re-create.
Fragmentation	Unfragmented.	Unfragmented.	Unfragmented.
Ecological linkage	Generally linked with adjacent natural habitats	No significant linkage	Linked with open sea
Potential value	Low.	Low.	Low. Already a natural and undisturbed habitat.
Nursery/breeding ground	No special nursery/breeding ground function observed	No special nursery/breeding ground function observed	No special nursery/breeding ground function observed, but some marine species might use estuarine areas as nursery grounds.
Age	N/A	N/A	N/A
Abundance/Richness of wildlife	Low	Low	Low to moderate
Overall Ecological value	Low	Low	Ranging from low to Moderate-high

Table 10-6c Ecological value of different habitats along HKLR and HKBCF

Criteria	Intertidal			
	Hard shore - Rocky shore	Sandy beach/ sandflat/ mudflat (including seagrass beds)	Mangroves	Hard shore - Artificial seawalls
Naturalness	Basically natural.	Basically natural.	Basically natural.	Artificial
Size	About 6km	NA	0.94 ha within the 500m assessment area	About 5.5km
Diversity	Low	Low for sandy beaches; Low to moderate for San Shek Wan, and Moderate for other soft shores	Low	Low
Rarity	Common habitat in Hong Kong	Common in Hong Kong for sandy beach; For the soft shores, limited in Hong Kong, with records of seagrasses and horseshoe crabs.	Common habitat in Hong Kong waters.	Common habitat in Hong Kong
Re-creatability	Not re-creatable.	Re-creatable for sandy beach; Difficult to recreate for sandflat/mudflats.	Creatable through planting	Readily creatable
Fragmentation	Unfragmented.	Unfragmented.	Unfragmented.	Unfragmented.
Ecological linkage	Generally linked with the open sea.	Generally linked with the open sea and/or mangroves.	Generally linked with sandflats/mudflats and the open sea.	Generally linked with the open sea.
Potential value	Low.	Low for sandy beaches;	Low. Already a natural habitat.	Low

Criteria	Intertidal: Hard shore - Rocky shore	Intertidal: Sandy beach/ sandflat/ mudflat (including seagrass beds)	Intertidal: Mangroves	Intertidal: Hard shore - Artificial seawalls
		Moderate for other soft shores which are currently disturbed by the clam harvesting activities		
Nursery/breeding ground	No special nursery/breeding ground function observed	Sandflat/mudflats provide horseshoe crab nursery ground	Breeding/nursery ground for marine species.	No special nursery/breeding ground function observed
Age	N/A	N/A	N/A	N/A
Abundance/Richness of wildlife	Generally low – moderate; low in the remnant rocky shore on Airport Island	Low for sandy beach; Moderate for other soft shores	Low to moderate	Low
Overall Ecological value	Low – moderate for rocky shore on North Lantau; Low for remnant rocky shore on Airport Island	Low to moderate for San Shek Wan; Moderate to High for Sham Wat, Sha Lo Wan, Hau Hok Wan, San Tau, Tung Chung Beach and Tai Ho	Moderate	Low

Table 10-6d Ecological value of different habitats along HKLR and HKBCF

Criteria	Marine waters: To the west of Airport Island	Marine waters: Airport Channel	Marine waters: Near eastern shore of Airport Island	Marine waters: Northeast Airport Island
Naturalness	Natural	Natural	Natural	Natural
Size	NA	NA	NA	NA
Diversity	Low	Low	Low	Low
Rarity	Common habitat in Hong Kong waters. Dolphin habitat.	Common habitat in Hong Kong waters. No dolphin records.	Common habitat in Hong Kong waters. No dolphin records	Common habitat in Hong Kong waters. Dolphin habitat.
Re-creatability	Not re-creatable.	Not re-creatable.	Not re-creatable.	Not re-creatable.
Fragmentation	Unfragmented.	Unfragmented.	Unfragmented.	Unfragmented.
Ecological linkage	Potentially a corridor for dolphin movement between Sha Chau and Lung Kwu Chau Marine Park and West Lantau waters	Generally linked with the open sea. Connect to soft shore habitats along the channel	Not functionally linked to any high value habitats (e.g. mudflat) in close proximity.	Potentially a corridor for dolphin movement between the Sha Chau and Lung Kwu Chau Marine Park and the Brothers Islands
Potential value	Low. Already a natural habitat. Development of coral colonies constrained by water quality	Low. Already a natural habitat. Development of coral colonies constrained by water quality	Low. Already a natural habitat. Development of coral colonies constrained by water quality	Low. Already a natural habitat. Development of coral colonies constrained by water quality
Nursery/breeding ground	Potential breeding/nursery ground for marine species.	Potential breeding/nursery ground for marine species.	Potential breeding/nursery ground for marine species.	Potential breeding/nursery ground for marine species.
Age	N/A	N/A	N/A	N/A
Abundance/Richness of wildlife	Low to Moderate	Low	Low	Low to Moderate
Overall Ecological value	Moderate-high	Low	Low	Moderate

Table 10-6e Ecological value of different habitats along HKLR and HKBCF

Criteria	Hard substrate seabed	Artificial reefs in Northeast Airport	Soft substrate seabed
Naturalness	Partially natural, and partially artificial.	Artificial	Basically natural.
Size	NA	1,200 m^2	NA
Diversity	Low Colonised by low coverage of common gorgonians and ahermatypic corals	Moderate	Low
Rarity	Common habitat in Hong Kong waters.	Deployed in at least 8 locations within Hong Kong waters.	Common habitat in Hong Kong waters.
Re-creatability	Re-creatable.	Re-creatable.	Not re-creatable.
Fragmentation	Unfragmented.	Unfragmented.	Unfragmented.
Ecological linkage	Generally linked with the open sea.	Generally linked with the open sea.	Generally linked with the open sea.
Potential value	Low. Development of coral colonies constrained by estuarine environment	Moderate.	Low. Limited by the mobile nature of the sediment. Already a natural habitat.
Nursery/breeding ground	Breeding/nursery ground for marine species.	Breeding/nursery ground for marine species.	Breeding/nursery ground for marine species.
Age	N/A	Deployed in 2000	N/A
Abundance/Richness of wildlife	Low	Moderate	Low
Overall Ecological value	Low-moderate	Moderate	Low

Table 10-6f Ecological value of recognised sites of marine conservation importance within North Western and North Western Supplementary WCZs

Criteria	Sha Chau and Lung Kwu Chau Marine Park	Proposed Marine Park at Fan Lau	San Tau Beach SSSI	Tai Ho Stream SSSI
Naturalness	Natural	Natural	Basically Natural	Basically Natural l
Size	1,200 ha	N/A	2.7 ha	5 ha
Diversity	Moderate	Moderate	Moderate	High
Rarity	One of the two most important sea areas for CWD in Hong Kong	One of the two most important sea areas for CWD in Hong Kong	San Tau harbours the largest seagrass area on Lantau; one of the three recognized horseshoe crab nursery sites Hong Kong.	Support the greatest diversity of fresh water and brackish-water fish in Hong Kong.
Re-creatability	Not re-creatable.	Not re-creatable.	Not re-creatable.	Not re-creatable.
Fragmentation	Unfragmented.	Unfragmented.	Unfragmented.	Unfragmented.
Ecological linkage	Generally linked with the open sea	Generally linked with the open sea.	Connect to soft shore habitats along the channel	Generally linked with the open sea.
Potential value	Low. Already a natural habitat.	Low. Already a natural habitat.	Low. Already a natural habitat.	Low. Already a natural habitat.
Nursery/breeding ground	Nursery ground for CWD.	Nursery ground for CWD..	Nursery ground for horseshoe crab	Nursery ground for horseshoe crab
Age	N/A	N/A	N/A	N/A
Abundance/Richness of wildlife	High for CWD	High for CWD	Moderate	High
Overall Ecological value	High	High	High	High

10.4.4.2 Based upon the evaluation, discussions are concentrated on the habitats that are simultaneously more important to the species/habitats of conservation importance and relevant to the Project.

10.4.4.3 West Lantau and North Lantau waters which are the most important dolphin habitats in Hong Kong. The CWD are present commonly year-round in the waters north and west of Lantau, and are found only seasonally or rarely in other places of Hong Kong.

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

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

10.4.4.5 12 floral species of conservation interest have been identified. Eight species were identified in both **EBS** and **EVS** studies, while sedge *Carex tristachya* and orchid *Arundina chinensis* were not recorded in the **EVS**. These two species were previously recorded in tall shrubland and shrubby grassland. Among them, three species of seagrasses are considered relevant to the impact assessment as they colonise intertidal zone and potentially subject to water quality impacts.

10.4.4.6 A total of 51 faunal species of conservation interest or restricted range, based on Fellowes *et al*. (2002), IUCN redlist, China Redlist, and Hong Kong legislations, have been recorded during the **EBS** and **EVS**. Among them, a total of 22 fauna species of conservation concern is considered relevant to the impact assessment of this Project, as they were recorded in habitats potentially subject to direct or indirect impacts from the HKLR and HKBCF, including marine mammal, wetland dependent birds, terrestrial fauna recorded in Scenic Hill, soft shore intertidal fauna.

10.4.4.7 This project would only affect limited area of terrestrial habitats within the terrestrial study area. In addition, terrestrial habitats would be affected are mainly disturbed/developed areas, which are of low ecological importance. Most terrestrial fauna of conservation concern were recorded at locations distant from the proposed alignment. Therefore not all the 51 fauna species utilize the habitats relevant to the Project. Only 22 species are considered relevant to the impact assessment.

10.4.4.8 The proposed alignment would span over coastal waters. Therefore, fauna relevant to the impact assessment for the Project are those foraging in coastal habitats, in particular avifauna. This included 9 water dependent bird species.

10.4.4.9 Romer's Tree Frog, though not recorded during the **EBS** or the **EVS**, was reported by AFCD in Scenic Hill (Chan *et al*. 2005b). The proposed alignment would encroach part of the Scenic Hill and potentially disturb the nearby habitats of this endemic frog species. This species is protected under the Wild Animals Protection Ordinance (Cap. 170) and considered of potential global concern. This species is therefore also put into the list of species of conservation concern.

10.4.4.10 Chinese White Dolphin is a Class I protected species in the Mainland. In the SAR, it is protected from capture or direct harm under the Wild Animals Protection Ordinance. The degree of threat to the global population is also ranked as Near Threatened by IUCN World Conservation Union.

10.4.4.11 Of the fauna species of conservation concern within the Assessment Area reported from literature reviews and field surveys, only Pacific Reef Egret mainly forages in coastal habitats. The artificial coastline of Airport Island is not considered to be important habitat of Pacific Reef Egret, due to the deep water and poor food base. More important habitat is present in the inter-tidal mudflats.

10.4.4.12 Though not presently protected under local law, Horseshoe crabs have recently been identified as a species of conservation importance in Hong Kong.

10.4.4.13 Established coral communities of any size are regarded as important habitat types in Hong Kong as defined in Annex 8 of EIAO-TM.

10.4.4.14 The list and evaluation of the floral and faunal species of conservation interest recorded within the Assessment Area, according to the TM-EIAO, are given in **Tables 10-7** and **10-8**. Relevant species are in bold form.

Table 10-7 Evaluation of floral species of conservation concern within the Assessment Area

Species	Protection status/China Red Data Book	Locations/Habitats recorded	EBS	EVS	Rarity	Relevant to the assessment
Dwarf Eel Grass *Zostera japonica*		San Tau Beach SSSI	✓	✓	Locally Rare (Hu *et al.* 2003)	Potentially subject to water impacts
Halophila minor		San Tau Beach SSSI		✓	Not previously recorded at San Tau. Locally Rare (Hu *et al.* 2003)	Potentially subject to water impacts
Halophila ovalis		San Tau Beach SSSI	✓		Locally Rare (Xing *et al.* 2000)	Potentially subject to water impacts
Hong Kong Pavetta *Pavetta hongkongensis*	Cap. 96	Tall Shrubland	✓	✓	Common (Xing *et al.* 2000)	No, on North Lantau
Indian Sundew *Drosera indica*		Stream (HHW)	✓	✓	Rare (Xing *et al.* 2000)	No, on North Lantau
Pale Purple Eulophia *Eulophia graminea*	Cap. 586; Cap. 96	Stone crevices in Stream (HHW)	✓	✓	Restricted (Siu 2000)	No, on North Lantau
Incense Tree *Aquilaria sinensis*	Cap. 586; Cap. 96;Near Threatened**; Class II Protected*	Tall Shrubland, Secondary woodland	✓	✓	Common (Xing *et al.* 2000)	No, on North Lantau
Portia Tree *Thespesia populnea*		Coastline, Mangrove associate.	✓	✓	Limited range; coastal areas (Xing *et al*. 2000)	No, on North Lantau
Clammy Hop Seed *Dodonaea viscosa*		Coastal habitat (SLW)	✓	✓	Rare (Xing *et al.* 2000)	No, on North Lantau
Carex tristachya,		Tall Shrubland (HHW)	✓		Very rare (Xing *et al*. 2000)	No, on North Lantau
White-green sedge (*Carex leucochlora*)		Not in present study			Very rare (Xing *et al*. 2000)	No, on North Lantau and not recorded in EBS and EVS
Bamboo Orchid *Arundina chinensis*	Cap. 586; Cap. 96	Shrubby grassland	✓		Very Common (Siu 2000); Common (AFCD 2001)	No, on North Lantau

* Species relevant to impact assessment are bolded.

Table 10-8 Evaluation of fauna species of conservation concern within the Assessment Area (Species relevant to impact assessment are bolded.)

Species	Species of Conservation Interest*	Protection status**/China Red Data Book***	Locations/Habitats recorded	EBS	EVS	Rarity****	Relevant to assessment
Mammals							
Chinese White Dolphin (Indo-pacific Humpback Dolphin) *Sousa chinensis*	-	WAPO; Cap. 586; CITES App. 1; China Class I protected; IUCN Redlist (Near Threatened)	Mostly in waters north and west of Lantau, Seasonally in waters south and east of Lantau	#	#	Locally found in western waters, especially the North and West Lantau waters; some 103-193 individuals inhabit Hong Kong waters in various time of the year.	Yes. Habitat loss and potential water impacts
Red Muntjac *Muntiacus muntjac*	PRC	WAPO	Scrubland, Streams	✓	✓	Widespread (Shek 2004)	No, on North Lantau
Birds							

Species	Species of Conservation Interest*	Protection status**/China Red Data Book***	Locations/Habitats recorded	EBS	EVS	Rarity****	Relevant to assessment
Little Grebe *Tachybaptus ruficollis*	LC	-	Open water	✓		Locally common	No, not recorded in the EVS
Grey Heron *Ardea cinerea* w	PRC	-	Soft Shore; Hard shore		✓	Abundant winter visitor	Yes. Waterbirds,
Great Egret *Egretta alba* w	PRC (RC)	-	Soft Shore; Hard shore		✓	Common to abundant resident	Yes. Waterbirds,
Little Egret *Egretta garzetta* w	PRC (RC)	-	Soft Shore; Hard shore		✓	Abundant resident	Yes. Waterbirds,
Pacific Reef Egret *Egretta sacra* w	(LC)	Class II Protected* Rare***	Hard Shore		✓	Locally uncommon resident	Yes. Waterbirds,
Cattle Egret *Bubulcus ibis*	(LC)	-	Soft Shore	✓		Uncommon to common resident	No, on North Lantau
Chinese Pond Heron *Ardeola bacchus*	(LC)	-	Hard Shore	✓		Common resident	No, on North Lantau
Striated Heron *Butorides striatus* w	(LC)	-	Intertidal; Streams		✓	Uncommon in summer, scare in winter	Yes. Waterbirds,
Black-crowned Night Heron *Nycticorax nycticorax* w	(LC)	-	Intertidal; Streams		✓	Common to abundant resident	Yes. Waterbirds,
Black Kite *Milvus migrans*	(RC)	Class II Protected*	Overhead		✓	Abundant winter visitor and resident	No,
Peregrine Falcon *Falco peregrinus*	LC	-	Overhead	✓		Scare resident and winter visitor	No, not recorded in the EVS.
Black-winged Stilt *Himantopus himantopus*	RC	-	Soft Shore	✓		Common to uncommon winter visitor	No, not recorded in the EVS.
Little Ringed Plover *Charadrius dubius* w	(LC)	-	Soft Shore		✓	Locally common winter visitor, scarce breeding.	Yes. Waterbirds,
Whimbrel *Numenius phaeopus* w	LC	-	Soft Shore		✓	Common passage migrant	Yes. Waterbirds,
Grey-tailed Tattler *Heteroscelus brevipes* w	LC	-	Soft Shore		✓	Passage migrant	Yes. Waterbirds,
Eurasian Woodcock *Scolopax rusticola*	LC	-	Secondary Woodland	✓		Scare winter visitor	No, not recorded in the EVS.
Collared Scops Owl *Otus bakkamoena*	-	Class II Protected*	Tall Shrubland		✓	Common and widespread resident	No, on North Lantau
Pacific Swift *Apus pacificus*	(LC)	-	Overhead	✓		Common spring migrant, localized summer visitor, scarce and irregular in autumn and winter	No, not recorded in the EVS.
White-throated Kingfisher *Halcyon smyrnensis*	(LC)	-	Soft Shore, Hard Shore	✓		Resident, locally common in autumn and winter	No, not recorded in the EVS.
Emerald Dove *Chalcophaps indica*	-	Near Threatened**; Vulnerable***	Tall Shrubland		✓	Scarce but widespread resident	No, on North Lantau
Hwamei *Garrulax canorus*	-	Near Threatened**	Shrubland		✓	Common and widespread resident	No, on North Lantau
Blyth's Leaf Warbler *Phylloscopus reguloides*	LC	-	Shrubland		✓	Scarce winter visitor	No, on North Lantau
Common Rosefinch	LC	-	Village/farmland		✓	Rare winter visitor	No, on North

Species	Species of Conservation Interest*	Protection status**/China Red Data Book***	Locations/Habitats recorded	EBS	EVS	Rarity****	Relevant to assessment
Carpodacus erythrinus							Lantau
Red-billed Starling *Sturnus sericeus*	GC	-	Coastal habitat, secondary woodland		✓	Abundant but localized winter visitor	No, on North Lantau
White-shouldered Starling *Sturnus sinensis*	(LC)	-	Village/farmland		✓	Common passage migrant, scare and localized breeding summer visitor and winter visitor	No, on North Lantau
Black-naped Oriole *Oriolus chinensis*	LC	-	Plantation		✓	Scarce autumn migrant and irregular breeder	No, on North Lantau
Brown Fish Owl			Tai Ho Stream			Rare	No, at Tai Ho on North Lantau
Reptiles							
Tokay Gecko *Gekko gecko*	RC	-	San Tau Village	✓		Rare (Karsen *et al.* 1998)	No, on North Lantau
Amphibians							
Chinese Bullfrog *Hoplobatrachus chinensis*	PRC	IUCN Least Concern Class II Protected*	Scenic Hill – concrete drainage system		✓	Fairly common and widespread in NT and Lantau (Chan *et al.* 2005)	Yes, at Scenic Hill
Lesser Spiny Frog *Paa exilispinosa*	GC	IUCN Vulnerable	Streams	✓	✓	Common & Widespread in protected areas (Chan *et al.* 2005).	No, on North Lantau
Romer's Tree Frog *Philautus romeri*	PGC	IUCN Endangered	Literature review and AFCD (Pers. comm.)			Endemic to Hong Kong. Locally Common in protected areas (Chan *et al.* 2005)	Yes, at Scenic Hill
Fish							
Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis*	GC	-	Stream (ST9)		✓	Rare (Lee *et al.* 2004)	No, on North Lantau
Indo-Pacific Tropical Sand Goby *Favonigobius reichei*	-	IUCN Lower Risk/Near Threatened	Estuaries of Streams (ST9, HH5, SL3)		✓	Common and widespread (Lee *et al.* 2004, Nip 2005)	Potentially subject to water impacts
Dark-margined Flagtail *Kuhlia marginata*	RC	-	Stream (ST9)		✓	Status unknown (Lee *et al.* 2004)	No, on North Lantau
Rice Fish *Oryzias curvinotus*	GC	-	Stream (ST9, HH3, HH5)		✓	Uncommon (Lee *et al.* 2004)	No, on North Lantau
Predaceous Chub *Parazacco spilurus*	-	Vulnerable***	Stream (ST9, SL3)		✓	Common and widespread (Lee *et al.* 2004)	Potentially subject to water impacts
Snowy Puffer *Takifugu niphobles*	-	IUCN "Data Deficient"	Soft Shore (San Tau)		✓	Considered to be common in Hong Kong (AFCD 2008).	Potentially subject to water impacts
Takifugu ocellatus	LC	-	Stream (ST9)	✓		-	No, on North Lantau
Butterflies							
White Dragontail *Lamproptera curius*	LC	-	Stream At San Tau (ST9))		✓	Limited Distribution (Lo 2005)	No, on North Lantau
Common Albatross *Appias albina*	LC	-	Cultivated field at San Tau	✓		Rare (Lo 2005)	No, on North Lantau

Species	Species of Conservation Interest*	Protection status**/China Red Data Book***	Locations/Habitats recorded	EBS	EVS	Rarity****	Relevant to assessment
Danaid Eggfly *Hypolimnas misippus*	LC	-	Shrubland at Scenic Hill	✓		Uncommon (Lo 2005)	Yes, at Scenic Hill
Crustaceans							
Sesarmine Crab *Chiromantes sereni*	-	-	Stream (HH3, SL3)		✓	Endemic. Only known from four sites(Kwok & Tang 2005)	No, on North Lantau
Greasyback Shrimp *Metapenaeus ensis*	-	Vulnerable***	Stream (ST9, SL3)		✓	Found on sandy-mud or muddy bottoms. Major species cultivated at Mai Po Marshes Nature Reserve (AFCD 2004)	Potentially subject to water impacts
Freshwater Crab *Somanniathelphusa zanklon*	-	IUCN Endangered	Stream (SL12)		✓	Locally abundant in Lantau (DSD 2002, EPD 2007),	No, on North Lantau
Horseshoe Crabs							
Tachypleus tridentatus	-	Vulnerable***	San Tau, Hau Hok Wan, Sham Wat, Tung Chung Bay,	✓	✓	Declining in range due to water pollution/ loss of nursery grounds (Morton & Lee 2003)	Yes. Potentially subject to water impacts
Carcinoscorpius rotundicauda	-	Vulnerable***	San Tau, Hau Hok Wan, Tai Ho Wan. (Tung Chung Bay from TMCLKL survey),	✓		Declining in range due to water pollution/ loss of nursery grounds (Morton & Lee 2003)	Yes. Potentially subject to water impacts
Echinoderm							
Sea cucumber *Holothuria leucospilota*	-	Endangered	Sham Wat		✓	Endangered in CSIS 2008 due to over-exploitation.	Yes. Potentially subject to water impacts
Coral							
Echinomuricea sp.			Sham Wat to San Shek Wan; east of Chek Lap Kok; Northeast and southeast shores of Airport Island	✓	✓	Common in Hong Kong Waters (AFCD 2004)	Yes. Direct impacts and potentially subject to water impacts
Balanophyllia sp.,	-	Cap 586	Sham Wat to San Shek Wan (e.g. DS1 and DS2); east of Chek Lap Kok; Northeast shore of Airport Island	✓	✓	Common in Hong Kong Waters (AFCD 2004)	Yes. Direct impacts and potentially subject to water impacts

* Fellowes *et al*. 2002.

** All birds are protected under WAPO

*** Zeng and Wang 1998.

**** Rarity for birds follows Carey *et al*. 2001

\# Not covered by the field survey programmes

10.5 Assessment Methodology

10.5.1 Identification of Impacts

10.5.1.1 Ecological impact assessment aimed at to protect, maintain and rehabilitate the natural environment.

10.5.1.2 The ecological impact assessment included:

- identification and quantification of any direct/indirect and on-site/off-site ecological impacts to foraging areas, breeding grounds, reduced survival of adult or juvenile wildlife;
- identification of parameters (e.g. water quality parameters) including any potential toxic contaminants released from the dredged sediment;
- evaluation of the identified impacts, caused by the construction and operation of the Project, such as habitat loss, water quality deterioration, underwater noise, bioaccumulation, marine collision, chemical spillage and disturbance;
- recommendations for mitigation measures; and
- review of the need for monitoring and to propose a monitoring and audit programme if needed.

10.5.1.3 The ecological impact assessment followed the criteria and guidelines for evaluating and assessing ecological impact as stated in Annexes 8 and 16 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

10.5.1.4 Potential aquatic and terrestrial and marine ecological impacts arising from the Project, including construction phase and operation phase, would be identified. Predicted impacts would be quantified as far as possible and evaluated with reference to the criteria in Annexes 8 and 16 of the EIAO-TM. Where significant negative impacts are predicted, based upon the priority of “avoid, minimize, and compensate”, the strategy followed the approaches as: the feasibility of modifications to the design, consideration of alternate sites or options, special controls on construction methods and schedule, or compensatory habitat creation or enhancement. The acceptability of residual impacts following mitigation was assessed. Finally, the assessment evaluated the need for ecological monitoring and audit, and prescribed in detail any required EM&A programme in accord with the Study Brief.

10.5.2 Criteria to Evaluate Impacts

10.5.2.1 The significance of ecological impacts was evaluated based primarily on the criteria set forth in Table 1, Annex 8 of the EIAO-TM:

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

10.5.2.2 The determination of the above first 3 items, namely "habitat quality", "species affected" and "size/abundance of habitats/organisms affected", made reference to the baseline conditions. "Duration of impacts" and "reversibility of impacts" are closely related to the nature of the impacts. Usually construction disturbance such as noise is regarded as a short-term impact. Temporary occupation of natural habitats can be reversible. In contrast, the occupation of space by the development itself is a permanent and irreversible impact. "Magnitude of environmental change" is determined by the scale of the projects, i.e. the extent of the works area and/or the degree of changes of the ambient environment. The abundance and/or distribution of the same kind of habitat in Hong Kong, or individuals of the same species, is also considered.

10.5.2.3 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 varies, based on the criteria listed above. Wherever possible, significance of impacts is quantified to allow ready appreciation of relative significance. Quantification is straight forward for certain types of impact, particularly habitat loss (usually measured in hectares).

10.5.2.4 Quantification of levels of ecological impact requires the application of professional judgement and value judgements, as noted in paragraph 5.3.1, Annex 16 of the EIAO-TM. Such judgements are often not amenable to quantification.

10.5.2.5 Nearby projects, especially any associated works of the HZMB portion outside the HKSAR boundary, are assessed for potential cumulative impacts with the present project. The study team liaised with Mainland and Macao authorities, consultants of relevant feasibility studies, relevant departments/offices, and private and public organisations to address interfacing issues and cumulative environmental impacts.

10.5.3 Identification of Sensitive Receivers

10.5.3.1 Sensitive receivers of impacts are defined for this report as 1) species of conservation importance whose local, regional, or global populations would be expected to show the effects of reduced survivorship or productivity caused by the project. This implies that project-induced losses are predicted to exceed the range of fluctuation attributable to natural population variation; and 2) important habitats identified during the ecological baseline study to be within the study area, and have the potential to be affected indirectly by the project, for example, through deterioration of water quality. Such impact would normally be evaluated by the predicted magnitude of changes, e.g. extent of increase in suspended solids or other contaminants at the sensitive receivers.

10.5.4 Recommendation of Mitigation Measures

10.5.4.1 Impacts are assessed in the absence of mitigation. Efforts are made to identify feasible and practicable mitigation measures to reduce the severity of any significant negative impacts to acceptable levels. For the purposes of this EIA, "Significant" is used to refer to impacts requiring mitigation and is applied to "moderate" and "severe" impacts, while "minor" and "insignificant” impacts do not require mitigation. Where significant negative impacts are predicted from the Project, mitigation responses are developed to “Avoid, Minimize and Compensate” for impacts in that order of priority. As stipulated in EIAO-TM, the study team, in consultation with the client, resolved impacts by first determining the feasibility to avoid impacts (modifications to project design, consideration of alternate sites or alignments). The second priority was to minimise impacts (refining the bridge design or alignment, special controls on construction methods and schedule). The third priority was to design measures to compensate for impacts (compensatory habitat creation or enhancement). Mitigation measures are provided in the ecological assessment to address the potential impacts identified. These measures are described in terms of their scope, programme, feasibility and financial implications during the construction and operation of the project. The acceptability of residual impacts following mitigation is assessed. Finally, the assessment evaluates the need for ecological monitoring and audit, and prescribes in detail any required EM&A programme in accord with the Study Brief.

10.5.4.2 Finally, the assessment concludes whether the mitigation measures envisaged could bring secondary impacts of the project and control them to within acceptable bounds. The acceptability of the overall residual ecological impacts is determined. Besides adverse impacts, potential benefits of the Project are also considered in the EIA.

10.6 Impact Identification and Evaluation

10.6.1 Description of the Project

10.6.1.1 The present Project (HKLR and HKBCF) has gone through different stages including conceptual planning, feasibility study and option selection, under various studies. During those studies, the environmental feasibility and acceptability have been thoroughly investigated and assessed.

10.6.1.2 In the mid 1990's, the Crosslinks study investigated the needs and potential options of cross border links, mainly in western Hong Kong. A bridge connecting the eastern and western sides of Pearl River Estuary was considered.

10.6.1.3 In the early 2000's, the Hong Kong-Zhuhai-Macao Bridge was proposed. A Preliminary Environmental Study for HZMB was conducted (Scott 2002).

10.6.1.4 The PER verified that the environmentally optimal landing point of the bridge would be at Northwest Lantau. After reaching the proposed landing point at Northwest Lantau, the HZMB would connect to North Lantau Highway in both the interim and the long term. In 2007, it is agreed that separated boundary crossing facilities would be established for the three areas. A second PER for the Hong Kong Boundary Crossing Facilities (HKBCF) was conducted to formulate the form and location of the HKBCF (Arup 2008).

10.6.1.5 In 2008, the current alignment of the HZMB with the HKBCF and the integrated TMCLKL was derived. The present assessment is based upon this latest alignment and form of the HZMB-HKBCF-TMCLKL complex.

10.6.1.6 The connection point between the HZMB Main Section and the HZMB HKLR would be on the western HKSAR boundary. The proposed connection point lies on the HKSAR boundary about 4 km west of Sham Wat and 3 km north of Tai O pier.

10.6.1.7 From the connection point, HKLR (previously referred as the HZMB Hong Kong Section) alignment will run eastward through the open sea of western Hong Kong waters, and go into Airport Channel. Inside the Airport Channel, the alignment will span over the headland at Sha Lo Wan and get close to the headland at Hau Hok Wan so as to avoid getting close to the touch down zone of southern runway and the Government Flying Service (GFS) headquarters, but will not actually land on either headland. The supporting piers in this section are still located in subtidal zone as other piers in the open sea. After passing the GFS headquarters near Hau Hok Wan, the alignment will cross the Airport Channel and the actual landing point of the alignment would be on the seawall at the southern shore of Airport Island.

10.6.1.8 After landing on Airport Island, the HKLR will comprise several sections of different forms. HKLR will run in viaduct form, first alongside the Airport Island artificial seawall, and then on Airport Island developed area, until it reaches Scenic Hill at the southeast end of Airport Island. HKLR will go through Scenic Hill in tunnel form, and then change into at-grade road on a new reclamation area along the southeast shore of Airport Island.

10.6.1.9 At the end of this at-grade road, HKLR will connect to the HKBCF, which is formed entirely on a new reclamation near the northeast Airport Island.

10.6.1.10 TMCLKL provides road connection between HKBCF to Tuen Mun and Tai Ho. Its reclamation will be immediately adjacent to the HKBCF. The details of TMCLKL are provided in a separated EIA study.

10.6.1.11 In assessing the ecological impacts of HKLR and HKBCF, three major components need to be addressed (see **Section 3**):

1) The section from Hong Kong-Zhuhai connection point to the landing point in Hong Kong SAR on Airport Island, i.e. the marine section of HKLR, which could be further divided into two parts (open sea part and airport channel part);

2) The section from the landing point at Airport Island, through the tunnel in Scenic Hill and at-grade road on reclamation land, and connect HKBCF, i.e. the land and reclamation section of HKLR; and

3) The HKBCF reclamation.

10.6.1.12 HKLR and the first phase of HKBCF would be constructed from 2010-2015 while the remaining of HKBCF would be completed in 2016.

10.6.2 General Environmental Impacts

10.6.2.1 There are some marine recognised sites of conservation importance and important habitats inside the marine ecological impact assessment area but far away from the Project Site, including Shui Hau in South Lantau, the proposed marine park in Soko Islands, Sham Wan SSSI in south Lamma, and Cape d'Aguilar Marine Reserve in Hong Kong Island (see **Figure 10.1**). These sites due to the vast distance are not likely to be affected, directly or indirectly, by the present Project. For the recognized sites of conservation importance identified within the North West Water Control Zone, including Sha Chau and Lung Kwu Chau Marine Park, San Tau Beach SSSI and Tai Ho Stream SSSI, there will be no direct impact, and the water quality model concluded that there will be no impact to these sites of conservation importance. The construction sediment plume is confined within the Tung Chung Bay and all water quality parameters in these sites are well within the WQO. Details of the water quality results are presented under the water quality impact sections.

10.6.2.2 HKLR and HKBCF are not expected to cause direct impacts to Finless Porpoises. This is because porpoises do not occur in the North Lantau waters where the Project is located. Thus, the Project does not potentially impact Finless Porpoise.

10.6.2.3 The primary global threats to populations of Chinese White Dolphin are considered to be entanglement in anti-shark nets, fishing nets including gillnets and pair trawls, and vessel collisions (IUCN Redlist 2009 at www.redlist.org). Contamination by organochlorine compounds and mercury are also thought to threaten dolphins and porpoises in South China coastal waters (IUCN Redlist 2009). With respect to these threats, the Project would have no effect on the risks associated with entanglement in fishing gear or anti-shark nets. The threats of vessel collision and contamination are addressed under construction phase impacts below.

10.6.3 Construction Phase – Direct Impacts

10.6.3.1 Construction phase direct impacts would include the following:

- Habitat losses in the subtidal and intertidal zones in project footprint and works areas; and
- Terrestrial habitat loss in project footprint and works areas.

HKLR Marine Section – Open Sea part

Marine Habitat Loss (Soft substrate seabed and marine waters loss during construction)

10.6.3.2 The open sea part of the marine section of HKLR refers to the viaduct from HKSAR boundary to immediately to the west of Sha Lo Wan headland. This section of viaduct is completely on open sea area and about 5.6km in length. No terrestrial habitat will be affected. Furthermore, the nearest pier to Sha Lo Wan headland would be at least 30m from the shore. Therefore no direct impact on intertidal habitat or coral communities on shallow subtidal hard substrate will be resulted from the open sea part of HKLR (The EVS dive survey confirmed that at the western shore of Sha Lo Wan headland, i.e. DS2 in EVS study, the subtidal hard substrate extends less than 10m from the shore.)

10.6.3.3 The marine section HKLR will be a viaduct supported by piers. Some physical loss of marine habitat (seabed and water column) will result from construction works at each location where piers are installed to support the bridge deck. The HKLR marine section would be around 7.6 km in length (5.6 km in the open sea from HKSAR boundary to Sha Lo Wan, and about 2 km within the Airport Channel from Sha Lo Wan to the actual landing point on Airport Island). If the 50m pier spacing is adopted in the open sea part and 100m spacing is adopted in the Airport Channel part as shown in engineering layout (see **Section 4**), the number of pier sites would be about 112 in the open sea and about 20 in the channel. At each pier site two piers would be constructed side-by-side, each supporting 3 lanes of bridge deck (half of the highway).

10.6.3.4 At each pier site two sets of 4 piles (each of 2m diameter) would be bored through the seabed sediment to reach a solid (rock) substrate. Atop each set of 4 piles a concrete pilecap will be constructed (most of pilecaps would be near the water surface, except a few inside the Airport Channel which would be beneath seabed surface to maintain the vessel traffic) to support the bridge pier. The size of each pilecap would be approximately 8m x 12m.

10.6.3.5 Taking a conservative approach, the footprint of the pilecap would be assumed a seabed loss in this assessment. The seabed area to be lost at each pier site (for both open sea and inside the Airport Channel) would be 8 x 12 x 2 = 192 m^2 (about 200 m^2). The total seabed loss due to the project footprint in the open sea part of the marine section of HKLR would be 112piers x 200 m^2 = 22,400 m^2, i.e. 2.24 ha or less than 3 ha. The 50m pier spacing in the open sea part represents the most conservative scenario: The required number of piers in the open sea part declines as spacing increases from 50m. While standard engineering practice specifies bridge pier spacing at 50m, wider spacing would probably be specified for this Project in an effort to reduce the number of piers and the resulting environmental impacts.

10.6.3.6 This estimation of seabed and water column loss due to project footprint is conservative because all sets of pilecaps are assumed to occupy 200 m^2 of seabed. In reality, all pilecaps in the open sea would be near the sea surface for reasons of marine navigation safety, while the pilecaps inside Airport Channel would be beneath seabed to avoid influences on the sea current flow. In that event the total seabed loss occupied by the pier would be the total cross-sectional area of the 8 piles protruding from the seabed (8 piles x 3.14 m^2 = 25.12 m^2). In such cases the actual seabed loss from project footprint of 25.12 m^2 would be around 12.5 % of the assumed 200 m^2. However, we adopt the most conservative approach, assuming that the seabed beneath/above the pilecap is lost in all cases.

10.6.3.7 In addition to the loss of the seabed and water column due to the project footprint (these losses will become permanent habitat loss after completion of construction), works areas in each pier site will cause additional temporary loss of seabed and water column habitat.

10.6.3.8 To provide access for construction equipment and labour each pier construction site would include an area of works area which could be considered as temporary marine habitat loss: (i) 5m from the outer perimeter of the paired pilecaps as a disturbance perimeter for coffer dam construction and silt curtain deployment; and (ii) the 4m gap between the two pilecaps. Thus the size of each pier construction site would be (5+12+4+12+5 = 38m) x (5+8+5 = 18m) = 684 m^2 (about 700m^2). Of this pier-site total area, the area of temporary habitat loss would be 700 – 200 = 500 m^2. The HKLR marine section open sea part temporary marine habitat loss would be 112 pier sites x 500 m^2 = 56,000 m^2, or 5.6 ha.

10.6.3.9 This 5.6 ha of marine habitat would not be disturbed at the same time. Piers would be constructed in sequence. The viaduct of the open sea part will be constructed portion by portion (totally in three portions). Each portion comprises about 35 continuous pier sites, and the construction of these portions would not overlap. Thus the maximum number of pier sites simultaneously under construction would be 35 in the open sea. Presuming the worst-case, in which the maximum number of work fronts is under construction and all other piers have been completed, the habitat loss during this construction period is estimated in **Table 10-9.** It would be (700 x 35) + (200 x 77) = 24,500 + 15,400 = 39,900 m^2 (about 4 ha) for open sea.

In other words, the maximum temporary seabed loss at any given time would be 500 m^2 x 35 = 17,500 m^2, or about 1.8 ha. But even this is a conservative estimate because this optimum works schedule is unlikely to occur (Due to other environmental considerations such as water quality protection, the minimum distance between two pilecap construction sites would be 180 m.).

Table 10-9 Calculation of worst-case habitat loss during construction

Location	Habitat	Area (m^2/ha)		Total Affected Area
		Under construction / works areas	Completed	
HKLR Marine section				
Open Sea	Soft substrate seabed and marine waters	700 m^2 x 35 = 24,500	200 m^2 x 77 = 15,400	39,900 m^2 (about 4 ha)
Airport Channel	Soft substrate seabed and marine waters	700 m^2 x 10 = 7,000	200 m^2 x 10 = 2,000	9,000 m^2 (about 0.9 ha)
HKLR Land and reclamation section				
Airport Island	Developed area	Less than 1 ha	Less than 1 ha	1 ha
Scenic Hill	Grassland/ shrubland	2 ha	1 ha	3 ha
Southern shore of Airport Island	Artificial seawalls	Less than 1.5 km	200 x 25 = 5,000 or 200m in length	Maximum 1.5 km
Southeast shore of Airport Island	Remnant rocky shores	NA	2 km	2 km
Southeast reclamation	hard substrate seabed	NA	2 km	2 km
	Soft substrate seabed and marine waters	10 ha	27 ha [1]	37 ha
HKBCF				
Existing Fire Station	Artificial seawall and hard substrate seabed	NA	Less than 150m sloping seawalls and less than 100m vertical seawalls	250m
Northeast Airport Island	Soft substrate seabed and marine waters	26 ha	138 ha [2]	164 ha

Notes : 1. For the HKLR reclamation, the land area to the copeline is about 23 ha. The seabed loss is estimated to be about 27 ha (for the footprint area to the bottom of the seawall where it intersects the seabed).

2. For the HKBCF reclamation, the land area to the copeline is about 130 ha. The seabed loss is estimated to be about 138 ha (for the footprint area to the bottom of the seawall where it intersects the seabed).

10.6.3.10 This section would have small area of soft substrate seabed and marine waters loss (less than 3 ha of loss due to the footprint, and at any given time would not exceed 4 ha). The results from the various studies and sampling indicated that the ecological values of the benthic communities on soft substrate seabeds at different parts of the North Lantau waters are similar, at low value. Although the marine waters to the west of Airport Island are of moderate to high ecological value due to the relatively closer distance to the dolphin hotspot in West Lantau waters. The marine habitat loss from the marine section open sea part of HKLR is of small area and is scattered, thus the impact is considered as **minor**.

HKLR Marine Section – Airport Channel part

Marine Habitat Loss (Soft substrate seabed and marine waters loss during construction)

10.6.3.11 The Airport Channel part of the marine section of HKLR refers to the section of viaduct from the western shore of Sha Lo Wan Headland, via the Airport Channel, to the landing point of HKLR on Airport Island. Although the alignment of this part of HKLR would span over and get close to the two headlands at Sha Lo Wan and Hau Hok Wan, none of the piers would encroach onto the headlands or other terrestrial habitats, and thus there would be no terrestrial habitat loss for this section of viaduct. Similarly the alignment also crosses some intertidal habitats, such as the natural rocky shores on the headlands at Sha Lo Wan, but piers would not be constructed at the intertidal zones and there would be no direct impacts on intertidal habitats. The EBS and EVS dive survey also confirmed that there is no hard or soft coral inside the airport channel. Therefore no direct impact on coral communities on subtidal hard substrate seabed will be resulted from the Airport Channel part of HKLR.

10.6.3.12 As described in the above sections, the Airport Channel part would be about 2 km within the Airport Channel from Sha Lo Wan to the actual landing point on Airport Island. A 100m spacing is adopted in the Airport Channel part as shown in engineering layout (see **Section 4**). The number of pier sites would be about 20 in the channel.

10.6.3.13 The design of the piers at Airport Channel would be similar with those in the open sea, so the seabed area to be lost at each pier site inside the Airport Channel would also be about 200 m^2. The total permanent seabed loss in the Airport Channel of HKLR would be 20 piers x 200 m^2 = 4,000 m^2, i.e. 0.4 ha.

10.6.3.14 In addition to the permanent loss of the seabed and water column, works areas in each pier site will cause temporary loss of seabed and water column habitat.

10.6.3.15 The temporary seabed loss in HKLR marine section Airport Channel part would be 20 pier sites x 500 m^2 = 10,000 m^2, or approximately 1 ha.

10.6.3.16 This 1 ha of seabed would not be disturbed at the same time. Piers would be constructed in sequence. The viaduct of the Airport Channel part will be constructed portion by portion (totally in two portions). Each portion comprises less than 10 continuous pier sites, and the construction of these portions would not overlap. Thus the maximum number of pier sites simultaneously under construction would be 10 inside the Airport Channel. Presuming the worst-case, in which the maximum number of work fronts is under construction and all other piers have been completed, the habitat loss during this construction period is estimated in **Table 10-8.** It would be (700 x 10) + (200 x 10) = 7,000 + 2,000 = 9,000 m^2 (about 0.9 ha) for Airport Channel. In other words, the maximum temporary seabed loss at any given time would be 500 m^2 x 10 = 5,000 m^2, or about 0.5 ha. But even this is a conservative estimate because this optimum works schedule is unlikely to occur. Due to other environmental considerations (such as water quality protection), the minimum distance between two pilecap construction sites would be 180 m.

10.6.3.17 This section would have small area of soft substrate seabed and marine waters loss (about 0.4 ha of permanent loss, and at any given time would not exceed 0.9 ha). The soft substrate seabeds at different parts of the North Lantau waters are at low ecological value. And the marine waters inside Airport Channel are not used by CWD, and thus of low ecological value. The marine habitat loss from the marine section Airport Channel part of HKLR is thus considered a **low impact**.

HKLR Land and Reclamation Section

10.6.3.18 The HKLR Land and Reclamation section would cause habitat loss in terrestrial, intertidal and subtidal zone, as it involves different forms in areas of different nature.

Terrestrial Habitat loss (Loss of Developed Area and Grassland/Shrubland during construction)

10.6.3.19 The majority of the HKLR and the entire HKBCF would be on newly reclaimed area or piers in sea areas. The only exceptions are a section of viaduct and a tunnel portal on Airport Island, and thus would cause a small scale loss of terrestrial habitat. On Airport Island, the alignment of HKLR would first run along the seawall by viaduct, go through the southeast part of Airport Island in viaduct and tunnel form, and then go through a new reclamation area as at-grade road. Only two types of existing terrestrial habitats, i.e. developed areas (between the seawall and Scenic Hill) as well as the grassland/shrubland habitat on the lower reach of the south-western slope of Scenic Hill will be affected by the alignment.

10.6.3.20 The section of HKLR going through the developed area will be in viaduct form. Less than 1 ha of developed area within the project works boundaries would be affected by the construction of about 6 viaduct piers and/or maintenance access. The works areas would be subject to temporary habitat losses and the pier footprint would be a permanent habitat loss after completion. While the developed areas are of low ecological value and the affected area size is very small, the impacts on this habitat are considered **insignificant** in terms of ecology and do not require mitigation.

10.6.3.21 The viaduct will connect to a tunnel going through Scenic Hill with one portal at the southwest slope of Scenic Hill. The other portal of the tunnel will be on the new reclamation land and thus the location of this southwest portal will be the only existing terrestrial habitat to be affected by the tunnel. The portal location is currently a grassland/shrubland habitat which is of low ecological value. The affected area is outside the woodlands at northern Scenic Hill with Romer's Tree Frog records and considered of high ecological value. The terrestrial habitat to be lost would be grassland/shrubland habitat and the size of the loss would be about 1 ha. Both abundance and species richness of terrestrial flora and fauna in grassland/shrubland habitat on Scenic Hill, which is isolated from other natural habitats on North Lantau, surrounded by highly disturbed areas, and recently partially disturbed by the construction of the Cable Car angle station, are low. The site for the portal was currently covered by vegetations dominated by common grasses such as *Panicum maximum* and isolated common shrubs such as *Melastoma candidum*.

10.6.3.22 In addition to the permanent loss of the terrestrial habitats, works areas in the tunnel portal will cause temporary loss of another 2ha of grassland/shrubland habitats. The impact area is small and these works area will be reinstated by planting or hydroseeding during the operation phase. Grassland/shrubland is not the important habitat for fauna of conservation concern listed in **Table 10-7**. Due to the very small area size and the low ecological importance of the habitat affected, the impacts for both footprint and works areas are considered **minor**. Mitigation measure is not required.

10.6.3.23 There are records of remnant population of Romer's Tree Frog by AFCD in the secondary woodlands on the northern slope of Scenic Hill (Chan *et al*. 2005b). These secondary woodlands will not be encroached by the construction works. Most of the Romer's Tree Frogs on Chek Lap Kok have already been collected during the rescue programme for the Airport project. The remnant population on Scenic Hill may be low. And this remnant population, which has withstand the construction work of the Airport (scale much larger than this Project), also indicate Romer's Tree Frog is disturbance tolerant to certain extent. There was also a record of Chinese Bullfrog in Scenic Hill during the EVS study, but the grassland/shrubland to be encroached was not their habitats.

10.6.3.24 Apart from Scenic Hill, no other identified terrestrial site/ terrestrial habitat of conservation importance (e.g. woodlands) is in the vicinity of the Project. Those terrestrial sites/habitats are all on North Lantau and not going to be impacted by HKLR or HKBCF due to the physical separation of Airport Channel (a 250 m channel). There also would not be any encroachment on any terrestrial recognised sites of conservation importance (i.e. Lantau North (Extension) Country Park) which is also on North Lantau.

10.6.3.25 Most fauna species listed in **Table 10-7** mainly utilise terrestrial habitats. As there will be no loss of terrestrial habitats of higher ecological values (such as streams or woodlands), these fauna will not be adversely affected by loss of habitats.

Intertidal Habitat Loss (Loss of Artificial Seawalls, Disturbed/Remnant Rocky Shores and patchy sandy beaches during Construction)

10.6.3.26 After landing, HKLR alignment will go along the artificial seawall on the southern shore of Airport Island in viaduct form, and would directly affect limited areas in the intertidal zone. The main impact area would be a length of the constructed seawall on the Airport Island's southern shore (of 1.5 km) on which about 25 bridge piers would be constructed. Artificial seawalls on Airport Island are a man-made habitat and were all constructed in the mid 1990's (approximately 15 years of age) during the development of the new airport. For this 1.5 km section, the seawall to be permanently lost would be 25 piers x 200 m^2 = 5,000 m^2, or 0.5 ha. In terms of length, the loss would be 25 x 8 m = 200m.

10.6.3.27 The intertidal zone along the southeast shore of Airport Island will be lost due to a new reclamation to accommodate the at-grade road of HKLR. This section of shoreline (total 2km in length) comprises artificial seawalls (about 500 m), and remnant rocky shore (about 1,500 m), and a few patchy sandy beaches.

10.6.3.28 The remnant rocky shores along the southeast shore of Airport Island are all the remnant of the original Chek Lap Kok Island shore before the airport development. Though not completely converted into artificial shores, these shores have been disturbed and modified to various extents at different locations. Artificial seawalls and rocky shores (both natural rocky shores on North Lantau and remnant rocky shores on Airport Island) within the assessment area are all of low ecological value as indicated by the results from the various field surveys (i.e. EVS, MSS and HKBCF field survey programme), in particular for the seawalls near the Marine Cargo Terminal which are vertical and constantly disturbed by logistics operations. The remnant rocky shores on Airport Island is of even lower value than the natural rocky shores on North Lantau, as the number of species recorded there is much lower (approximately half the number of recorded in North Lantau side). The patchy sandy beaches were of very low abundance of intertidal fauna as recorded during the **MSS**, and no infauna was recorded in the sediment in these sandy beaches (see **Appendix 10C**).

10.6.3.29 For the southern shore, in addition to the permanent loss of the artificial seawalls, works areas in each pier site will cause temporary loss of artificial seawalls. These works areas will only cause limited temporary impacts on areas of low ecological value. However there would be no temporary loss in the southeast shore (with both artificial seawalls and remnant disturbed rocky shores) as all the losses due to reclamation are permanent.

10.6.3.30 During the EVS study, 9 species of water dependent bird of conservation concern were recorded. Among the nine species, Pacific Reef Egret is of higher conservation status, while Great Egret and Little Egret were recorded on artificial seawalls of Airport Island which will be impacted by the Project, and are more relevant with this impact (other species of wetland dependent birds were recorded on North Lantau side and would not be impacted).

10.6.3.31 The artificial coastline within the Project Area is not considered an important habitat for Pacific Reef Egret, Great Egret and Little Egret. The slopes of the existing artificial seawall are steep, with little area of shallow water for these waterbirds to feed. In addition, the boulder substratum of the artificial seawall may only provide a poor food base. Inter-tidal mudflat and natural rocky shores on North Lantau shore is actually more important foraging habitat of these species. In addition, there will be an increase in length of artificial coastline in the Project Area during operation stage, which can be utilised by these waterbirds, and constitute an increase in foraging habitat of fauna utilise coastal area (a potential positive effect). Therefore, the loss of foraging habitat of waterbirds will only be temporary.

10.6.3.32 **Insignificant impact** on the intertidal habitat would be expected on the southern shore of Airport Island because the entire works area consists of constructed seawall, as well as artificial seawalls on southeast shore, while **minor impact** on the remnant and disturbed rocky shores (together with the patchy sandy beaches) on the southeast coastlines are anticipated. As new artificial seawalls will be created in the new reclamation, intertidal habitats will be provided after the Project. No further mitigation is required for the loss of the low value intertidal habitat.

Subtidal Habitat Loss (Loss of Soft Substrate Benthic Habitat, Hard Substrate Coral Communities and Marine Waters during Construction)

10.6.3.33 The sea area (27 ha) immediate offshore to the southeast coastline of Airport Island will be lost from a reclamation to accommodate the northeast portal of the HKLR tunnel and the at-grade road. The sea areas to be lost mainly include soft substrate seabed and a strip of hard substrate subtidal area (less than 2km) along the coastline (the subtidal zone of the Airport Island coastline). The soft substrate seabed in this area was also investigated by grab sampling survey during the EVS and MSS. The results indicated that the ecological value of the soft substrate seabed is also low. Results of the dive survey of the MSS revealed that only low coverage (<1%) of common gorgonian corals *Echinomuricea* sp. colonised in scattered locations (*Echinomuricea* sp. was only recorded in 2 out of the 8 dive survey locations along this coastline) along the subtidal hard substrate in this area. The ecological value of the coral communities along this shore was ranked as low (**Appendix 10C**).

10.6.3.34 Similar subtidal hard substrate habitats are abundant along the coastlines of North Lantau, and dive surveys from EBS and other studies such as LLP EIA study confirmed that the gorgonian corals *Echinomuricea* sp. were widespread in the North Lantau coastlines. And more hard substrate habitats would be provided by new artificial seawalls at the future HKBCF and HKLR reclamation (after the total reclamation, there will be an increase of at least 4km of artificial seawalls). New hard substrate habitat will be provided for the colonization of gorgonians. Corals could naturally colonise in a fairly short period if hard substrate surface are provided. The Penny's Bay reclamation provided new artificial seawalls for about 5 years and coral colonisation has been reported during the monitoring programme.

10.6.3.35 As described in previous sections, the inshore waters along the southeast shore of Airport Island are not used by dolphin. There has been no sighting record of adult or juvenile in this area.

10.6.3.36 Besides the loss within the footprint of the marine structures, there are also some losses around the boundary of the reclamation. Silt curtains around the reclamation sites will be established during the construction phase. The area enclosed by silt curtains would be not available for marine organisms during construction phase, and thus are considered a temporary habitat loss. Though silt curtains for reclamation sites will be established in 5m from the seaward boundary of the reclamation footprint, it is anticipated that working vessels might occasionally need to operate close to the silt curtains and the disturbance level would be high near the silt curtains. To take a conservative approach, the 50m distance from the footprint would be assumed as temporary loss of habitats, cover an area of the perimeters (~2km) times the width of 50m distance, approximately 2,000m x 50m = 100,000 m^2, i.e. 10 ha.

10.6.3.37 Given the above, the ecological impacts caused by HKLR reclamation are ranked as **minor impact**. With this increase of habitats for the common gorgonians impacted, the impact would be acceptable. No mitigation is required, but a pre-construction dive survey for corals will be provided as additional enhancement measure (see **Section 10.7.8**).

<u>HKBCF</u>

Intertidal Habitat loss (Loss of Artificial Seawall during Construction)

10.6.3.38 The majority of the northeast shore of Airport Island is artificial seawalls, with only a small section of remnant rocky shore at the most northern end. Artificial seawalls and remnant rocky shores at the northeast Airport Island are all of low ecological value as indicated by the results from the HKBCF field survey, in particular for the vertical seawalls near the Marine Cargo Terminal which are vertical and constantly disturbed by logistics operations, as well as the vertical seawall to the north of the existing fire station. The remnant rocky shore at the northern end was also previously disturbed by modification.

10.6.3.39 An "Automatic People Mover" (APM) will be constructed at the northwest part of the HKBCF reclamation. This APM will be a tunnel and its alignment starts from the HKBCF western shore, goes through the waters between the HKBCF and Airport Island, crosses the berth of the existing Fire Station, and then connects road systems on Airport Island.

10.6.3.40 The construction of APM would encroach the berth of the fire station, which is currently a sloping seawall and less than 150m in length. Though the APM is in tunnel form, cut and cover construction method will be required and thus direct encroachment on this seawall is anticipated. This seawall was surveyed for intertidal fauna by quantitative transect method during the HKBCF survey programme (Northern transect in the HKBCF survey, see **Appendix 10D**). The diversity and abundance of intertidal fauna recorded in this location were low, and no species of conservation importance was found. The ecological value was ranked as low.

10.6.3.41 A new fire station will be constructed at the northern end of the vertical seawall just to the north of the existing fire station. A small section of artificial seawall (less than 100m vertical seawall) at this new fire station location will be lost due to the construction.

10.6.3.42 Artificial seawalls on Airport Island were all constructed in the mid 1990's during the development of the new airport. Given the low ecological value of these artificial seawalls, the impact of intertidal habitat loss from HKBCF is ranked as **insignificant**. The remnant rocky shore at the northern end will not be encroached by the HKBCF project.

Subtidal Habitat loss (Loss of Soft Substrate Benthic Habitat, Hard Substrate Coral Communities and Marine Waters during Construction)

10.6.3.43 The majority of the HKBCF would be on newly reclaimed area which would be adjacent to urbanised areas. The land reclamation is 130 ha to the copeline. The sea area (138 ha, the footprint area to the bottom of the seawall where it intersects the seabed) near the northeast Airport Island will be reclaimed for the HKBCF. The sea area to be lost is soft substrate seabed. The soft substrate seabed in this area was investigated by grab sampling survey during the HKBCF survey. The results indicated that the seabed is of low value.

10.6.3.44 The encroachment of the sloping seawall and the loss of vertical seawall mentioned in above paragraphs also cause impacts on subtidal hard substrate habitats (i.e. the subtidal part of the seawalls). Results of the dive survey of the HKBCF field survey (see **Appendix 10D**) revealed that low coverage of common gorgonian corals *Echinomuricea* sp and common ahermatypic corals *Balanophyllia* sp. (both common in western Hong Kong waters) colonised the subtidal hard substrate in this area. Dive surveys from **EBS** and other studies such as LLP EIA study confirmed that the affected gorgonian corals *Echinomuricea* sp. were widespread in the North Lantau coastlines and *Balanophyllia* sp. was also recorded in both to the east and to the west of Airport Island during **EBS** and **EVS** studies. These were the only coral species recorded, and the subtidal hard substrate habitat was ranked as low ecological value.

10.6.3.45 The proposed reclamation site was thus not of unique importance for marine benthos and corals. No hermatypic corals or other marine benthic infauna or epifauna of conservation importance were recorded inside or in the vicinity of the proposed reclamation site as shown by the HKBCF survey and other studies. Only low coverage of common gorgonian corals and ahermatypic corals would be affected. Though the proposed reclamation site is potentially used by adult horseshoe crabs, similar habitats (soft substrate seabed) are abundant throughout the North Lantau waters and thus the loss of this area should not constitute a major impact. The impact from the physical loss of marine habitat caused by the Project would be **minor** in terms of the conservation for marine benthos, corals and horseshoe crabs. No mitigation is required, but a pre-construction dive survey for corals will be provided as additional enhancement measure (see **Section 10.7.8**).

10.6.3.46 Besides habitats for benthos, the sea areas to be occupied are also habitat for Chinese White Dolphin.

10.6.3.47 The temporary habitat loss for HKBCF reclamation would be an area of the perimeters (~5.2km) times the width of 50m distance, approximately 5,200m x 50m = 260,000 m^2, i.e. 26 ha.

10.6.3.48 Marine waters loss would reduce the habitat size for CWD. As illustrated in the above sections on baseline conditions, at the earlier stage of the HKBCF study, the waters to the east of Airport Island and the waters to the west of Airport Island were both the potential areas for locating HKBCF. The pros and cons of the two options were thoroughly studied, and the current proposed HKBCF location is considered a preferred option in terms of dolphin conservation. Although within the range of activities, the waters within the HKBCF footprint are not frequently used by the Chinese White Dolphin and thus not important for CWD (the majority of the HKBCF reclamation footprint falls within the waters near the eastern shore of Airport Island, i.e. of low ecological value, while only its northeast part falls within the waters of moderate ecological value at Northeast Airport Island, which ecological value for dolphin has been elevated due to one of the dolphin hotspot, the Brothers Islands, is located to the east of the reclamation. The HKBCF site option desk-top study revealed that more dolphin groups were sighted near the northeast corner of the airport (north of the HKBCF site) and near the Brothers Islands). This impact (dolphin habitat loss) therefore would not be severe. The marine waters habitat in the HKBCF locations is thus ranked as **moderate for dolphin**. Given the low usage of this area by CWD, physical loss of habitat therefore should not be a critical issue for CWD. But taking into account the reclamation size and relatively close to the Brothers Islands, this impact is therefore considered **moderate impact for dolphin**, mitigation measure is recommended.

Seabed Physical Disturbance

10.6.3.49 The areas of temporary marine habitat loss quantified above would not be occupied by the bridge structure after completion of construction. However, at these locations the seabed would be disturbed during construction and this could adversely affect benthic fauna.

10.6.3.50 Benthic communities are resilient to seabed disturbances. Whilst dredging destroys or degrades benthic habitats, recovery of benthos within several years, even months, after substrate disturbance is evident from many studies. Sampling station from previous marine borrow area (e.g. Station 24), showed relatively high species richness, numbers of individuals and biomass in the study commissioned by AFCD (CCPC 2002). This recovery is attributed to the rapid recolonisation of the disturbed area by nearby dominant and/or opportunistic benthic species. Because benthic communities are capable of quickly recovering after physical disturbance, this potential impact is considered insignificant in the present Project.

Off-site Works Areas

10.6.3.51 There would be off-site works areas for the present Project. These off-site works areas are all located in existing developed areas or existing/previous works areas for other projects. The disturbed nature of these sites limits their ecological value, and the operation of these works areas is not anticipated a significant ecological impact.

10.6.4 Construction Phase – Indirect Impacts

10.6.4.1 Construction phase indirect impacts would include the following:

- Disturbance of protected areas including country parks and SSSIs;
- Disturbance of wildlife;
- Degradation of marine water quality and associated habitats including seagrass beds and mangroves; and
- Degradation of terrestrial habitats.

Water Quality

10.6.4.2 The major potential water quality impacts that may arise during the construction phase of the Project include:

- Seawall dredging and filling;
- Reclamation filling behind seawall;
- Pier site dredging;
- Construction site runoff; and
- Wastewater from construction activities.

10.6.4.3 Besides these, sewage from workforce and accidental spillage of works site chemicals might also potentially cause water quality impact but would be, if any, in a much smaller scale.

10.6.4.4 In the modelling for the water quality impact assessment, the Year 2010 is considered a baseline year. The tidal flow simulations have been chosen to represent the worst case scenarios during both the constructional and operation phases of the project. As the project works will last over some years, several interim construction stages were considered beside the final operation phase (see **Section 9.8.3.4**), including:

- Year 2011 Construction Scenario 1: when the construction of the HKBCF and HKLR has begun and the potential sediment loss rates from dredging and filling were at their maximum.
- Year 2012, Construction Scenario 2: when the construction of the TMCLKL, HKBCF and HKLR would be well under way and would have had the potential to modify tidal currents.
- Year 2013, Construction Scenario 3: when the construction of the TMCLKL, HKBCF and HKLR would be near completion and would have had the potential to modify tidal currents.
- Year 2026: The Completed Scenario: It is anticipated that the TMCLKL+HKBCF and HKLR will be completed in 2016. In order to assess long term operational impacts, the target year of 2026 has been selected to allow for completion of all other expected reclamations. This scenario includes the completed TMCLKL+HKBCF+HKLR reclamations and associated bridges, the HKLR and HZMB bridges and HZMB artificial islands. This scenario also considers the completion year of 2026 for all committed projects, such as Road P1, the increased water depths in the Kwai Tsing Container Basin and

associated fairways, the LLP completed reclamations (72ha and 40ha), and the completed Tung Chung East and West Reclamations.

10.6.4.5 As the Year 2011 is the peak period for dredging and filling, to take a more conservative approach, the constructional phase water quality impact on marine ecology will consider this scenario. The present assessment will also focus on the two nearest marine ecological sensitive receivers to the Project, i.e. Artificial reefs in Northeast Airport (= WSR41) and San Tau Beach SSSI (=WSR 27). In addition, the dolphin hotspot in Brothers Islands (= WSR 49) would also be considered. If these three nearest locations are not affected by water quality impact, then it is assumed that other marine ecological sensitive receivers more distant to the Project will not be affected.

10.6.4.6 During construction phase, this project would involve dredging (for seawall foundation, reclamation and pier construction) and filling (see **Section 4** for details on construction methodology). Large-scale dredging and filling works both are potential sources of suspended solids and thus the potential to cause associated water quality deterioration such as reduction in dissolved oxygen.

10.6.4.7 Both the HKBCF and HKLR reclamation sites would be divided into several portions. Where possible, the seawall formation for each portion would be completed (optimally with small marine access of 100m only) before any dredging and filling activities commence. Full depth silt curtain will also be used to surround the access. The seawall thus formed would be a very effective means to reduce the dispersion of the sediment during the dredging and filling processes. The reclamation sequence (with completed seawall, silt curtain and marine access) is illustrated in **Sections 4 and 9**. As demonstrated in most other reclamation projects such as Penny's Bay, by this approach (the seawalls to be constructed prior to the dredging and filling works), reclamation would cause limited water quality impacts. In this manner, the occasion with higher potential of sediment release would be the dredging and filling of the seawall, which are of much smaller scale when compared with the reclamations.

10.6.4.8 Where the reclamation dredging and filling activities cannot be deferred until the seawalls are completed due to programme constraints, the dredging and filling of reclamation will be scheduled to be carried out at the areas where the leading edge of the formed seawall is about 200m as far as practicable. The provision of leading edge of seawall for the reclamation dredging and filling activities could effectively reduce the dispersion of the sediment and prevent any significant deterioration of water quality. This is expected to reduce the potential sediment loss from the reclamation dredging and filling by at least 45% (see **Section 9.8.4.17**). Barges would unload materials within the seawall, along the seawall, or within silt curtains.

10.6.4.9 In addition, closed-grab dredging and silt curtain for the dredging and filling would also be used. The measures would effectively prevent any significant deterioration of water quality. The use of a layer of stand (floating) type silt curtains surrounding each reclamation site (while taking into account the need for marine access), combined with a cage-type silt curtain around each grab dredger to be used (referred as the (1+1) silt curtain system), has been recommended and modelled. This (1+1) silt curtain system is expected to reduce the overall potential sediment loss to the surrounding water columns by 72% in the 2011 scenario year (with the maximal potential sediment loss rates from dredging and filling, see **Section 9.10.1.8** and **Table 9.16b**).

10.6.4.10 If closed-grab dredging and silt curtain around dredging sites are used, the associated water quality impacts would be localised, and would effectively reduce the sediment release. The potential for sediment resuspension is predicted to be low. The Artificial Reef at NE Airport (WSR 41) is very closed to (about 300m from the HKBCF and about 1km from the TMCLKL) and downstream (during flooding tide) of the project site. If without mitigation, this WSR would be subject to exceedances of the calculated WQO in terms of the predicted maximum depth average SS elevations (see **Section 9, Table 9.19**). After the implementation of mitigation measure, WQO exceedances are reduced but still present (see **Section**

9, Table 9.20). Hence, mitigation measures for the Artificial Reef at NE Airport (WSR 41) are required (see below sections on mitigation measures).

10.6.4.11 It was found from the water modelling results that even under an unmitigated conditions, the sediment plumes generally remain around the East Tung Chung Bay near the project site, although during the flooding time of the spring cycle, the plumes from HKLR could pass the Tung Chung Channel (underneath the North Lantau Highway) and reach Ma Wan Chung at low concentrations (<10 mg/L), but not reaching the San Tau Beach SSSI (WSR 27)(see **Section 9.10.1.4**). This situation is, again, very rare and the plumes only last for around 2 hour if it does occur. For other key marine ecology sensitive area around the project area, no WQO exceedances are predicted under both unmitigated and mitigated conditions for Sha Chau and Lung Kwu Chau Marine Park (WSR 10), Tai Ho Wan (WSR 22a-c) or Airport Channel (WSR 27, 29 and 30)(see **Section 9.10.1.5 & 9.10.1.12**). Without mitigation, the predicted maximum depth average SS elevations, at south of Tai Mo To (WSR49) would exceed the WQO in dry season (see **Section 9, Table 9.19**). With the mitigation measures, exceedences in WQO at Tai Mo To (WSR WSR 49) (i.e. the predicted maximum percentage of time to exceed respective WQO) are small and only of very short time. Given the short transient time of exceedence, adverse impact on this sensitive receiver is not anticipated (see **Section 9, Table 9.20**). Details of the water quality assessment are given in the **Section 9.10**. In view of the above, the impacts on suspended solids could be controlled to acceptable level. Apart from the reclamation, construction of piers for the marine viaducts is required in this project and these activities are the potential sources of water quality impacts.

10.6.4.12 The HKLR alignment will pass through natural seabed where limited dredging and bored piling would be required for construction of piers. There would be about 112 pier sites in the open sea to the west of Airport Island and another 20 inside the Airport Channel. But piers would be constructed in sequence rather than all at the same time. The viaduct will be constructed portion by portion (totally in three portions in the open sea part and two portions in the Airport Channel part). Each portion comprises about 35 and 10 continuous pier sites in the open sea and in the Airport Channel respectively, and the construction of the portions within one part would not overlap. Thus the maximum number of pier sites simultaneously under construction would be 35 in the open sea and 10 inside the Airport Channel. The water quality impact is thus controlled. Furthermore, the pier locations would be enclosed by cofferdams and silt curtains, and the minimum distance between two pilecap construction sites would be maintained to 180 m.

10.6.4.13 Western Hong Kong waters are characterized by high background levels of suspended solids due to the proximity to the Pearl River estuary. Trawling and sediment disposal are common in western waters and both activities disturb the seabed sediment and cause increased SS levels. Wildlife in western waters including CWD and horseshoe crabs are all well adapted to a high SS environment and are not expected to be impacted by the SS increase caused by the Project. Water quality impact on CWD has been discussed in Section 9.10.8.

10.6.4.14 Artificial Reefs - The artificial reefs near the northeast corner of Airport Island within the Marine Exclusion Area is the nearest marine ecological sensitive receiver to the HKBCF reclamation (**Figures 10.1** & **10.13**). These reefs are outside the HKBCF footprint and thus would not be directly impacted, but they are potentially subject to water quality impact from the reclamation. The seawalls would be constructed prior to the filling where possible and mitigation measures will be implemented accordingly during the seawall construction. After the implementation of mitigation measures, WQO exceedances are reduced and predicted for, in maximum, 12% of the time (wet season for the mid-depth), while the exceedances for depth average are 0% of the time in dry season and 4% of the time in wet season (see **Section 9, Table 9.20**). The potential of the artificial reefs influenced by the works, however, is still high even with the mitigation measures in place given the close distance. Impact is ranked as **moderate**. Mitigation is recommended for the artificial reefs.

10.6.4.15 Soft shores (mudflats, seagrass beds, mangroves, horseshoe crab nursery sites) – The soft shores along North Lantau shore in Airport Channel are important habitats. Degradation of marine water quality due to dredging and filling and associated impacts might potentially affect marine fauna inside these soft shores. They are just second to the ARs in terms of the distance to HKLR and HKBCF construction sites, and are on higher potential risk of being affected by the sedimentation.

10.6.4.16 However, the water quality assessment results indicate that if the above recommended mitigation measures such as silt curtains are provided, the increased concentrations of suspended solids caused by the dredging and filling works at all the water sensitive receivers, including those nearest to the reclamation such as Tung Chung Bay (represented by San Tau Beach SSSI, WSR 27) would be within the statutory requirements of 30% (the increases in maximum SS at WSR 27 would be 0.1 mg/L (see **Section 9, Table 9.20**), lower than assessment criteria). This increase has included the contributions of other concurrent projects that would have a bearing on the water quality during the construction phase of the Project (the worst case scenario, see cumulative impacts in below sections). Tung Chung Bay (represented by WSR 27 San Tau Beach SSSI which is at the mouth of Tung Chung Bay) is the nearest soft shore habitat for the project. As Tung Chung Bay would not be subject to adverse water quality from the Project, other embayments along the north Lantau shore, such as Tai Ho Wan, would not be affected by the SS from the Project construction.

10.6.4.17 Resuspended seabed sediment from dredging might also settle on nearby subtidal and intertidal habitats, including the mudflats along Airport Channel where horseshoe crabs and seagrass beds were recorded. Sediment resuspension will be controlled by the use of closed-grab dredgers, cofferdams surrounding works areas, and bored piling. The resulting water quality impacts would be highly localised. The number of work fronts would be much smaller than if all construction works were to be conducted at the same time. Use of these construction methods and protective measures would minimize impacts from suspended solids and/or dissolved oxygen. Given the mitigation measures implemented during the dredging works, it is unlikely that impacts would be significant in an environment where baseline SS levels are high. Any impacts on intertidal fauna such as horseshoe crabs and coastal birds which feed on intertidal fauna such as Pacific Reef Egret on the intertidal mudflats along the Airport Channel would be **minor**.

10.6.4.18 Many factors can affect the survival of seagrasses and often these are interlinked. Two most crucial are: the change of sediments, and the availability of light. Both sedimentation and erosion could impact seagrasses. Deposition of sediment on leaf blades can affect the absorption of light. In extreme cases, Sedimentation could result in partial or complete burial of seagrasses. Though seagrasses can help control of erosion, they also subject to erosion if the currents exceed some certain speed. Erosion could affect the physical stability of the seagrasses. Severe erosion can result in healthy plants being dislodged and washed ashore, and even the reduction of the size of their habitats. The availability of light is mostly determined by the dynamics of sediments. An increase in suspended solid level is usually accompanied in both the cases of sedimentation and erosion. This can increase turbidity in the water column and in turn lead to less light reaching the seagrass leaves which results in a decrease in photosynthetic activity and an increase in stress on the plant.

10.6.4.19 Seagrass beds in San Tau was studied during the 90's as part of the PADS mitigation plan. At that time, reclamation works for the airport at Chek Lap Kok was being conducted in the vicinity of San Tau. In that study, sedimentation is considered as one of the most important threat to seagrass. Correlative studies revealed that sedimentation is probably a strong stress on the San Tau seagrass. It is supported by data on potential and actual sedimentation rates estimated, respectively, by sediment traps and measurements of superficial sediment on leaf blades. Sedimentation rate measured by sediment traps ranged between 2.89 to 14.52 mg/cm/day (or 28.9-145.2 g/m^2/day)(SWIMS 1994).

10.6.4.20 200 g/m^2/day is adopted as the criteria for sediment deposition rate for hard corals in previous EIA studies (Binnie 1996, Meinhardt 2007, Mouchel 2002) Seagrasses are often found in the low to middle intertidal area, especially where the sediments are silty or sandy (Kwok *et al*. 2005). It should also be noted that the seagrass bed at San Tau has been subject to impacts associated with the reclamation works for the airport at Chek Lap Kok. The seagrass has, however, recovered since the works were completed. Seagrasses are therefore expected to be less sensitive to and more tolerant of suspended solids and sediment deposition than are hard corals, which prefer oceanic waters. For this reason, the threshold values adopted for hard corals (i.e. sediment deposition rate of 200 g /m^2/day) may also be applicable to seagrasses. There are water quality mitigation measures to control the SS level and the sedimentation rate in the construction sites to meet the sedimentation rate. As mentioned above, the increased concentrations of suspended solids caused by the dredging and filling operation at San Tau Beach SSSI (WSR 27) would be 0.1 mg/L, lower than assessment criteria (see **Table 9.20**). Furthermore, the daily deposition rate in San Tau Beach SSSI (WSR 27) would be below 10 g/m^2/day (6.8 during dry season and 8.0 during wet season) even under the unmitigated conditions (see sections and tables for mitigated sediment plumes under Year 2011 Scenario in **Section 9.10.1.14**). If with mitigation in place, the daily deposition rate would be below 1.0 g/m^2/day under all scenarios (with or without concurrent project in different years) (see **Section 9**). This is much lower than the criteria of 200 g /m^2/day and the impact on seagrasses could be controlled. As San Tau Beach is the nearest soft shores to the reclamation sites, all other soft shores sites along the Airport Channel would not be significantly impacted by sedimentation. Other soft shores such as Tai Ho and Tung Chung Bay and mangrove habitats, as well as other aquatic organisms, mainly those recorded on soft shores such as *Metapenaeus ensis* will not be significantly affected by water quality impact as they were all at North Lantau shore and farther from the major reclamation site than San Tau Beach.

10.6.4.21 Recognised sites of conservation importance – the potential water quality impact at recognised sites of conservation importance within the North Western and North Western Supplementary WCZs (i.e. San Tau Beach SSSI, Tai Ho Stream SSSI, Sha Chau and Lung Kwu Chau Marine Park, and the proposed Marine Park at Fan Lau) is also a concern. As the San Tau Beach SSSI, which is much closer to the Project Site, would not be affected by the SS or the sedimentation impact as illustrated in above sections, the other recognised sites would not be affected due to the longer distance. Similarly, ,the mudflats in Deep Bay including those in Mai Po, Tsim Bei Tsui and Pak Nai would not be affected by water quality or would not have changes in the local erosion and sedimentation patterns.

10.6.4.22 Marine Mammals – Generally, degradation of water quality due to increases in suspended solids or decreased dissolved oxygen are not considered to be the major issue of concern for marine mammals, which do not obtain oxygen from the water and would not have the risk of gill blockage by high level of suspended particles as fish might encounter. Dolphins and porpoises, that use echolocation as well as vision to navigate and find food, are even less susceptible to sedimentation effects than are other marine mammals that filter prey from the water. However, significant alteration of physical water characteristics may influence prey and therefore affect the animals indirectly. Resuspension of seabed sediment or filling materials might also settle on nearby subtidal and intertidal habitats and indirectly affect their prey.

10.6.4.23 The HKBCF and HKLR reclamation sites are not frequently used by Chinese White Dolphin (**Figure 10.8**). Some of the areas to be dredged (inside Airport Channel and the area on southeast Airport Island) are even not used by Chinese White Dolphin (**Figure 10.8**). Physical separation of dredging works from areas used by Dolphin will further reduce risks of sedimentation impacts. If closed-grab dredging and silt curtains are used, the associated water quality impacts would be localised and would not affect Chinese White Dolphin. The distribution of sediment plumes was compared with the distribution of dolphin density DPSE (see **Figure 10.12**), it was found that the predicted maximum plumes would not reach the Brothers

Islands (a recently identified key dolphin habitat, represented by WSR49). The predicted SS level would be controlled below the WQO, and no impacts are anticipated with the mitigation measures (i.e. sit curtain) implemented. The silt curtain system encloses the entire project sites, the SS elevation band at around 500m of the site are largely reduced to <30 mg/L. SS at this level would not adversely affect CWD which is air-breathing and navigate by echo-sounding, and establishing a SS mixing zone for CWD is not considered as being warranted. Discussion on the water quality impacts on CWD had been presented in **Section 9.10.8**. It is expected that the impacts from suspended solids in the present Project could be controlled to **minor to moderate** after implementing all good site practices.

10.6.4.24 The maximum potential instant DO depletion has been estimated using the estimated maximum potential increase in suspended solids. Among the ecological sensitive sites (WSR 10 – Sha Chau and Lung Kwu Chau Marine Park, WSR 27 – San Tau Beach SSSI, WSR 41 – Artificial Reef in northeast airport, and WSR 49 – the Brothers Island), the predicted highest depth-averaged SS elevation (29.9 mg/L in 2011 unmitigated scenario) is at the artificial reef at the NE airport (WSR 41) and with this level of SS elevation, the potential maximal DO depletion is only 0.4 mg/L which is well within the natural background fluctuation of the area (see **Section 9.10.7.3**).

10.6.4.25 The effects of sewage on wild cetaceans remain largely unknown (Johnston *et al*., 1996). However, it is known that sewage can introduce pathogenic bacteria (such as *Salmonella* sp. and *Vibrio cholera*) and viruses, which in turn can cause diseases such as hepatitis. Sewage-borne bacteria have been found in tissues of Chinese White Dolphin stranded in Hong Kong (Parsons and Jefferson 2000). However, it cannot be confirmed if these bacteria were taken-up while the animals were alive or post-mortem. The Project has low potential to cause increased sewage discharge, therefore this potential impact is **insignificant**. The potential water quality impacts due to site runoff, sewage from workforce and wastewater from various construction activities, and accidental spillage would be controlled through the implementation of suitable mitigation measures, including temporary drainage system, chemical toilets, etc (See sections on **Mitigation of Water Quality Impacts**).

10.6.4.26 Redistribution of environmental contaminants (especially heavy metals and organochlorines), and increased exposure of small cetaceans to pollutants, can have damaging effects on dolphins and porpoises. The impacts from redistribution of environmental contaminants into the water column are discussed under **Bioaccumulation** below.

Chemical Spillage

10.6.4.27 There is an increased risk of small-scale oil or chemical (construction works solvent) spills from vessels due to the increased number of vessels working in the area. Because of the small volumes of such materials involved, this risk is considered **insignificant**.

Surface runoff

10.6.4.28 Potential impacts to aquatic habitats and associated fauna from sedimentation due to surface runoff may arise during the construction phase. Elevated suspended solids levels caused by site runoff could increase the suspended solid load in the water bodies, and could decrease dissolved oxygen levels. This may affect the survivorship of aquatic fauna, e.g., larvae of amphibian and dragonfly, or intertidal fauna. The result could be a temporary reduction in abundance of aquatic or intertidal life. However as there was only limited land-based construction works on Airport Island which lacks of aquatic habitats of ecological value, and intertidal habitats of high ecological value are all located on North Lantau shore (separated from the Airport by the Airport Channel), the potential impact from runoff to aquatic or intertidal communities would be **insignificant.**

Bioaccumulation

10.6.4.29 Resuspension of seabed sediment might potentially incur the release of toxic substances, if any, into the seawater. If toxic substances are present in the seawater, bio-accumulation might occur through the food chains and impact marine fauna, particularly those on higher trophic levels such as dolphins. Bioaccumulation is a concern for top predators such as cetaceans, but other marine organisms such as horseshoe crabs and corals are much less susceptible to this impact. High levels of environmental contaminants including heavy metals (e.g. mercury and cadmium), organochlorines (e.g. DDTs, PCBs and HCHs) and organotins (TBTs) have been found in the blubber, liver and kidney of stranded CWD and porpoises (Jefferson 2000; Jefferson et al. 2006; Minh et al. 1999; Parsons 1999). A few compounds from several classes were considered to be of particular concern when dealing with Chinese White Dolphin in the Pearl River Estuary. These include:

- DDTs and Polychlorinated Biphenyls (PCBs) among the organochlorines;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Arsenic (As) and mercury (Hg) among the metals; and
- Total BTs (including Tributylin (TBT), Dibutylin (DBT) and Monbutylin (MBT)) among the butyltins (see Parsons 2004).

10.6.4.30 A risk assessment conducted for the ecological monitoring programme of Contaminated Mud Pit IV (Mouchel 2002a) examined the content of heavy metals, PAH, PCB, organochlorines, and TBT in trawling catches from the mud pit area and two reference sites, one near Sha Chau and Lung Kwu Chau Marine Park and the other to the southwest of Airport Island. The assessment concluded that only three contaminants showed potential risks for CWD. Two of them, TBT and MBT (a breakdown product of TBT), are only marginally in excess on a risk index (RQ, Risk quotient) and thus the risk to dolphin health could be considered to be low or negligible. While for the third contaminant, arsenic, there was no significant difference in arsenic concentration in fish at the reference sites versus those at the mud pits. Arsenic is regularly encountered at elevated concentrations in the North Lantau area due to the naturally occurring arsenic-rich mineral deposits. This indicates that the mud pits are not a source of contamination.

10.6.4.31 Ecological risk assessment for marine mammals was also conducted during the EIA study for new mud pits at the South Brothers, to determine whether contaminated mud disposal operations at South Brothers are predicted to pose any risk to CWD. The operation of mud pit facilities includes sequentially dredging of the original seabed sediment within the pits, followed by backfilling with contaminated mud and capping with uncontaminated mud. The nature of these works are similar with the works for reclamation in the Project, except the backfilling materials in the HKBCF and HKLR reclamation will be all uncontaminated materials.

10.6.4.32 Impacts associated with the backfilling are of concern as the pollutants in the contaminated mud might potentially be released into the environment and intaken by marine organisms. Pathways of contaminant release to sensitive receivers (ie CWD) include ingestion of contaminated sediment, ingestion of dissolved and suspended contaminants in water, and ingestion of organisms with contaminant residues. The contaminants examined included PAHs, PCBs, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc. It was found that for almost all examined contaminants, the potential risk of exposure would be very similar with the background, only Silver was identified as of potential concern in relation to the diet of Chinese White Dolphin from coastal waters near Hong Kong.

10.6.4.33 The above risk assessment indicates that inputs of bio-accumulable contaminants into the environment were insignificant even near pits for disposal of contaminated mud, both capped or in operation. As the backfilling in the present Project would only involve uncontaminated materials, the risk from the present Project would be much lower than the above two cases.

10.6.4.34 The locations of the reclamation sites of the present Project will be largely natural seabed where contaminated materials due to anthropogenic causes are not anticipated. However, biological screening results for the samples from HKBCF showing exceedance of the LCELs indicated that some of them should be disposed of under requirements (e.g. at the confined mud pit). According to **Section 9.10.5**, dredged Mf sediment would be re-used in reclamation on-site. Mitigation measures for the re-use of those sediments will be provided (detailed in **Section 9**) and thus the release of any contaminants could be controlled. The alignment of the HKLR will not pass through contaminated materials, but rather will cross natural seabed where limited dredging and bored piling will be required for construction of piers. The pier works sites will be surrounded by silt curtains. The number of work fronts would be controlled and would be much smaller than if all construction works were to be undertaken at the same time.

10.6.4.35 During the water quality assessment, elutriation tests were conducted for sediment samples for the present Project, for the purpose of water quality assessment of the extent of contaminant release when dredging activities take place, with the results given in **Section 9.10.6**. The testing parameters included heavy metals (cadmium, chromium, copper, mercury, nickel, lead, zinc and silver), metalloid (arsenic) and organic micro-pollutants (PCB, PAHs and TBT), chlorinated pesticides and nutrients including TKN, NO3-N, NO2-N, NH4-N, PO4-P and total phosphorus. In general, no exceedance of the assessment criteria for all heavy metals and PAH was found. The concentrations of PCBs and TBT were all below the corresponding detection limits and assessment criteria. It is therefore anticipated that the potential impact associated with the release of PAHs, PCBs and TBT from sediments during dredging and filling is insignificant. However, exceedances are observed for Metalloid (i.e As), and the ammonia nitrogen, total phosphorus and total reactive phosphorus are also concern. After the estimation of dilution, however, it was found that under the worst-case condition (no mitigation measure, and assuming the highest concentration values obtained from elutriate testing as the source concentrations), at the nearest water quality sensitive receiver WSR 46 near Tai Mo To (WSR 41 the artificial reef at NE airport is excluded as there will be reprovision for it), the estimated highest concentrations of As at WSR 46 is well within the water quality criteria of 25 μg/L, while the diluted concentration of ammonia is still within the WQO of 0.021mg/L. The diluted concentrations of the phosphorus are very close to the background levels. Since silt curtains need to be used in the seawall dredging and filling activities, release of pollutants from the dredging/filling sites should be minimal, and concentrations of pollutants are not likely to be elevated (see **Section 9.10.6**).

10.6.4.36 Pore water tests were also conducted for the sediment samples. The parameters of Cd, Cr, Cu, Ni, Pb, Ag, Zn, As, PCBs, TBT and chlorinated pesticides in pore water are all below the corresponding reporting limits and the assessment criteria for release of contaminants during dredging and filling. Only one sample exceed the EU limit of 0.2 μg/L for PAH. Nevertheless, given the long distance (> 200m) to the nearest sensitive receivers (WSR 41) and the dilution factor (greater than 10), adverse water quality impact is not anticipated (see **Section 9.10.6**).

10.6.4.37 It is clear in the above worst case estimations, based upon the assumptions that the suspended sediments from the projects would be moderately contaminated up to the threshold of UCELs and could immediately desorbed/dissolved from the solid phase into solution, the predicted maximum increases in the sediment borne contaminants will be well within the criteria for the protection of marine life. The potential impacts from the release of the above contaminants would thus be insignificant. Furthermore, the locations for the dredging required for reclamation will be protected by silt curtains. Silt curtain is a proven measure to effectively control sediment re-suspension. The concerned contaminants, if any, would therefore be controlled to be redistributed into the water column, and would not be made more available for uptake by CWD or their prey. It is thus reasonable to predict that bioaccumulation impacts would not be significantly increased by the Project. Thus **insignificant** bioaccumulation impacts from the construction of HKBCF & HKLR are predicted for Chinese White Dolphin populations.

Terrestrial disturbance (Noise, dust and visual disturbance)

10.6.4.38 Noise, dust and visual disturbance will be generated during construction stage, potentially affecting the distribution and behaviour of fauna of the adjacent terrestrial habitats, but will only affect areas adjacent to the Project Area. Areas adjacent to the Project Area included only developed areas on Airport Island, Scenic Hill and the two headlands on North Lantau near Sha Lo Wan and Hau Hok Wan.

10.6.4.39 The background noise on Airport Island is high. Construction noise will be short-term, intermittent, and lower in volume when compared with aircraft noise. The ecological value of the site for the SkyCity Golf Course on Airport Island was investigated during the EIA study and was considered low in terms of terrestrial ecology, as the land is man-made and reclaimed in the early 1990s (Bhanja Cheung 2005). It is likely that the ecological value of the remaining parts of the airport as habitat for terrestrial fauna would also be low. In addition, measures are implemented in airport to reduce wildlife abundance, especially birds and their prey (e.g., amphibians), to reduce the potential hazards of birdstrike. Terrestrial fauna diversity in the airport is thus very low, due to the low vegetation cover, high disturbance level and absence of aquatic habitats. Disturbance to terrestrial fauna at woodland in Scenic Hill due to construction noise would be limited as the tunnel construction works would not involve disturbing methods such as blasting or cut-and-cover.

10.6.4.40 There would be no construction work on the headlands at Sha Lo Wan (where the HKLR alignment spans overhead) and Hau Hok Wan (where the HKLR alignment gets close to, which is also part of the Lantau North (Extension) Country Park. The noise generated from bored piling at the nearby pier construction sites in the Airport Channel would be much less than if percussive piling were to be used. Terrestrial fauna on the headlands at Sha Lo Wan and Hau Hok Wan may be disturbed by noise generated during the construction of the section of bridge deck overhead. As precast method would be used, the disturbance would be short-term and localised.

10.6.4.41 Lantau North (Extension) Country Park is only less than 50m from its nearest point (the headland of Sha Lo Wan Pier) to the HKLR alignment. But noisy construction method such as percussive piling would not be used and precast method will be applied, the disturbance impact to this recognised site of conservation importance is not significant

10.6.4.42 Except the tall shrubland on Sha Lo Wan headland, other terrestrial habitats of higher ecological value on North Lantau (e.g., woodland) are away from the Project Area. It is anticipated that noise, dust or visual disturbance from the Project Area will not have significant impact over this distance. The terrestrial fauna in North Lantau of conservation concern listed in **Table 10-7** would not be affected. The sizes of these terrestrial habitats are small. The impact will be localised and short-term. In addition, abundance of fauna is low. Due to the small area affected and the short duration of disturbance, the potential ecological impact is considered as **insignificant**.

Marine Noise

10.6.4.43 In the present Project, cetaceans are the major concern related to marine noise, while other marine organisms in the marine study area such as horseshoe crabs are not considered subject to noise impacts.

10.6.4.44 Small cetaceans are acoustically sensitive, and sound is important to their survival. Noise pollution adversely affects marine mammals, such as Chinese White Dolphin, which rely on sound as a primary means of exploration and communication (Most of them rely on echo-location method to navigate and detect prey). During project design, two types of work activities that are known to be most disturbing for cetaceans were excluded, i.e. underwater blasting and percussive piling (see below), to minimize the potential noise impacts on cetaceans, in particular on the Chinese White Dolphin. Noise from other construction activities (e.g. bored piling, marine traffic and dredging) might still be a source of impacts.

10.6.4.45 The National Research Council (2003) classified industrial noise related to marine mammal conservation. There are six major types of underwater noise:

1) Blasting,
2) Pile driving,
3) Industrial machinery,
4) Dredging,
5) Power plant, and
6) Power-generating windmills.

10.6.4.46 Noise from the above sources can cause adverse impacts to dolphins from the mildest short-term behavioural disturbance, threshold shifts, auditory masking, physiological stress, to acoustic trauma, long-term displacement from preferred habitat, or even injury or death in the most serious cases (see Richardson *et al*. 1995; National Research Council 2003; Wartzok *et al*. 2003).

10.6.4.47 Although, in some cases, dolphins may adjust the characteristics of their emitted sounds to accommodate foreign noise sources (Geraci & St. Aubin 1987; Wartzok *et al*. 2003). In other cases, they may habituate, sensitize, or become tolerant of introduced noise. Therefore, caution must be exercised in the present Project, in which noise over long periods of time may be produced.

10.6.4.48 Blasting, which produces a shock wave similar to but much stronger than percussive piling and represents the most serious threat among the six industrial sources listed above, will not be required in the Project and will not be discussed further.

10.6.4.49 Piles could be divided into two main categories, i.e. driven piles and bored piles. Driven piles (or referred as impact piling) are considered to be displacement piles. In the process of driving the pile into the ground, soil is moved radically as the pile shaft enters the ground. Bored piles are generally considered to be non-displacement piles but replacement piles. A void is formed by boring or excavation before piles is produced. Piles can be produced by casting concrete in the void. In unstable ground, temporary support from casing would be required (Abebe & Smith 1999).

10.6.4.50 The noise from pile driving displays high peaks associated with each hammer blow. In the case of bored piling equipment, much of the noise emanates from the engine providing the power, and it is possible to reduce the steady noise level by improving the soundproofing qualities of the engine enclosure (Fleming *et al*. 2008). During bored piling, metal case for the piles will be pushed into seabed sediment by machines rather than driven by hammers. But some of the noise associated with the driving and extraction of temporary casings would still be produced.

10.6.4.51 Percussive piling is an impact piling in which piling by sinking or driving a pile by direct or indirect hammering or other percussive means, and generates noise of greatest concern relative to cetaceans in Hong Kong. For the proposed Project piles will be bored rather than driven, therefore percussive piling impacts will not be discussed further.

10.6.4.52 Bored piling is considered “usually a lot less disturbing than hammer piling” (EPT 2003). Bored piling would produce much lower levels of noise than percussive piling, and this method is recommended by governing authorities and construction companies when quieter construction method is required. When comparing bored piles and impact-driven piles, bored piles “would minimise noise and vibration impacts” (TIDC 2007). In the present Project, bored piling will be conducted at all HKLR pier sites, including both the open sea part and the Airport Channel part under the Marine section. The bored piling works in pier sites within Airport Channel would not be a concern for CWD as the channel is not utilized by them. As described in the above sections on habitat loss, the viaduct of the open sea part will be constructed portion by portion (totally in three portions). Each portion comprises about 35 continuous pier sites, and the construction of these portions will not overlap. Thus the maximum number of pier sites simultaneously under construction would be 35 in the open sea. Among these 35 pier sites within one portion, the bored piling works will not be conducted at all pier sites at the same time. The bored piling works will be scheduled to conduct in a limited number of sites at any given time (The maximum number of sites with bored piling works at the same time would be 17 or lower, and the number is also limited by the availability of the equipment, as pier construction will also be conducted in some pier sites inside Airport Channel).

10.6.4.53 Sheet piling is also a replacement piling method, but it is the metal sheet piles instead of steel metal casing to be put into sediment. The magnitude of noise should be similar with bored piling as the machines used are similar, but the noise level could be lower as sheet piles are usually not for supporting purposes and are not necessary to reach solid rock layer.

10.6.4.54 Industrial machinery and dredging noises are the most common types of noise from marine construction in Hong Kong. Dolphins and porpoises use mostly high-frequency sounds (>5 kHz) for communication and echolocation, while the vast majority of noise associated with development and construction activities is low-frequency (< 5 kHz). Low-frequency noise is generally not considered to be a serious problem for small cetaceans (Geraci & St. Aubin 1987; Richardson *et al*. 1995).

10.6.4.55 Since the completion of the AFRF, it has been found that noise from vessels offloading fuel at the facility is barely detectable above the ambient noise at distances exceeding about 500 m (Würsig & Greene 2002). This result may imply that the general construction works for the present Project, including vessel traffic (Vessel noise is also covered in the Marine Traffic section below), would not constitute a significant noise impact to the vicinity.

10.6.4.56 There are cases in which construction noise may be a problem for dolphins, such as when high-frequency components are present (e.g. certain types of equipment that use high-speed engines), when a source of noise is relatively loud and continuous for long periods of time (e.g. oil-drilling or dredging operations), and when the noise is impulsive and emits shock waves (e.g. with pile-driving or blasting). As explained in previous sections that percussive piling and blasting would not be required. Mitigation measures for high-speed engines would be proposed (see **Section 9**).

10.6.4.57 Very little is known about the effects of dredging on cetaceans in general. The few studies that have been done dealt with large whales. Richardson *et al*. (1990) conducted sound playback experiments with bowhead whales (*Balaena mysticetus*) in the Arctic, and used sounds recorded from active dredgers. The whales showed some behavioural responses, changing their vocalization patterns, feeding, and diving behaviour when the noise corresponded to that of dredgers at about 3-11 km distance.

10.6.4.58 In general, dolphins utilize more on the high frequency sound, and make them less vulnerable to the effects of dredgers, which generally produce very low frequency sounds (less than a few kHz - see Greene 1987). Also, stationary dredgers appear to have less effect than more transitory sound sources (Richardson & Würsig 1997). The only small toothed whale for which there is some quantitative data on reaction to dredgers is the beluga whale (*Delphinapterus leucas*). In general, the reactions of belugas to dredgers were of a low level, and whales tended to occur well within the ensonified areas, suggesting that they did not find the noise to be highly disturbing (Richardson & Würsig 1997). Similarly, Thomas *et al.* (1990) conducted studies of the behavioural responses of captive belugas to record playbacks of oil drilling operations (which in some ways are similar to those of dredging operations). They found no discernable behavioural responses, and also found no evidence of stress from examination of blood catecholamines.

10.6.4.59 The dolphins appeared to be attracted to the disturbance of the sea bottom such as trawling (perhaps this makes prey more accessible for them). CWD activities associated with trawlers have been reported in the AFCD annual dolphin monitoring programme. This is probably indicative that the level of disturbance and noise is minor. The level of seabed disturbance and noise caused by dredging would be similar or even smaller than that from trawling as it is stationary. Furthermore, in the present Project all dredging works would be conducted within silt curtains, the noise level would be reduced and it also avoids the chances of a dolphin being struck by equipment or vessels involved in the operations.

10.6.4.60 As the other five industrial activities (i.e. blasting, pile driving, industrial machinery, power plant and power-generating windmills) would not be conducted in the present project, they are not of concern and will not be discussed further.

10.6.4.61 Further to the above 6 types of marine noise, vessel noise is well-known as a potential disturbance factor for dolphins, although it is mainly the smaller, faster-moving boats with outboard engines that are considered most disturbing (Richardson *et al*. 1995; Richardson & Würsig 1997). Dolphins mainly use sounds that are well above the frequencies produced by most large vessels used in shipping and marine construction activities. Based on available experience in Hong Kong SAR, these types of vessels are not thought to be a significant source of acoustic disturbance.

10.6.4.62 Bored piles would minimise noise and vibration impacts when compared with traditional impact-driven piles (TIDC 2007). Construction of HKLR and HKBCF phase 1 would be completed prior to 2015 and remaining of HKBCF in about 2016. The number of work fronts would thus be smaller than if all construction works were to be undertaken at the same time. The viaduct of the open sea part will be constructed portion by portion (totally in three portions), which construction would not overlap. Within each portion, bored piling will be scheduled to conduct in only several sites at any given time. Only minor noise impacts are identified from the construction works for the present Project. However, there is still a small possibility that noise would be transmitted from the onboard equipment (e.g. air-compressor) and during the installation of temporary casings into the sea. The level of noise from this source would be much lower than those from percussive piling and might be similar with marine industrial activities. To take a precautionary approach, however, the noise impact is ranked as **Moderate**, and mitigation measure is proposed to reduce this impact. Furthermore, there will be an underwater noise monitoring for the bored piling works during the construction phase to verify the predictions of the assessment.

Marine Traffic

10.6.4.63 Although vessel noise is not thought to be a major source of acoustic disturbance to cetaceans, dolphins may need to change their diving and surfacing patterns to avoid being hit by large vessels (the skippers of which generally do not know or care that there are dolphins in their path). This may result in behavioural disturbance in areas of very busy shipping, ferry lanes, or regions with active marine construction.

10.6.4.64 CWD and porpoises have been injured and/or killed by vessel collisions in Hong Kong (Parsons & Jefferson 2000). Boat traffic is intensive in Hong Kong for trading and transportation between Hong Kong and China. The Urmston Road shipping channel is situated at the area of highest density of Chinese White Dolphin in Hong Kong (Hung 2008). Some CWD may get hit by high-speed vessels and become seriously injured or killed. From the photo-ID results, a few identified individual CWD showed permanent injury marks on their bodies and fins caused by propellers. Further evidence from several stranded CWD presented wounds consistent with blunt traumatic injury, probably caused by impacts from vessel bows or hulls during boat collisions (Jefferson 2000; Parsons and Jefferson 2000). Of CWD and porpoises stranded in Hong Kong, 10% showed evidence of probable or definite vessel collisions (Parsons & Jefferson 2000), and at least 2.1% of individual CWD in the photo-ID catalogue show evidence of propeller cuts (Jefferson 2004). This indicates that vessel collision is a significant cause of death for local cetaceans. Though the actual collisions have not been observed, it is considered that high speed vessels such as out-board engine speed boat would be the prime source of collision risk. Since most of the vessels that will be involved in the construction of the HKLR and HKBCF construction will be slow-moving working barges and vessels, this issue is not likely to be critical.

10.6.4.65 Increased vessel traffic through the Northwest Lantau area would likely affect Chinese White Dolphin. However, since most of the vessels that will be involved in the HZMB construction will be larger, slow-moving vessels (which generally involve low-frequency sound, to which dolphins are less sensitive), this issue is not likely to be critical.

10.6.4.66 The increase in vessel movements in the area during construction is also of concern, and if the number of movements is very high it could cause some avoidance of the area by CWD. However, the proposed reclamation area is not adjacent to the Urmston Road channel which is known very busy and noisy in Hong Kong's western waters (Würsig & Greene 2002), the potential for this situation seems quite low.

10.6.4.67 Since the proposed reclamation areas are not used frequently by the CWD, and most of the vessels that will be involved in the construction will be larger, slow-moving vessels which would be of low hazardous level in terms of both collision risk and disturbance, the impact from marine traffic on the dolphin is thus ranked as **minor to moderate,** mitigation measures would be needed. Some precautions would also be taken such as to locate the HKBCF reclamation access opening at the far side from the dolphin hotspot of Brothers Islands, so as to minimise the disturbance from the reclamation-associated marine traffic.

Entanglement and entrapment

10.6.4.68 There will be double-layer silt curtains to be installed surrounding the areas for seawall dredging and filling. The silt curtains would be in the form of a fabric sheet rather than a net, and thus should not pose any net entanglement risk to the CWD. The opening for vessel access would be small and thus the chance that CWD accidentally enter the waters surrounded by silt curtains would be very low. Furthermore, a construction dolphin watching plan will be included in the EM&A programme. The plan would also include regular inspection of the curtains, scanning of the waters surrounded by the curtains, and an action plan in case CWD are found within the waters surrounded by the silt curtains. This impact is ranked as **insignificant**.

Disturbance on marine borrow areas and dredged/excavated material disposal sites

10.6.4.69 The dredging would also cause secondary impacts on the dredged/excavated material disposal sites, while the backfilling would require a large quantity of sand and would have implication on marine borrow areas. These disposal and sand dredging activities would follow the current practices, guidelines, and requirements.

Cumulative Impacts from Construction Phase impacts

10.6.4.70 In accordance with Section 4.3.3 (b) of EIA-TM, the assessment should examine the cumulative environmental effects if there may be interactions between the environmental impacts of the projects which might affect the sum total of its environmental impacts. In the present project, no interactions between the construction phase impacts, which would affect the sum total of all ecological impacts, are identified.

10.6.4.71 Construction phase impacts are summarised in **Table 10-10** below.

Table 10-10 Construction Stage Impacts

Impact	Source			Receiver	Nature of Impacts						Severity	Mitigation Required
	HKLR marine section	HKLR land and reclamation section	HKBCF		Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Terrestrial habitat loss (Project footprint)	NA	Tunnel Portal	NA	Grassland/shrubland habitat	Low	Common flora and fauna species	About 1ha	Turn into permanent loss after completion	Irreversible	Small	Minor	No
	NA	Viaduct columns	NA	Developed areas	Low	Disturbance tolerant fauna	About 1 ha	Turn into permanent loss after completion	Irreversible	Small	Insignificant	No
Intertidal habitat loss(Project footprint)	NA	Viaduct columns, reclamation	APM, Reprovision of fire station	Existing artificial seawall	Low	Common species of intertidal fauna and Waterbirds utilising coastal areas e.g. Pacific Reef Egret	200m (or 0.5ha) for viaduct; about 500m for reclamation, 250m for APM	Turn into permanent loss after completion	Irreversible	Small	Insignificant	No, But more seawall would be provided after reclamation
	NA	Reclamation	NA	Disturbed/Remnant rocky shores on Airport Island	Low	Common species of intertidal fauna	1,500m of remnant rocky shore	Turn into permanent loss after completion	Irreversible	Medium	Minor	No, But more seawall would be provided after reclamation
Seabed loss and loss of dolphin habitat above the seabed (Project footprint)	NA	Reclamation	APM, Reprovision of fire station	Shallow subtidal hard substrate seabed	Low to moderate	Gorgonians and ahermatypic corals	Approximately 2km (due to HKLR and HKBCF)	Turn into permanent loss after completion	Irreversible	Small to Medium	Minor for gorgonians and ahermatypic corals;	No, more hard substrate seabed would be provided after reclamation, but a pre-construction dive survey for corals will be provided as additional enhancement.
	Viaduct piers	Reclamation	Reclamation	Subtidal soft substrate seabed	Low	Benthic communities	<3ha for HKLR viaduct, 27 ha for HKLR reclamation and 138 ha for HKBCF reclamation	Turn into permanent loss after completion	Irreversible	Medium	Minor	No
	Viaduct piers in open sea	NA	NA	Marine waters west of Airport Island	Moderate to High	Chinese White Dolphin	< 3 ha	Turn into permanent loss after completion	Irreversible	Small	Minor	No.

Impact	Source HKLR marine section	HKLR land and reclamation section	HKBCF	Receiver	Nature of Impacts Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude	Severity	Mitigation Required
Seabed loss and loss of dolphin habitat above the seabed (Project footprint)	Viaduct piers in Airport Channel	NA	NA	Marine waters in Airport Channel	Low	Marine fauna	< 1 ha	Turn into permanent loss after completion	Irreversible	Small	Minor	No
	NA	Reclamation	NA	Marine waters to the east of Airport Island	Low	Marine fauna	27 h	Turn into permanent loss after completion	Irreversible	Medium	Minor	No
	NA	NA	Reclamation	Marine waters near Northeast Airport Island	Moderate	Chinese White Dolphin	138 ha	Turn into permanent loss after completion	Irreversible	Medium	Moderate	Mitigation during the operation phase
Terrestrial Temporary habitat loss (works areas)	NA	Works area for construction of viaduct column; maintenance access and tunnel portal	Modification of existing road system on Airport Island	Grassland/shrubland habitat and Developed areas	Low for developed area and grassland/ shrubland	Common flora and fauna species Disturbance tolerant fauna	About 2ha for HKL; more for HKBCF	Temporary	Reversible	Small	Minor	No, but the disturbed habitats should be reinstated after construction
Intertidal Temporary habitat loss (works areas)	NA	Works area for viaduct column on artificial seawalls	Works area for APM and fire station	Existing artificial seawall	Low	Common fauna species	About 1.5km	Temporary	Reversible	Small	Insignificant	No
Temporary Soft Substrate seabed loss (works areas) and seabed disturbance	Pier construction sites	Works areas for reclamation	Works areas for reclamation	Subtidal soft substrate marine habitat	Low	Common intertidal fauna species	About 6.6ha for HKLR viaduct; 10ha for HKLR reclamation; 26ha for HKBCF reclamation	Temporary	Reversible	Small	Minor	No, benthos able to self-recolonisation
Temporary marine waters loss (works areas)	Pier construction sites	Works areas for reclamation	Works areas for reclamation	Marine waters	Ranging from moderate-high to low in different locations	Chinese White Dolphin	About 6.6ha for HKLR viaduct; 10ha for HKLR reclamation; 26ha for HKBCF reclamation	Temporary	Reversible	Small	Minor	No.
Temporary land disturbance	Off-site works areas	Off-site works areas	Off-site works areas	Fauna on developed area and existing construction sites	Low	Disturbance-tolerant species	Low	Temporary	Reversible	Small	Insignificant	No

Impact	Source			Receiver	Nature of Impacts						Severity	Mitigation Required
	HKLR marine section	HKLR land and reclamation section	HKBCF		Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Marine water quality (e.g. Sedimentation and Resuspension during dredging; Decreased D.O., Dumping, spilling)	Reclamation Resuspension during dredging Decreased D.O., Dumping, spilling, and leakage of chemicals from vessels or equipment			Marine and coastal fauna in the nearby waters	Low to High for dolphin; Low for gorgonians and benthos	Chinese White Dolphin Gorgonians Marine benthos	Low to High for dolphin Low for gorgonians and benthos	Temporary	Reversible	Medium	Minor for gorgonians and benthos; minor to Moderate for CWD (with water quality mitigation in place)	There would be water quality mitigation measures
				Softshore habitats	Moderate for mudflat; High for juvenile horseshoe crab; High for seagrasses	Estuarine species, including horseshoe crab juveniles, seagrasses, and mangroves	Small for mangroves and seagrass beds; extensive for mudflat	Temporary	Reversible	Small	Minor	No, but there would be water quality mitigation measures
				Artificial reefs	Moderate	Epifauna and fish	3,600 m^3	Temporary	Reversible	Large given the close distance	Moderate	Re-provision of ARs of same volume
				Sha Chau and Lung Kwu Chau Marine Park	High	Chinese White Dolphin; coral communities	1,200 ha	Temporary	Reversible	Small given the vast distance	Insignificant	No.
				San Tau Beach SSSI	High	Estuarine species, including horseshoe crab juveniles, seagrasses, and mangroves	2.7 ha	Temporary	Reversible	Small given the vast distance	Insignificant	No.
				Tai Ho Stream SSSI	High	Estuarine species, including horseshoe crab juveniles, seagrasses, and mangroves	5 ha	Temporary	Reversible	Small given the vast distance	Insignificant	No.
				Proposed Marine Park at Fan Lau	High	Chinese White Dolphin	N/A	Temporary	Reversible	Small given the vast distance	Insignificant	No.
Bioaccumulation	Redistribution of contaminants during dredging	Redistribution of contaminants during dredging	Redistribution of contaminants during dredging	Nearby waters	Low to High	Chinese White Dolphin	Low to High	Long term	Irreversible	Insignificant	Insignificant	No, but there would be silt curtain to control sediment re-suspension, thereby minimizing availability for uptake by dolphins or their prey species

Impact	Source			Receiver	Nature of Impacts						Severity	Mitigation Required
	HKLR marine section	HKLR land and reclamation section	HKBCF		Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Terrestrial noise, dust and visual disturbance	Works equipment and human activities	NA	NA	Wildlife species on adjacent habitats, including urbanised/disturbed and grassland	Terrestrial habitats affected are of low ecological importance	Disturbance tolerant fauna	Low	Temporary	Reversible	Small	Insignificant	Good Site Practices.
Sedimentation from land-based works areas	NA	Construction of the tunnels in Scenic Hill and access roads	NA	Nearby natural habitats (woodland with Romer's Tree Frog records)	Low	Amphibians,	Very low	Temporary	Reversible	Small	Insignificant	Good Site Practices.
Marine noise	Dredging, and Works Vessels	Dredging, and Works Vessels	Dredging, and Works Vessels	Nearby waters	Low to High	Chinese White Dolphin	Low to High	Temporary	Reversible	Medium	Moderate	Acoustic decoupling Dolphin Exclusion Zone or Dolphin Watching Plan,
	Bored piling		Sheet piling	Nearby waters	Low to High	Chinese White Dolphin	Low to High	Temporary	Reversible	Medium	Minor to Moderate	Yes, use of quiet vibratory piler, to avoid drilling onto rock surface of bored pile during May and June; dolphin exclusion zone.
Marine traffic during construction	Vessel traffic associated with construction	Vessel traffic associated with construction	Vessel traffic associated with construction	Nearby waters	Low to High	Chinese White Dolphin	Low to High	Temporary	Reversible	Small	Minor to moderate	Yes to set up regular routes for vessels to avoid dolphin hotspots; vessel speed limits; training for vessel captains
Entanglement and entrapment	Silt curtain	Silt curtain	Silt curtain	Nearby waters	Low to High	Chinese White Dolphin	Low to High	Temporary	Reversible	Small	Insignificant	Dolphin watching plan during construction phase

10.6.5 Operation phase – Direct Impacts

Permanent habitat loss

10.6.5.1 After the construction of the Project, the temporary works areas will be restored by the contractor (for terrestrial habitats) or self-restored (for intertidal habitats and subtidal habitats), but the habitats occupied by the Project footprint would be permanently lost. The sizes of the permanent habitat losses have been calculated in the above sections for construction phase, i.e.

1) Less than 1ha developed area for HKLR;
2) About 1 ha grassland/shrubland habitat for HKLR;
3) 700m (200m on southern shore and 500m on southeast shore) artificial seawalls for HKLR;
4) 1500m remnant rocky shores for HKLR;
5) Less than 250m seawall lost for HKBCF;
6) About 2km hard substrate seabed for HKLR;
7) Less than 250m hard substrate seabed for HKBCF;
8) Less than 3ha of sea area (including soft substrate seabed and water column) in HKLR marine pier sites;
9) 27 ha of sea area (including soft substrate seabed and water column) in HKLR reclamation; and
10) 138 ha of sea area (including soft substrate seabed and water column) in HKBCF reclamation.

10.6.5.2 The severity of these habitat loss impacts have been discussed, and it is concluded that only the 138 ha sea area loss is considered a moderate impact and mitigation is required. The mitigation for this impact will be detailed in the sections on mitigation measures below.

Carrying Capacity

10.6.5.3 The major food items of CWD would be estuarine fish. The fish production in the sea areas to be lost would be an indication of the food supply for CWD. Port Survey conducted AFCD provides information of the fishing production in different areas in Hong Kong waters. In accordance with the results from Port Survey 2006, the sea area to be lost from the reclamations of the Project are not of high fishing production. The fishing production in these areas ranged from very low to moderate, when considering the fishing production distribution in Hong Kong. The project footprint also would not encroach any area of fish fry production or fisheries species spawning/nursery ground. There would not be any impact on the sustainability of the fish resources, i.e. the food supply to CWD, in North Lantau waters. It is not anticipated that the carrying capacity of the North Lantau waters for CWD would be affected.

Terrestrial and Intertidal Habitat Fragmentation

10.6.5.4 The Project Area is mainly located in marine environment, and therefore would not cause significant fragmentation of terrestrial habitats.

10.6.5.5 The HKLR will span over sea and span over the headlands at Sha Lo Wan. Therefore these viaducts will not cause fragmentation of natural habitats on these headlands. Flight behaviour of birds in relationship to bridges was studied during the EIA study of Shenzhen Western Corridor, and it was found that birds can fly across bridges, either above or below the deck (Appendix 9C in Arup 2002). The bridge would not be an obstacle to birds.

10.6.5.6 The impact from habitat fragmentation on Airport Island is insignificant as the alignment would go through the edge of the only affected natural habitats (grassland/shrubland on Scenic Hill) in tunnel form, rather than split them into different parts. The ecological value of the grassland/shrubland on Scenic Hill is low. The HKLR will not pass by the woodland of higher ecological value. The impact of habitat fragmentation to terrestrial fauna is ranked as **insignificant**.

Marine Habitat Fragmentation

10.6.5.7 Another consideration is whether a series of bridge piers would restrict the movement of CWD. Some Chinese White Dolphin individuals might use both the North Lantau and West Lantau areas (such as the year-round resident NL123, and the seasonal resident NL188, see AFCD 2009) and HKLR will be located in between these two areas. Though this alignment would have less magnitude of impacts to CWD than if the alignment were to pass directly through the high dolphin density areas, if the CWD restrict their movements because of the bridge, then this would be a significant impact, as it will affect their foraging efficiency and ability to socialize and find mates. The concern on the present Project would be on whether the space between any two bridge piers (minimal distance of 50m) would constitute a restriction for CWD movement or discourage them to pass through this space. Besides the presence of the bridge piers, it is also needed to consider if the shade of the viaduct (approximately 50m above water surface) on sea surface would affect CWD and make them avoid swimming underneath the bridge structure. However, there is no record that the existence of a bridge structure has any impact on dolphins. Furthermore the 50m pier spacing assumed in the habitat loss assessment is the minimal distance and is a conservative assumption. The actual pier spacing would be increased where possible during the detailed design stage. For a viaduct structure (i.e. elevated trestle bridge form) as HKLR, the optimal span-length (i.e. spacings between columns) is often in the range of 50m to 60m from structural points of view. Nevertheless, a larger span-length (i.e. wider column spacings) up to approximately 75m is structurally feasible, so as to enhance performance as regards ecology and water quality. For this reason, it is recommended that 75m should be adopted as the typical span-length for the portion of HKLR in the waters west of the Airport Island (where larger column spacings will be particularly beneficial not only to ecology and water quality, but also from the point of view of Pearl River Delta water flow). Hence, the typical spans for the portion of HKLR in the western waters will indeed be 75m, even though for conservatism, the assessment on ecology and water quality will show that it will be acceptable even if the spans are 50m.

10.6.5.8 Examples of bridge structures outside Hong Kong also provided evidences on the possible fragmentation impact on dolphins. The Kessock Bridge in Scotland crosses a tidal channel (Kessock Channel) connecting two inlets of the sea (Beauly Firth and Inner Moray Firth). The Inner Moray firth is a core part of the range of one of the resident populations of bottlenose dolphins occurring in UK waters (Wong 2006). Though the tidal channel is just less than 1 km wide with a maximum water depth of approximately 15m, since the opening of the bridge in 1982, the dolphins have continued to move in and out of their feeding area in the Kessock Channel on a daily basis. Groups of dolphins were seen swimming under the bridge within 30m of the concrete bridge supports. Normal activities such as swimming, playing, breaching, and feeding close to the Kessock Bridge are observed and photographed (*ibid*).

10.6.5.9 Xiamen waters lie in the estuarine area of Jiulong River and are inhabited by a population of CWD. The abundance of CWD in Xiamen is about 60 individuals in 2000 (Liu and Huang, 2000). CWD is widely distributed all around Xiamen waters of 700 km^2. They use mostly waters of Xiamen Harbour and Tongan Bay, which are the core areas of Xiamen CWD nature reserve. Haicang Bridge, spanning 6km over, is the second bridge to connect the Mainland and Xiamen Island. Haicang Bridge lies in the middle of the Xiamen Harbour core area of the dolphin nature reserve. During the construction of Haicang Bridge, CWD could pass the bridge as indicated by vessel surveys. During the operation phase, CWD were found to occur in the waters around Haicang Bridge very often (both sides of the bridge) according to the vessel surveys conducted from June 2003 to May 2004 (Liu pers. comm.). Especially, with the removal of mariculture in the inner Xiamen Harbour in 2002, water quality improved in this area, and more and more occurrences were recorded in the inner part to Haicang Bridge (Liu and Luo, 2004). It can be concluded that the construction of Haicang Bridge has no effects on the habitat use by CWD. CWD can pass the bridge and reach the northern (inner) part of the harbour waters.

10.6.5.10 Therefore, bridge structure is not predicted to cause a significant impact on cetacean movements or distribution. The dolphin monitoring programme for the HKBCF and HKLR will also cover the movement ranges of individual CWD, so as to verify the validity of the current assessment.

10.6.5.11 There is also a concern on whether reclamation would block the travel corridor of CWD. The study on individual movement range of CWD revealed that some individuals would utilize a larger size of sea area, which may cover different dolphin hotspots such as Sha Chau, the West Lantau waters, or the Brothers Islands. If large-scale reclamation is built in between these dolphin hotspots, the travel of the individual dolphins which are used to move between these hotspots might be blocked, subject to the sizes of the reclamations and the locations with reference to their travel paths. For the present Project, the alignment of the HKLR and the location of the HKBCF are carefully selected taking into account of our knowledge on CDW ecology. A detailed study to review the dolphin density distribution and individual movement ranges was conducted to support the selection process (Details on the study and option selection see **Section 10.4.3.101-103** and **Section 10.7.1**). The location of HKBCF reclamation is to the east of the airport island in an area not highly utilised by the CWD and away from the waters between the Sha Chau/Lung Kwu Chau area and the area around the Brothers Islands/Sham Shui Kok (i.e. a potential CWD travelling corridor), and this impact would not be significant.

10.6.5.12 The embayment along airport channel, including Tung Chung Bay, Hau Hok Wan and Sha Lo Wan are either confirmed, or considered of high potential, as horseshoe crab nursery sites. As explained in the sections above, all these intertidal sites would not be directly impacted or disturbed by the pier construction. On the other hand, there would be some temporary and permanent subtidal habitat loss on adult horseshoe crabs. As all soft substrate seabed of the vast Hong Kong western waters provides a habitat for adult horseshoe crab, the loss of soft substrate seabed from the Project would only affect a small fraction of their available habitat, and the density of the adult horseshoe crabs is not high as this species is only occasionally collected by trawlers. The impact of the habitat loss for adult horseshoe crabs would be **insignificant**. The temporary occupation of the space in Airport Channel by the pier construction sites, however, might have an additional indirect effect on horseshoe crabs besides habitat loss, as the Airport Channel provides the access for adult horseshoe crabs to those nursery sites to spawn. If the channel is blocked, the horseshoe crab might not be able to utilize the nursery sites.

10.6.5.13 This impact, however, is considered insignificant as the pier sites inside Airport Channel would only occupy a small proportion of the channel scattered along the bridge alignment. The piers inside the Airport Channel would be all located in deeper subtidal zone, and thus would not obstruct the access of adult horseshoe crabs to the intertidal nursery sites along airport Channel, and therefore would not cause fragmentation effects on them. The channel would not be blocked. Construction works would be conducted at these sites in turn rather than at the same time. Furthermore, the eastern opening of the channel would not be affected. Given the relative size of the horseshoe crabs and the space remained available during construction stage, there is no indication that the access of horseshoe crabs to the nursery sites would be impacted.

10.6.6 Operation Phase – Indirect Impacts

Hydrodynamic Regime and Water Quality

10.6.6.1 For HKLR, because the marine viaduct of it will be a raised structure that will only slightly affect water flow, the bridge should not have any significant effect on the hydrodynamic regime of the Pearl River Estuary in general. Erosion and sedimentation might however result from changes of the hydrodynamic regime in North-western Lantau, especially in the Airport Channel. The presence of the bridge piers in Airport Channel might also change the hydrodynamic conditions of the coastal bays and thus affect the erosion and sedimentation patterns of the mudflats and seagrass beds. The 138 ha HKBCF reclamation and 27 ha HKLR reclamation sites might cause some changes on the hydrodynamic regime in its vicinity in response to the physical presence of the reclamations, which were assessed in the water quality assessment. The hydrodynamic regime of the Pearl River Estuary as a whole, however, is not likely to be significantly affected by the Project as the reclamation size is relatively not large when compared with the entire estuary. The existence of the reclamation should not have any significant effect on the hydrodynamic regime of the Pearl River Estuary. The water quality of the area should not be significantly affected once construction is completed.

10.6.6.2 After the HKLR and the two phases of HKBCF finished in 2016, and with the Tung Chung East and West Reclamation in place, will give the worst scenario of the operation phase. For the flow through the Airport Channel. In wet season, the residual, peak flood and ebb flow are shown to reduce by 41.3%, 12.5% and 1.9% respectively, while in dry season, the residual, peak flood and ebb flow increase by 50.2%, 59.3% and 5.6% respectively (see **Section 9.9.2.7** and **Table 9.17)**. Implementation of the projects, therefore, are predicted to result in increased flows in the sea channel in both directions in the dry season and in general, the proposed developments cause more westward flow through the Airport Channel, both of which could improve the flushing of East Tung Chung Bay but with reduced flows in the wet season. The predicted increased tidal flows in the sea channel following construction of the TM-CLKL+HKBCF+HKLR project could have some impact on the stability of the seabed in the sea channel with some erosion of any soft marine deposits present. However, it is considered that any erosion would be relatively small and would take many years to develop.

10.6.6.3 There would be changes in salinity in the Airport Channel. According to **Section 9.9.3.8**, the maximum decrease in salinity of around 10%, or around 3 ppt, occurs at bottom layer of WSR 27 (San Tau Beach SSSI) in wet season. The decrease may be due to a reduction in oceanic flow into the airport channel in wet season. Nevertheless, the change in salinity is still within the WQO criteria of not causing the natural ambient salinity to change by more than 10%. There are several soft shore sites along the Airport Channel which are of moderate to high ecological value. These soft shores are all sandflats/mudflats at estuarine areas of streams/rivers. Under an estuarine environment, the salinity in the water would be affected by both the seawater and the freshwater input from the streams/rivers. When the tide is flooding, seawater will dominate the estuaries and the salinity will increase. However when the tide is ebbing, the freshwater influence will be more prominent and the salinity will drop. The salinity inside estuaries thus fluctuates in a wide range everyday. The range of the fluctuation would also change everyday following the tidal cycle, with the seawater influences more prominent in spring tides and less significant in neap tides. In a review of the water quality in Deep Bay (WWF-HK 2004), which is based upon the water quality monitoring data collected by EPD (EPD 2004), it was found that the salinities in Deep Bay could range between 0.3 to 23.6 ppt. Estuarine organisms are well-adopted to this kind of changes in salinity (i.e. euryhaline, able to adapt for a wide range of salinities). The predicted change of salinity (around 3ppt) would be small when compared with the regular salinity changes.

10.6.6.4 In the Airport Sea Channel (WSR28), it is found that the average speed decreases by about 10% (from about 10 cm/s to 9 cm/s) in the wet season, but increases slightly by about 3% (from about 8.9 cm/s to 9.2 cm/s) (see **Section 9.9.2.3**). At the eastern entrance to the channel, the average speed increases from around 4.8 cm/s to 6 cm/s in dry season and from 6.4 cm/s to 6.7 cm/s in wet season. In general, the induced change incurrent speed around the proposed development is at most up to 10 – 20% or a few cm/s and no extensive stagnant area is observed (see **Section 9.9.2.3**). As mentioned above, the induced changes in the tidal speeds are only up to a few cm/s and, therefore, it is not expected that such changes will cause significant differences in the deposition and erosion of sediments from the case without the new developments.

10.6.6.5 Hydrodynamic and sequential water quality impacts on important habitats such as Artificial reefs in the Marine Exclusion Zone 3 and the Brothers, and recognised sites of conservation importance (i.e. San Tau Beach SSSI, Tai Ho Stream SSSI, Sha Chau and Lung Kwu Chau Marine Park and the proposed marine park at Fan Lau), caused by the reclamation site are also a concern in ecological assessment. Hydrodynamic modelling results indicate that there is no significant change in the velocity vector in the open water. In both the wet and dry season, the peak flood and ebb flow at Artificial reefs in the Marine Exclusion Zone 3 (WSR41) located north of the HKBCF reclamation, were found to reduce by about 2.3% and 1.7% respectively, while the residual flows were reduced by about 4.5% (see **Section 9.9.2.6**). In terms of flow velocities, the average speed north of the Airport Island decreases by 11% (from 43 cm/s to 39 cm/s) in wet season and 3% (from 37 cm/s to 36 cm/s) in dry season (see **Section 9.9.2.3**). It is therefore anticipated that the environment in these areas can be maintained.

10.6.6.6 At the dolphin habitat of the Brothers Islands (WSR49 Tai Mo To) located to the north-east of the HKBCF, major water quality parameters, including salinity, DO, SS, BOD5 and E. coli, all would comply with the WQO. The speed increases by about 3% (from 40 cm/s to 41 cm/s) in the wet season and by 13% (from 32 cm/s 36 cm/s) in the dry season (see **Section 9.9.2.3**). These changes though relatively high in terms of percentage, are still low in terms of the changes of value. San Tau Beach SSSI, as illustrated in above sections, would not affected by water quality impact during operation phase. The remaining recognised sites of conservation importance, as they are more distant to the Project Site than San Tau Beach SSSI, the artificial reefs and the Brothers, they would not be affected by water quality impact neither.

10.6.6.7 Levels of Dissolved oxygen (DO) do not significantly change as a result of the implementation of the project. All results for both the scenarios with and without projects in 2026 show that the DO levels will comply with the DO criteria (depth average >=4 mg/L, bottom level >=2 mg/L). As a result, it can be concluded that the implementation of the project will not significantly affect DO levels and no sensitive receivers, including marine ecological and fisheries, will not be affected by the implementation of the project. The impact of the Project on water quality in these areas would therefore be acceptable. Detailed assessment results are given in **Section 9**.

<u>Erosion and Sedimentation patterns</u>

10.6.6.8 Soft shores on North Lantau – the local erosion and sedimentation patterns in San Tau, in particular the mudflats, during the construction phase is also a concern. The predicted annual sedimentation rate at San Tau Beach SSSI (WSR27) in Scenario 2026 would be 1,607 g/m^2, or 2.14mm. The difference with the “without project” baseline is a reduction of only 18 g/m^2 in each year, or a reduction of 0.02mm each year (see **Section 9.9.3.15**). This is a very minor change, especially for estuarine areas where the sedimentation rate fluctuates throughout the year with the changes in flow volumes of the streams/rivers. In the EM&A programme for the Project, a mudflat monitoring is included and the sedimentation rate will be one of the parameters to be monitored. (see **Section 10.9**).

10.6.6.9 Deep Bay – Regarding the local erosion and sedimentation patterns in Deep Bay during the construction phase, in particular the mudflats, it is unlikely to be affected given the distance from the Project Sites.

Water Quality (Surface Runoff from Bridge and Reclamation)

10.6.6.10 As stated in **Section 9.11.2**, no significant impacts are predicted for the operational stage. Notwithstanding, as a precautionary measures roadside gullies to trap silt and grit prior to discharging the stormwater into the marine environment. The sumps will be maintained and cleaned at regular intervals. The impact is ranked as **insignificant**.

Operation Disturbance

Noise

10.6.6.11 No negative impacts on the CWD and porpoises from the human activities (e.g. land traffic flows) are foreseen during the operation of the HKLR and HKBCF as they are mainly land-based activities.

10.6.6.12 For the HKLR, it is possible that the noise from traffic flows will be transmitted from the bridge to the waters. If this noise is of significant level, it might constitute a noise impact. The transmission of noise would be subject to various factors, including the types of vehicles, the types of the tyres, and the materials and forms of the bridge road surfaces, etc.

10.6.6.13 Noise will be generated during the operation stage (e.g., traffic, operation of machines). It is anticipated that noise from the proposed project will only affect adjacent areas. The HKBCF will be away from any terrestrial natural habitat. Only a small proportion of the HKLR would be close to natural habitats in the headlands on the west and east of Sha Lo Wan and the woodland habitats at Scenic Hill. As the bridge would only span over or get close to these headlands and the bridge deck may screen out some of the traffic noise, noise level to terrestrial fauna beneath the bridge deck is predicted to be low. Hence the impact to terrestrial fauna due to traffic noise is considered **insignificant**. The section encroaching Scenic Hill is a tunnel, hence impact from operation phase noise to terrestrial fauna of adjacent habitats is predicted to be **insignificant**. It is also anticipated that noise from the proposed project will not impose significant impact to terrestrial fauna on habitats on North Lantau (e.g., those inhabiting tall shrubland in Sha Lo Wan), due to the higher elevation of the viaduct, or on other natural habitats in North Lantau (such as Fung Shui Woods in Sha Lo Wan and San Tau), due to the long distance (approximately 700 m) between these habitats and the Project Area. The impact to terrestrial fauna, including all the fauna of conservation concern listed in **Table 10-7**, from this source is considered **insignificant**.

Light pollution

10.6.6.14 Observations from other parts of the world showed that birds may be confused by lighting during bad weather (e.g., mist, rain) (e.g. Merriam 1885, Culver 1915, Brooks 1951, Bagg 1965) and killed by collisions with man-made structures (e.g., windows, towers) (e.g., Brewster 1886, Carpenter and Lovell 1963, Peterson 1963, Savage 1965, Swales 1965). But bridges were not among the structures causing bird kills. A precautionary approach on lighting was taken for the Shenzhen Western Corridor because part of the bridge was cable-stayed and the bridge site was near Inner Deep Bay, a site of high bird abundance (ARUP 2002). The HKLR and HKBCF differ from Shenzhen Western Corridor in having no cable-stayed section and being located distant from any location with high bird abundance. A lighting design similar to other local or overseas bridges would not cause increased bird mortality due to collision with the bridge.

10.6.6.15 Other nocturnal animals (such as Brown Fish Owl in Tai Ho) are recorded far away from both the HKLR and HKBCF, and would not be affected by lighting of the Project.

Shading Effect

10.6.6.16 The HKLR viaduct will span over the Sha Lo Wan headland. The headland at Sha Lo Wan is young woodland habitat and of low-moderate ecological value. The intertidal and subtidal zones at the shores of the headland did not harbour light-sensitive habitats such as stony coral communities or seagrass beds. The

EIA study for Shenzhen Western Corridor demonstrated that shading by a bridge on mudflat (which is of higher ecological value than the young woodland) would not cause adverse impact on wildlife utilize the habitats beneath the bridge deck.

10.6.6.17 A computer model was run to demonstrate graphically the location of the bridge shadow on the mudflat at hourly intervals during an entire day in January, April, July, and September. The objective was to determine whether any portion of the beneath habitats (i.e. mudflat and seabed in Shenzhen Western Corridor EIA study) would be shaded during all hours of the day. This would not occur because the Shenzhen Western Corridor is on a southeast-northwest bearing. The sun rises on the east side of the bridge and sets on the west side, thereby lighting both sides of the bridge at different times of the day.

10.6.6.18 The model outputs demonstrated that the SWC bridge shadow would affect areas directly beneath the bridge for periods ranging from 4 to 5 hours per day, but no area beneath the bridge would be shaded at all times during any day in any season of the year. In our case, the HKLR alignment is on a southwest–northeast bearing. Though diagonal with the bearing of SWC, the HKLR is still have a certain angle with the east-west direction and the sun would rise on the east side of the bridge and sets on the west side, thereby lighting both sides of the bridge at different times of the day. Furthermore, because of the height of the bridge deck above the headland, either direct or indirect light would reach all portions of the headland during all hours of every day. Because the only light-sensitive organisms beneath the bridge are young woodland vegetation, and because no area beneath the bridge would be shaded at all times, we conclude that potential shading impacts are not a conservation concern for this project.

Physical Barrier

10.6.6.19 The Project Area is neither located near any known localities of high bird abundance, nor on the daily flight pathway of large number of birds. Birds fly at altitudes of around 3,700 m over Hong Kong during migration (Melville 1980), and the buildings in the Project Area will not become physical barriers of migrating birds.

10.6.6.20 The Project Area will be similar to the Kwai Tsing Container Terminal during operation phase. The No. 4 Container Terminal started to operate in mid 1970's, and more container terminals (No. 6, 7, 8) were built between Tsing Yi Island and Stonecutters Island in 1980's and 1990's.

10.6.6.21 Stonecutters Island (now a peninsula) is located near the Kwai Tsing Container Terminals. A big winter roost of Black Kite in Hong Kong is located at Stonecutters Peninsula (Carey et al. 2001). This roost has been used at least since 1930 (Hutson 1930). There were more than 700 Black Kites roosting on Stonecutters in winter 2004-05 (HKBWS, unpublished data). Nesting of Black Kites was also recorded on Stonecutters (Carey et al. 2001). There is no evidence that use of Stonecutters as roosting or nesting site is hampered by the presence of the Container Terminals.

10.6.6.22 The existence of a Black Kite winter roost on Stonecutters showed that the operation of the proposed project will not introduce physical barriers to flying birds, and will not affect habitat use by birds in nearby areas. Actually, the high rising structures in the Project Area are visible and can be avoided by flying birds, as in the study of behaviour of birds flying past bridges in Hong Kong and Macau (Arup 2002). Birds either ascend or descend, and fly above or below bridges. The potential impact on birds from this source is considered **Insignificant**.

10.6.6.23 The viaduct of HKLR, similar with HKBCF, is neither located near any known localities of high bird abundance, nor on the daily flight pathway of large number of birds. The deck of the viaduct will be about 50m from surface. Shenzhen Western Corridor EIA study has demonstrated that birds could either fly over or fly beneath bridge deck.

10.6.6.24 There would be some temporary and permanent subtidal habitat loss on adult horseshoe crabs. The temporary occupation of the space in Airport Channel by the pier construction sites, however, might have an additional indirect effect on horseshoe crabs besides habitat loss, as the Airport Channel provides the access for adult horseshoe crabs to those nursery sites to spawn. If the channel is blocked, the horseshoe crab might not be able to utilize the nursery sites. The pile caps for the piers inside Airport Channel would be beneath the seabed. Only the pile would occupy the seabed. As the sizes of the piles are limited (2m diameter each), the access for horseshoe crab should not be affected.

Air Pollution

10.6.6.25 Air quality during the operation was also assessed in this EIA study. The assessment results indicated that the air quality in all Air Quality Sensitive Receivers in Sha Lo Wan on North Lantau will meet the assessment criteria. The nearest one i.e. A93 is located at the headland between Sha Lo Wan and Hau Hok Wan, and is less than 100m from the HKLR alignment. As these nearer Air Quality Sensitive Receivers would not be impacted, the ecological sites such as Sha Lo Wan fung shui wood and San Tau fung shui wood (considered as important for butterflies) and fauna such as birds inhabiting the natural habitats on North Lantau and butterflies which were recorded in abundance between Sha Lo Wan and San Tau would not be impacted neither.

Chemical Spillage

10.6.6.26 There is a possibility of a traffic accident on the bridge involving a vehicle carrying hazardous chemicals, if vehicles with dangerous goods are allowed to enter the future HZMB, which would then be spilled into the water. This could affect dolphin habitats, in spite of the dilution of spilled chemicals by the marine waters. The potential for impacts from such an event would be related to the toxicity of the chemicals involved. Dolphins can detect and avoid oil under some circumstances (see Smith *et al*. 1983). They do not necessarily avoid oiled areas, however (see Smultea and Würsig 1995). Cetacean skin is vulnerable to damage from oil, and contact can cause skin injury. While ingestion of petroleum products is not generally a problem for dolphins, inhalation of concentrated petroleum vapours can prove fatal. At lower concentrations, inhalation can cause inflammation, hemmorhage, or lung congestion, and in some cases even hallucination, convulsion, and death (Geraci & St. Aubin 1987; Geraci 1990). Large-scale spills of petroleum products can have affect dolphins and small whales. This impact is however sporadic in occurrence, and therefore ranked as minor. But mitigation is recommended under precautionary approach. A contingency plan to deal with such accidents will be formulated by the future management company and agreed by relevant government departments and authorities.

Marine Traffic

10.6.6.27 No negative impacts on the CWD from the marine traffic flows are foreseen during the operation of the bridge. And some positive effects are anticipated, which are detailed in **Section 10.7**.

Cumulative Impacts from Operation –Phase impacts

10.6.6.28 In accordance with Section 4.3.3 (b) of EIA-TM, the assessment should examine the cumulative environmental effects if there may be interactions between the environmental impacts of the projects which might affect the sum total of its environmental impacts. In the present project, no interactions between the operation phase impacts, which would affect the sum total of all ecological impacts, are identified.

10.6.6.29 Operation phase impacts are summarised in **Table 10-11** below.

Table 10-11 Operation Stage Impacts

Activity	Source			Receiver	Nature of Impacts						Severity	Mitigation Required
	HKLR marine section	HKLR land and reclamation section	HKBCF		Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Permanent habitat loss	NA	Viaduct; tunnel portal	NA	Terrestrial habitat: developed area and grassland/shrubland	Low for developed area and grassland/ shrubland	Common flora and fauna	1ha of grassland/ shrubland; 1ha of developed area	Permanent	Irreversible	Low	Minor for grassland/ shrubland; insignificant for developed area	No
	NA	Viaduct; Reclamation	Reclamation; APM	Intertidal habitat	Low	Common species of intertidal fauna	950m of artificial seawalls; 1,500m of remnant rocky shore with patchy sandy beaches	Permanent	Irreversible	Moderate	Minor for remnant rocky shore with patchy sandy beaches; insignificant for artificial seawalls	No, but new hard shore will be provided by seawalls.
	Pier sites;	Reclamation	Reclamation	Seabed (Hard substrate and soft substrate)	Low for benthos; low to moderate for corals	Common infauna species; common gorgonian corals and ahermatypic corals	2,250m for hard substrate seabed, 168 ha for soft substrate seabed	Permanent	Irreversible	Moderate for HKLR; high for HKBCF	Minor	No, but new hard substrate seabed will be provided by seawalls; also a package of enhancement plan; additional artificial reefs.
	Pier sites;	Reclamation	Reclamation	Marine waters	For CWD, ranging from moderate to high in open sea to low in airport channel	Chinese White Dolphin	168 ha	Permanent	Irreversible	Moderate for HKLR; high for HKBCF	Minor for HKLR; Moderate for HKBCF	Setting up a marine park.
Terrestrial and intertidal fragmentation	Viaduct	NA	NA	Mobile terrestrial fauna and fauna utilized intertidal zone	Low	Terrestrial and intertidal species	Low	Long term	Irreversible	Insignificant	Insignificant	No
Marine fragmentation/ blockage of travel corridor	Viaduct	NA	Reclamation	Marine organism	Low to High	Chinese White Dolphin	Low to High	Long term	Irreversible	Insignificant	Insignificant	No But the dolphin monitoring programme will cover the individual movement range which could verify the assessment.

Activity	Source			Receiver	Nature of Impacts						Severity	Mitigation Required
	HKLR marine section	HKLR land and reclamation section	HKBCF		Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Change of hydrodynamic regime and water quality	Piers	Reclamation	Reclamation	North Lantau waters	Low to High	Chinese White Dolphin	For dolphin, low in the waters to the east of Airport, but high in West Lantau waters	Permanent	Irreversible	Insignificant	Insignificant	No
				Intertidal soft shore habitats	Moderate for mangroves; High for mudflat	Horseshoe crab Seagrass Estuarine species	Small for mangroves; extensive for mudflat Both horseshoe crab and seagrass are NOT abundant in Tai Ho Wan.	Permanent	Irreversible	Insignificant	Insignificant	No
				Sha Chau and Lung Kwu Chau Marine Park	High	Chinese White Dolphin; coral communities	1,200 ha	Permanent	Irreversible	Insignificant	Insignificant	No.
				San Tau Beach SSSI	High	Estuarine species, including horseshoe crab juveniles, seagrasses, and mangroves	2.7 ha	Permanent	Irreversible	Insignificant	Insignificant	No.
				Tai Ho Stream SSSI	High	Estuarine species, including horseshoe crab juveniles, seagrasses, and mangroves	5 ha	Permanent	Irreversible	Insignificant	Insignificant	No.
				Proposed Marine Park at Fan Lau	High	Chinese White Dolphin	N/A	Permanent	Irreversible	Insignificant	Insignificant	No.
Surface runoff	Road surface	Reclamation	Reclamation	North Lantau waters	Low to High	Chinese White Dolphin, marine organisms	For dolphin, low in the vicinity of HKBCF, but high in HKLR open sea part	Transitory	Irreversible	Low	Insignificant	No. Silt-grease traps in bridge and HKBCF

Activity	Source			Receiver	Nature of Impacts						Severity	Mitigation Required
	HKLR marine section	HKLR land and reclamation section	HKBCF		Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Terrestrial Noise	Terrestrial traffic	Terrestrial traffic	Terrestrial traffic	Nearby terrestrial fauna	Mainly affect areas adjacent to Project Area, which are of low quality	Mainly disturbance tolerant species	Low	Permanent	Reversible	Low	Insignificant	No
Light Pollution	Lightings at night	Lightings at night	Lightings at night	Nocturnal birds	Mainly affect areas adjacent to Project Area, which are of low quality	Mainly disturbance tolerant species	Low	Permanent	Reversible	Low	Insignificant	No
Shading effect	Bridge deck	NA	NA	Young woodland in Sha Lo Wan headland	Low to moderate	Common vegetation species	Small	Permanent	Irreversible	Low	Insignificant	No
Physical Barrier	Bridge deck	The reclamation area itself	High rising structures in the Project Area The reclamation area itself	Flying birds Horseshoe crabs	NA	All bird species occur near the Project Area Horseshoe crabs	Low	Permanent	Irreversible	Low	Insignificant	No
Air pollution	Vehicles	Vehicles	Vehicles	Natural habitats	Low to High	Inhabiting fauna, such as birds and butterflies	Low to High	Permanent	Reversible	Small	Insignificant	No
Chemical Spillage	Dangerous goods	Dangerous goods	Dangerous goods	North Lantau waters	Low to High	Chinese White Dolphin, marine organisms	For dolphin, low in the vicinity of HKBCF, but high in HKLR open sea part	Transitory	Reversible	Small	Insignificant	Spillage response plan Silt-grease traps in bridge and HKBCF

NA = not applicable

10.6.7 Overall Cumulative Impacts with other developments

10.6.7.1 As stipulated in Section 4.3.3 of EIAO-TM, the assessment and evaluation of cumulative environmental effects are applied in three circumstances:

- the impacts arising from the project are predicted to extend beyond the boundaries of the project or over a long period of time;
- there may be interactions between the environmental impacts of the project, affecting the sum total of its environmental impacts; or
- there may be interactions between the environmental impacts of the project and those of other developments, and this could result in accumulation of impacts, which would affect the total effect.

10.6.7.2 The potential interactions between the construction and operational phase impacts of the HKLR and HKBCF were examined in previous sections. This section examines whether there might be interactions between the environmental impacts of the Project and those of other developments whose construction or operation phases would overlap with the HKLR and HKBCF, thereby resulting in cumulative impacts whose effects would exceed in severity those of the various projects taken individually. **Sections 1.7** and **1.8** have listed out all the concurrent projects during the construction and the operation phases of HKLR and HKBCF respectively, and provided descriptions of these projects. Nearby projects that would have potential cumulative marine ecological impacts during the construction and the operation phases of HKLR and HKBCF are summarised in **Table 10-12** below.

Table 10-12 Concurrent Projects with Implications on Marine Ecology

Proposed Development	Nature of the projects	Impacts to be Considered		Marine habitat loss	Schedule
		Construction	Operation		
Tonggu Channel	in the southeast region of the Pearl River Estuary, connecting the Urmston Road to the north and the Lantau Channel to the south		✓ (annual maintenance dredging)	The alignment of the channel is outside Hong Kong. The construction phase of this project has been completed (Re 1.7.6.2) though there might be some water quality impacts arising from maintenance dredging (Re 1.8.1 and Table 1-2)	
Kwai Tsing Container Basin Dredging	involves the deepening of the existing seabed to facilitate safe navigation of new generation of ultra large containerships to KCTC	✓	✓	No, but an area of about 415 ha will be dredged.	commence construction in 2010 and for completion in 2013.
New Contaminated Mud Disposal Facilities at South of Brothers / East of Sha Chau	to accommodate contaminated sediment	✓		No, but about 270 ha of seabed will be dredged.	Though the timing of the new pits at South of Brothers is not yet decided, to plan for the worst scenario on water quality impact assessment, it would be

Proposed Development	Nature of the projects	Impacts to be Considered		Marine habitat loss	Schedule
		Construction	Operation		
					considered as concurrent with the construction of the HKLR and HKBCF
Existing Mud Disposal Facilities at North of Brothers and East of Sha Chau (Existing East Sha Chau Confined Marine Sediment Disposal Area)	the existing mud disposal facilities at East Sha Chau are currently in use	✓	✓	No, but about 101 ha of seabed will be dredged.	Existing facilities
Existing Mud Disposal Facilities at North of Brothers and East of Sha Chau (Suspended North Brothers Open Sea Sediment Disposal Area to be re-opened).	the North Brothers' is scheduled to be re-opened (date not yet confirmed)		✓	No, but about 290 ha of seabed will be dredged.	Existing suspended facilities
Proposed Lantau Logistics Park (LLP)	at Siu Ho Wan	✓	✓	72 ha	2010-2012
Possible LLP Extension	possible Logistics Park extension or other compatible uses		✓	40 ha	no confirmed implementation programme
Future Tung Chung East and West Development	New Town Extension and the Possible Theme Park Recreational Uses		✓	110 ha and 50 ha	commence by either end 2015 or early 2016 and the construction would be completed beyond 2017
Tuen Mun-Chek Lap Kok Link	a dual-two-lane carriageway about 9km long connecting Tuen Mun Western Bypass in the north and with the proposed HKBCF and North Lantau in the south.	✓	✓	About 47 ha	Commence in 2010, for completion in 2016

Proposed Development	Nature of the projects	Impacts to be Considered		Marine habitat loss	Schedule
		Construction	Operation		
Road P1, Sham Shui Kok to Sunny Bay	one of the possible road projects in the Revised Concept Plan for Lantau	✓	✓	About 9.5 ha	Completed by 2026
Hong Kong Zhuhai Macao Main Bridge (HZMB)	constructed concurrently with the HKLR and HKBCF	✓	✓	Beyond the HKSAR boundary, the HZMB Main Section would also cause marine habitat loss, in particular 80 ha for two artificial islands near HKSAR boundary and less than 10 ha for the marine piers (about 356 piers, and assuming those piers are of similar sizes as Hong Kong piers, i.e. 200 m^2). Other major marine habitat losses include the Zhuhai BCF and the Macao BCF, which would be located close to the western shore of Pearl River Estuary where the dolphin sightings are much less frequent. According to the EIA Report of the HZMB (Mainland Section), the marine habitat loss is considered insignificant (approx. 0.4% loss of habitat) in compare with the Mainland waters in the Pearl River Delta. Outside Hong Kong	Commence in 2010, for completion in 2014

Water Quality

10.6.7.3 These concurrent projects all involve dredging and/or filling works, and would have the potential to produce cumulative construction phase water quality impact if their constructions are conducted at the same time. Water quality parameters such as suspended solid level in ecological sensitive receivers, e.g. dolphin hotspots might be deteriorated.

10.6.7.4 Besides the temporary water quality impact during the construction, these projects might have implications on the hydrological regime in the North Lantau area if they involve large-scale reclamations. This might in turn produce cumulative operation phase water quality impact on ecological sensitive receivers, e.g. San Tau Beach SSSI.

10.6.7.5 The above nearby concurrent projects, are included in the water quality modelling and assessed for potential cumulative impacts, both construction and operation phases, with the present project in the water quality assessment. The results indicate that the water quality parameters, in particular the increased concentrations of suspended solids caused by the dredging and filling operation would be within the statutory requirements of 30% with the recommended mitigation measures in place. This includes the contributions of other concurrent projects that would have a bearing on the water quality during the construction phase of HKBCF and HKLR, including but not limited to future Tung Chung East and West Development, LLP, the contaminated mud pits, etc. Details of the water quality assessment results and the compliance with WQO are presented in **Section 9**.

10.6.7.6 The sediment plumes from the TMCLKL+HKBCF+HKLR are generally confined to within the sheltered East Tung Chung Bay and do not merge with sediment plumes from the other concurrent projects. The plumes could, however, under certain tidal conditions, slightly mix with the plumes from the (unmitigated) LLP.

The predicted cumulative maximum SS elevation, however, is still low although it will infrequently exceed the WQO. It is expected that the LLP will have extensive mitigation measures in place to avoid cumulative impacts with other projects and, thus, it is not expected that the plume would merge during actual construction.

Chinese White Dolphin

A) Marine Noise

10.6.7.7 If those concurrent projects involve noisy construction methods such as percussive piling to be conducted at different areas in North Lantau, there might be cumulative construction phase acoustic disturbance to CWD, i.e. disturbance of various projects affecting different parts of the dolphin range at the same time. But the majority of the concurrent projects are either dredging projects such as mud pits, or reclamation projects such as LLP. Both types of projects would mainly apply dredging and filling works. Piling works will be required in bridge construction and are needed in TM-CLKL and HZMB Main Section, and the potential of produce noise impact is higher in piling works. But like the present Project, only bored piling method, which is much less noisy than the percussive piling, will be applied in these two projects.

10.6.7.8 The potential of cumulative marine noise impacts from simultaneously bored piling works would be low as noise impacts are localised and transient in nature, unless the sources lie adjacent to each other. Marine bored piling will also be applied in the HZMB Main Bridge, and the construction period would overlap with that of HKLR. As the HKLR will connect to the artificial island beyond the HKSAR boundary, and the two artificial islands for the tunnel underneath Tonggu Waterway is 6.7km apart, there is sufficient separation between the bored piling activities for the two projects. The bored piling works in Mainland waters would be conducted far away from HKSAR boundary. Similarly, the bored piling works for TMCLKL will be conducted in the waters between Tuen Mun and Northeast Airport, and no marine piling works for HKLR will be conducted to the east of Airport (the bored piling works for HKLR will be conducted in Airport Channel and to the west of Airport). The bored piling works for TMCLKL would be conducted far away from HKLR. Furthermore, similar mitigation measures for marine noise impact, including decoupling of noisy equipment on vessels and establishment of dolphin exclusion zone, will be applied in TMCLKL. The potential of cumulative noise impact would be limited.

B) Disturbance/Collision from Marine Traffic

10.6.7.9 The potential of a cumulative marine traffic disturbance or collision risk due to the work-related vessel traffic flow during construction phase is also considered. The potential of an escalation in collision risk would be low as the working vessels in other projects, like in the present Project, would be mainly large-sized and slower vessels (It is considered that the high-speed outboard engine boats pose higher risk on collision). The cumulative marine traffic disturbance is possible if the locations of concurrent projects are close with each other. However, it is anticipated that similar measures on mitigating marine traffic disturbance on CWD, such as speed limits and regular routes, will be applied in other Projects including TMCLKL. The magnitude of any cumulative marine traffic disturbance impact would be low.

C) Blockage of Dolphin Traveling Corridors

10.6.7.10 There is also a concern on the possible blockage of dolphin travelling corridors by construction and operation of concurrent projects. The potential of this impact would be higher in reclamation sites in which sea areas will be replaced by reclamation lands and not available for CWD to pass through, but would be much lower in bridge construction projects in which only the pier sites would be contained and the remaining sea areas are still available for travelling to both vessels and marine life, and would not even exist in tunnel construction project using Tunnel Boring Machine (i.e. TMCLKL) or mud pit projects involving no marine structure. Among the concurrent projects listed in **Table 10-12** above, the reclamation projects are all adjacent to existing shores/landmass (e.g. LLP and Future Tung Chung development), rather than in the sea areas in between dolphin hotspots. Currently the Sha Chau, the West Lantau waters, and the Brothers Islands are known dolphin hotspots in Northwest Hong Kong waters. Sea areas in between these hotspots might be the travel corridors of CWD if they need to travel from one hotspot to others. But these reclamations are not located in between any dolphin hotspots.

D) CWD Habitat Loss

10.6.7.11 Besides the cumulative water quality impacts, there would be cumulative marine habitat loss from some of these projects. The marine habitat loss from the present Project is estimated to be about 168 ha, including the 3ha for HKLR marine bridge piers, 27 ha of HKLR reclamation and 138 ha of HKBCF reclamation. The mud pit projects would not cause permanent marine habitat loss. Marine habitat loss due to TMCLKL is estimated to be about 47 ha (with 21 ha at the northern reclamation in Tuen Mun shore; 25.4 ha adjacent to HKBCF; and about 0.2 ha for viaduct). Other marine habitat loss (272 ha) includes the two development phases of LLP (112 ha), and the Future Tung Chung East and West Development (110 ha from the east development and 50 ha from the west development). The total marine habitat loss from other concurrent projects would count up to about 319 ha (47 ha from TMCLKL + 272 ha from others)a. If it is assumed that all of these projects with reclamation occurring in North Lantau will actually proceed to construction, a cumulative marine habitat loss from these projects is possible as these projects are all located in the Western Hong Kong waters. The different concurrent projects' contribution towards the issue of permanent loss of dolphin habitat however would not be the same. Quite a significant portion of the loss is not in key dolphin habitats, such as the future Tung Chung East and West Development which is adjacent to the existing Tung Chung town. For the coastal waters, there are very limited dolphin sightings on Tung Chung coastlines except the waters around Sham Shui Kok (see **Section 10.4.3.102** above). Similarly, the LLP extension is also located in coastal waters near Tung Chung town and limitedly used by CWD. Therefore the area size of the cumulative loss of habitats regularly used by CWD would be much smaller than 319 ha.

10.6.7.12 Beyond the HKSAR boundary, the HZMB Main Section would also cause marine habitat loss, in particular 80 ha for two artificial islands near HKSAR boundary and less than 10 ha for the marine piers (about 356 piers, and assuming those piers are of similar sizes as Hong Kong piers, i.e. 200 m^2). Other major marine habitat losses include the Zhuhai BCF and the Macao BCF, which would be located close to the western shore of Pearl River Estuary where the dolphin sightings are much less frequent.

10.6.7.13 Having so many projects being constructed in parallel in the same area is unusual in Hong Kong. Given that the affected area is part of the dolphin habitat, efforts to lessen the cumulative impacts will be required.

10.6.7.14 The HKBCF reclamation is the main contributor towards the cumulative permanent loss of CWD habitat (Different from the future Tung Chung East and West Development or the LLP extension which are located in areas not used by dolphin, HKBCF is a large reclamation within dolphin habitats, and thus would contribute to the impact in terms of both significance of impacts and area size.). If the HKBCF habitat loss to CWD could be effectively mitigated, the severity of cumulative loss of CWD habitat would also be significantly reduced. The measure of setting up a marine protected area is proposed to mitigate the marine habitat loss from HKBCF reclamation (see **Section 10.7.4** below) and is considered an effective measure. As such, the cumulative CWD habitat loss would not require other specific mitigation measure.

Corals

10.6.7.15 Some of the concurrent projects would impact, or have the potential to impact, gorgonians and ahermatypic corals, such as TMCLKL in which gorgonians and ahermatypic corals at Pillar Point would be directly impacted.. However, a similar pre-construction dive survey will be conducted for TMCLKL, and translocation of corals will be proposed if colonies suitable for translocation are identified. These projects will also provide some new habitat in the form of new seawalls around the reclamations which should help compensate for the loss, together with a newly deployed artificial reef and, as such, the cumulative impacts are not expected to be significant, and specific mitigation measure is not required

Benthic Communities

10.6.7.16 All the concurrent projects are located in the same sampling stratum (i.e. the Western waters stratum covering Urmston Road, Deep Bay and North Lantau waters) in the territory-wide benthic survey commissioned by AFCD (CCPC 2002). Benthic species of conservation concern such as the amphioxus *Branchiostoma belcheri* was not recorded in any sampling locations within the Western waters stratum. Though the diversity and abundance might vary, no location of special conservation importance in terms of the benthic communities was reported in this area. As such, the cumulative impacts on benthic communities are not expected to be significant, and specific mitigation measure is not required.

10.7 Mitigation of Adverse Impacts

10.7.1 Design Phase Considerations

10.7.1.1 The following paragraphs identify feasible and practicable mitigation measures to reduce the severity of any negative impacts identified in the previous sections.

10.7.1.2 Following the "Avoid, Minimize and Compensate" approach of dealing with impacts as stipulated in EIAO-TM, the feasibility to avoid impacts was first examined. Where impacts are anticipated, efforts were made to minimise the impacts such as by refining the bridge design or alignment. Mitigation measures were then provided to address the potential impacts.

10.7.1.3 The following sections describe the considerations taken into account during the design process.

HZMB Landing Area at HKSAR

10.7.1.4 The PER (Scott Wilson 2002) compared the advantages and disadvantages of a series of proposed alignments with bridge landing points at three different areas, i.e.

- Area A - North Lantau;
- Area B - Black Point; and
- Area C - South Lantau.

10.7.1.5 The PER verified that the environmentally optimal landing point of the bridge would be at North Lantau. In terms of cetacean conservation, having the landing point at North Lantau could avoid the encroachment of the bridge alignment onto the two highest density Chinese White Dolphin areas, i.e. Lung Kwu Chau and West Lantau (between Tai O to Fan Lau Kok) (**Figure 10.8**).

10.7.1.6 The sea near Sha Chau and Lung Kwu Chau Marine Park is an area of high density of dolphin sightings throughout the year. With the landing point at North Lantau, the proposed alignment is located away from this prime area with high density dolphin sightings.

10.7.1.7 The West Lantau area (between Tai O to Fan Lau Kok) has been found recently to be a very high density area for Chinese White Dolphin (Jefferson 2003). The bridge alignment would not intrude into this area with the landing point at North Lantau.

10.7.1.8 The HKLR landing point at North Lantau is consistent with the strategic planning framework for Hong Kong and Lantau because it is sited in proximity to the Hong Kong International Airport, the North Lantau Highway, MTR Tung Chung Line and the Penny's Bay international theme park. Additional transport routes including Route 10 (TMCLKL) are also being planned to improve connections to Lantau Island.

HKLR Connection Point Location

10.7.1.9 The connection point between the HZMB Main Section and HKLR would be on the western HKSAR boundary. The current connection point lies on the HKSAR boundary about 4 km west of Sham Wat and 2.5 km north of Tai O pier.

10.7.1.10 The proposed location maintains acceptable distances to several sites of conservation importance. It is approximately 6km from Sha Chau and Lung Kwu Chau Marine Park which also contains artificial reefs, and 5km from the proposed marine park at Fan Lau.

10.7.1.11 The water around Sha Chau and Lung Kwu Chau Marine Park is the area with often dolphin sightings throughout the year. The proposed location is southwest of the marine park and remains distant from this prime area of dolphin sightings. The proposed location is also to the north, though less distant, of another prime area of dolphin sightings at the West Lantau waters.

10.7.1.12 If the connection point shifted either northward or southward along the HKSAR boundary, the bridge alignment would shift closer to Sha Chau and Lung Kwu Chau Marine Park or the proposed marine park at Fan Lau. If this were the case, the magnitude of impacts on CWD, such as underwater noise and marine traffic during construction, would be potentially higher.

10.7.1.13 The current proposed location is considered to be appropriate in terms of ecology because it minimises negative impacts to an extent unachievable under the alternative alignments.

HKLR Alignments Selection

10.7.1.14 With the proposed connection point, three options of the HKLR alignment were proposed for selection. All three options would go through the waters to the west of Airport. The option with the tunnel going through North Lantau would cause large scale impacts on natural habitat and is thus abandoned, while the option going alongside the northern edge of Airport Island requires additional reclamation is also undesirable. The option going through Airport Channel is considered the preferred option.

HKBCF Options Selection

10.7.1.15 With refer to Section 3, a number of site options were long-listed in the Site Selection Study for HKBCF. As the Site Selection Study and the Investigation Consultancy proceeded, relevant factors and assessment results were revealed which rendered most of the site options not feasible (see **Section 3** for details). For a finer level ecological assessment, two options were further discussed in the sections below, namely Option WCLK (locating the HKBCF in the waters to the west of airport) and Option NECLK (locating the HKBCF in the water adjacent to the north-eastern side of the Airport Island),

A) Option WCLK

10.7.1.16 The proximity between WCLK and the West Lantau waters however is a concern. The waters around West Lantau have the highest dolphin encounter rate recorded in Hong Kong. Moreover, it is also an important nursery ground for the CWD. The most frequent sightings of calves and juveniles in Hong Kong have been recorded in these waters (i.e. the area is important for nursing young CWD), and its importance to dolphin nursery is recognized and incomparable. An artificial island constructed in this location will seriously affect the marine ecology.

10.7.1.17 According to the results from the regular AFCD dolphin monitoring surveys, Chinese White Dolphin frequently uses the whole stretch of the West Lantau waters between Fan Lau to Sham Wat, and some of the sightings of juvenile CWD were even beyond Sham Wat. This finding has been further supported by an additional AFCD land-based dolphin survey in 2004-2005 on the shore between Tai O to Sham Wat, specifically for facilitating the assessment of HZMB on CWD in west Lantau (AFCD 2005). It is thus important to safeguard these waters for dolphin conservation. The risk of having large scale reclamation near this dolphin nursery ground would be unacceptable from conservation view point.

10.7.1.18 To locate the HKBCF in WCLK option would reduce the sea area (and also dolphin habitat) in the Western waters, and also pose a higher risk from construction works (mainly water quality risk from accidental incidents) on the natural coastlines and the important area for nursing young CWD as it lacks of any landmass in between as a shelter.

B) Option NECLK

10.7.1.19 For Option to locate the HKBCF to the east of Airport Island, the majority of the nearby coastlines (including the Airport and at and westward to Tung Chung town e.g. the North Lantau Highway) have been converted to artificial shores and are of lower ecological value. The landmass of the Airport could also shelter the western waters from any accidental water quality incident from HKBCF construction, and thus better protect the dolphin nursery ground in West Lantau waters. It was found that during the 2,857 dolphin groups (or 11,189 dolphin individuals) sighted during the 2002-08, only a few dolphin sightings overlapped with the NECLK option while more sightings overlapped with the WCLK option.

10.7.1.20 The importance of the Brothers Islands for dolphin is well aware as stated in recent AFCD dolphin monitoring reports (one of the dolphin hotspots in Hong Kong). Nevertheless, there is a buffer distance of about 750m between the proposed HKBCF and the Brother Islands and stringent environmental mitigation measures will be provided during reclamation.

10.7.1.21 It is important that the West Lantau waters to be maintained in a high level of ecological intactness to ensure sustainability of Chinese White Dolphin. NECLK option (HKBCF on eastern side) is considered a better option after considering all the pros and cons of the various options, including those on dolphin conservation. The current location of NECLK has achieved a balance between conservation considerations and the potential influences to Tung Chung as it has maximized the distance to Tung Chung shore.

Minimize Reclamation Size

10.7.1.22 As discussed in Section 3.7.13 to 3.7.16, the HKBCF needs to provide the necessary facilities for the clearance of vehicles and passengers using HZMB, together with other supporting facilities. Various sub-options have been considered to minimize the reclamation size while not jeopardizing the operation of HKBCF, including (a) Co-locating clearance plazas of cars and goods vehicles; (b) Adopting 2-level design for clearance plaza; and (c) Adopting 2-row arrangement for clearance kiosks. However, substantial problems are envisaged in the sub-option (b) in view of the hazard, air ventilation and traffic operation. This idea of co-locating the cars and GVs facilities and adoption 2 row arrangement for clearance kiosk are thus adopted and taken into account in the finalization of the layout for HKBCF.

Pier Spacing

10.7.1.23 For a viaduct structure (i.e. elevated trestle bridge form) as HKLR, the optimal span-length (i.e. spacings between columns) is often in the range of 50m to 60m from structural points of view. This is also the reason for assuming such a column spacing in Chapter 9 (Water Quality) and in Chapter 10 (Ecology). These two chapters show that such a column spacing should be acceptable as regards water quality and ecology. Nevertheless, a larger span-length (i.e. wider column spacings) up to approximately 75m is structurally feasible, so as to enhance performance as regards ecology and water quality. For this reason, it is recommended that 75m should be adopted as the typical span-length for the portion of HKLR in the waters west of the Airport Island (where larger column spacings will be particularly beneficial not only to ecology and water quality, but also from the point of view of Pearl River Delta water flow). Hence, as described in **Figure 3.20**, the typical spans for the portion of HKLR in the western waters will indeed be 75m, even though for conservatism, the assessment on ecology and water quality will show that it will be acceptable even if the spans are 50m. As discussed in Section 3.5.6, at a finer level, the following further points should be noted:

- Structurally, the local spans adjacent to a movement joint (MJ) will need to be shorter than typical. Hence, though the typical spans are 75m, the spans adjacent to each MJ will only be 60m;
- At individual special locations, the spans will need to deviate from typical due to special reasons. For instance, where HKLR overpasses a navigation channel, its span will need to be even larger than 75m in order to meet marine traffic requirement (exact length of each such navigation span is assessed under the Marine Traffic Impact Assessment, depending on traffic-volume and sizes of vessels involved). And for instance, a local large span is required over the San Shek Wan/Sha Lo Wan headland to avoid toughing the headland physically.

10.7.1.24 The outcome of all the above mentioned efforts during the design phase is a project footprint avoiding all areas with high ecological values, including recognised sites and important habitats. Though local individual parts of the footprint would be near the ecological sensitive areas, the indirect impacts could be mitigated by the measures described below.

10.7.2 Mitigation on Construction Phase – Direct Impacts

Habitat loss during Construction (terrestrial)

10.7.2.1 The only terrestrial habitat loss for this Project would be small areas of developed area (low ecological value) and grassland/shrubland habitat (low ecological value), both on Airport Island. Owning to their small sizes, compensation for construction phase terrestrial habitat loss is not considered necessary.

10.7.2.2 Temporarily affected habitats at Scenic Hill should be re-instated after completion of construction works. Stream(s) on Scenic Hill should not be modified in order to retain suitable breeding habitats of Romer's Tree Frog.

Habitat loss during Construction (Intertidal)

10.7.2.3 No specific mitigation is required for the artificial seawall habitat loss on the southern, southeast, and northeast shores of Airport Island, as the impact was ranked as insignificant. These areas are all of low ecological value.

10.7.2.4 No specific mitigation is required for the remnant disturbed rocky shore with patchy sandy beaches along the southeast shore of Airport Island as the impact was ranked as minor. This habitat type is also of low ecological value (with only common intertidal fauna and without any species of conservation importance recorded; also the diversity is low in view of the limited number of species involved).

Habitat Loss during Construction (Marine)

10.7.2.5 No mitigation is required for the loss of shallow subtidal hard substrate seabed. This habitat type is of low to moderate ecological value and is abundant in Airport Island and North Lantau coastlines. More similar habitat will be provided after reclamation. No mitigation is required for the loss of soft substrate seabed. This habitat type is of low ecological value and is abundant in the Hong Kong western waters.

10.7.2.6 The marine waters to the west of the Airport Island are of moderate to high ecological value due to the close proximity to West Lantau waters, but the habitat loss caused by the marine bridge piers of HKLR to the west of Airport Island is small and scattered, the impact is thus ranked as **Minor** and no mitigation measure is required. The habitat loss caused by the marine bridge pier construction of HKLR inside Airport Channel is similar in nature, but the marine waters there are of low ecological value due to the low occurrence of CWD. The impact is thus ranked as **Minor**. No mitigation measure is required. The habitat loss due to construction would largely be carried forward to the operational phase and become permanent habitat loss, mitigation measures for operation phase (see **Section 10.7.4**) will mitigate this impact as well.

10.7.2.7 37 ha of sea area (27 ha of reclamation footprint and 10 ha of works area) will be lost during construction due to the reclamation for HKLR along the southeast shore of Airport Island. Compensation for this seabed loss is not required as the impact is **Minor** for dolphins. The ecological value of this area is low as it is not utilized by CWD.

10.7.2.8 164 ha of sea area (138 ha of reclamation footprint and 26 ha of works area) will be lost during construction due to the HKBCF reclamation near the northeast Airport Island. Although the sea area is only utilized by limited number of CWD, it is of moderate ecological value due to the close proximity with dolphin hotspot. **Moderate** impact is anticipated and mitigation measure is required. As the habitat loss due to construction would largely be carried forward to the operational phase and become permanent habitat loss, mitigation measures for operation phase (see **Section 10.7.4**) will mitigate this impact as well.

10.7.3 Mitigation on Construction Phase – Indirect Impacts

Water Quality

10.7.3.1 Low disturbance construction method: Any significant changes in water quality or turbidity should be avoided. This could be mitigated through construction methods. Closed-grab dredges and silt curtains around the work areas (wherever feasible) should be used in all dredging activities.

10.7.3.2 Piles of piers would be bored rather than driven. The Shenzhen Western Corridor project demonstrated that bored-piling construction, besides less noisy, caused limited water quality impacts even inside the sheltered Deep Bay area. The potential for sediment resuspension during the pier construction of HKLR is predicted to be very low, since only limited dredging would be required for pier construction, closed-grab dredges would be used, and piles would be bored inside casings that are in turn contained within cofferdams, that were built using closed-grab dredges, surrounded by silt curtains. These measures could effectively prevent any significant deterioration of water quality.

10.7.3.3 Every attempt should be made to avoid resuspension of solids/contaminants back into the water column during dredging and dumping operations. For reclamation, the seawall should be constructed prior to the filling works where possible. Using pipes that bring the sediment directly to the sea bottom during dumping, and conducting operations preferentially at slack tide (when feasible).

10.7.3.4 Reduce dredging scale – The amount to be dredged has been minimized as far as practicable. Details of this effort are provided in **Section 3**.

10.7.3.5 Limit the concurrent works front - The number of concurrent dredging/filling work fronts will be limited (maximum 35 pier sites in the open sea part of HKLR, and 10 pier sites in Airport Channel). For the benefit of water quality protection, the minimum distance between any two pilecap construction sites will be kept as 180 m.

10.7.3.6 Good Site Practices: – The integrity and effectiveness of all silt curtains should be regularly inspected. Effluent monitoring should be incorporated to make sure that the discharged effluent from construction sites meets the relevant effluent discharge guidelines.

10.7.3.7 Strict enforcement on No-dumping – To avoid degrading the Chinese White Dolphin habitat, restrictions prohibiting dumping of rubbish, food, oil, or chemicals will be strictly enforced.

10.7.3.8 Site runoff control - For works on land, standard site runoff control measures will be established and strictly enforced to ensure that discharge of contaminated or silt-laden runoff into North Lantau waters is minimised.

10.7.3.9 Spill response plan – In the event of vessels operating in the works areas transporting oil or other hazardous chemicals, an oil-spill response plan, with specific provisions for protecting marine ecology and CWD, will be formulated.

10.7.3.10 Replacement Artificial Reefs - The artificial reefs near the northeast corner of Airport Island within the Marine Exclusion Area is the nearest marine ecological sensitive receiver to the HKBCF reclamation. They are potentially subject to water quality impact from the reclamation. Even though water mitigation measures will be adopted during the dredging for seawall construction, the artificial reefs may still be potentially influenced by the works. These artificial reefs (ARs) near the HKBCF reclamation had been deployed there for eight years or more. It is considered that the relocation process would not keep the ARs intact once they are mechanically disturbed. As such, it would be more practicable to deploy replacement ARs to mitigate the potential disturbance on ARs by the HKBCF reclamation works. The replacement ARs should have the same volume as the existing ARs (i.e. 3,600 m^3). The implementation of the replacement Artificial Reefs will be incorporated with the deployment of additional Artificial Reefs, as described below for the additional enhancement measure.

Terrestrial Disturbance

10.7.3.11 The impact from this minor and short-term source can be reduced by good site practice, including strictly following the permitted works hours, using quieter machines where practicable, and avoiding excessive lightings during night time.

Sedimentation from Land-based works areas

10.7.3.12 The woodland in Scenic Hill would not be encroached upon by the Project. Nevertheless, in order to protect this habitat for Romer's Tree Frog, protection measures will be implemented as described below.

10.7.3.13 Although the extent of earthwork will not affect habitats of Romer's Tree Frog, good site practices (e.g., watering to reduce dust generation, prevention of siltation of freshwater habitats) are still recommended to be implemented. Site runoff should be desilted, to reduce the potential for suspended sediments, organics and other contaminants to enter streams and standing freshwater (which are potential breeding habitats of Romer's Tree Frog). Caution must be taken to avoid runoff entering the area in which Romer's Tree Frog has been recorded.

Marine Noise and Disturbance

1) Bored piling

10.7.3.14 Avoidance of percussive piling – In view of the potential to cause serious noise impact upon Chinese White Dolphin, percussive piling will not be adopted in the Project.

10.7.3.15 Dolphin Exclusion Zone – Marine bored piling involves the installation of a temporary steel casing, excavation within the casing, concrete filling into the casing and removal of casing. Dolphin exclusion zone of 250m radius should be implemented in marine pier sites of HKLR located in the waters to the west of Airport during the installation of bored pile casing (i.e. the open sea part of the marine section of HKLR). Works will be suspended when any Chinese White Dolphin (CWD) is found within the exclusion zone. After the bored piling casing is installed, all the subsequent works will be conducted inside the casing (a small and completely confined area), and a dolphin exclusion zone is not required.

10.7.3.16 Temporal suspension of installation of bored pile casing at marine pier sites – Though all works involved will be much quieter than percussive piling, the installation of the bored pile casing would be relatively disturbing as steel casing will be drilled onto the rock surface below seabed. For the marine bored piles of HKLR located at the waters to the west of Airport Island (i.e. the open sea part of the marine section of HKLR), installation of steel casing onto rock surface will be suspended during May and June (i.e. the peak months of the dolphin calving season). In other words, the bored-piles for the section of HKLR in the Airport Channel is not subject to such restriction. HKBCF should not be affected by this issue at all as it has no marine-piling anyway. If the HKLR works need to carry out marine bored-piling into rock to the west of Airport Island during May & June, then application of bubble curtains or bubble jackets shall be provided and agreed with AFCD.

2) Sheet piling

10.7.3.17 Vibratory piler for installation of sheet piling – Sheet piling into the soft seabed sediment (i.e. not requiring to drill onto rock surface) is required along the northern edge of HKBCF reclamation for protecting the reclamation site from water current. To minimize the acoustic disturbance to Chinese White Dolphin (CWD), sheet piles wall will be driven by using vibratory piler, which is a type of silence piling equipment and the noise generated is anticipated to be minimal.

10.7.3.18 Dolphin Exclusion Zone – dolphin exclusion zone of 250m radius should be implemented in the northern edge of HKBCF reclamation during the installation of the sheetpile wall. Works will be suspended when any Chinese White Dolphin (CWD) is found within the exclusion zone.

3) Reclamation and Works Vessels

10.7.3.19 Dolphin Exclusion Zone – dolphin exclusion zone of 250m radius should be implemented in the HKBCF and HKLR reclamation sites during the installation of the perimeter silt curtains and any re-deployment of the perimeter silt curtains. Works will be suspended when any Chinese White Dolphin (CWD) is found within the exclusion zone.

10.7.3.20 Dolphin Watching Plan - A dolphin watching plan for works areas will also be implemented and included in the EM&A programme. For reclamation sites, once the perimeter silt curtains are installed or re-deployed, the dredging and filling works would be conducted inside the silt curtains and a dolphin exclusion zone is no longer required. Subsequently, a dolphin watching plan will then be performed. The plan would include regular inspection of the silt curtains, visual inspection of the waters surrounded by the curtains, and an action plan should be devised to cope with any unpredicted incidents such as the case that CWD is found within the waters surrounded by the silt curtains.

10.7.3.21 Acoustic decoupling of compressors and other equipment – Air compressors and other noisy equipment that must be mounted on construction vessels will be acoustically-decoupled.

Marine Traffic

10.7.3.22 Vessel speed limit control – It is known that fast-moving vessels are a threat to CWD and porpoises, a speed limit of 10 knots will be strictly enforced within the work areas. This speed limit for vessels within the boundaries of the Sha Chau/Lung Kwu Chau Marine Park appears to be effective in protecting the CWD from vessel collisions.

10.7.3.23 Skipper training – Captains of construction vessels working in the West Lantau waters and working near the Brothers Islands should undergo training to learn about local CWD and porpoises. They should be trained to be aware of the protocol for “dolphin friendly” vessel operation (refer to the Code of Conduct for Dolphin Watching Activities available from AFCD).

10.7.3.24 Predefined and regular routes for working vessels – Captains of all working vessels should be required to use regular travel routes, in order to minimize the chance of vessel collision. And the routes would not go through the dolphin hotspot in Brothers Islands.

10.7.3.25 Mitigation measures for the construction impacts on ecology are summarised in **Table 10-13**.

10.7.4 Mitigation on Operational Phase – Direct Impacts

Permanent Habitat loss (terrestrial)

10.7.4.1 The only permanent terrestrial habitat loss for this Project would be small areas of developed area, and grassland/shrubland habitat on Scenic Hill, both on Airport Island. Owing to their low ecological value and small size (1 ha each) of the loss, the impact is ranked as insignificant and compensation for habitat loss is not considered necessary.

Permanent Habitat loss (Intertidal)

10.7.4.2 No specific mitigation is required for the artificial seawall habitat loss on the southern, southeast, and northeast shores of Airport Island, or the remnant disturbed rocky shores along the southeast shore of Airport Island, as the impacts are ranked as insignificant (for artificial seawalls) and minor (for remnant rocky shore). This is because the area is of low ecological value (with only common intertidal fauna and without any species of conservation importance recorded; also, the diversity is low in view of the limited number of species involved). In addition to the re-provision of intertidal habitat by the HKLR reclamation seawalls (sloping and rip-rap form) which could provide new intertidal hard bottom habitats for epifauna colonization on the surface of the new seawalls, there will be additional seawalls in the HKBCF reclamation. The total seawalls in the area will increase after the HKBCF reclamation is completed (after the reclamation, about 4km of additional sloping seawalls will be created).

Permanent Habitat loss (Marine)

10.7.4.3 No mitigation is required for the marine habitat loss caused by the marine bridge piers (< 3 ha in total) as the loss for each pier is small and scattered.

10.7.4.4 27 ha of marine habitat will be lost due to the reclamation for HKLR along the southeast shore of Airport Island. Compensation for this marine habitat loss is not required as the impact is ranked as minor given the low ecological value (due to the low occurrence of CWD and other marine species of conservation importance in this area.).

10.7.4.5 138 ha of marine habitat will be lost due to the reclamation for HKBCF near the northeast Airport Island. The sea area is of moderate ecological value for dolphin. **Moderate** impact is anticipated and mitigation measure is required.

10.7.4.6 To enhance the Chinese White Dophin (CWD) habitat, the Administration has made a firm commitment to seek to designate the Brothers Islands as a marine park in accordance with the statutory process stipulated in the Marine Parks

Ordinance. A study will be conducted to work out the details of the proposed marine park before the commencement of the statutory procedures as stipulated in the Marine Parks Ordinance. The designation of the proposed marine park would proceed after the completion of HKBCF.

10.7.4.7 The Administration's commitment to the marine park and subjecting it to control and management in accordance with the Marine Parks Ordinance as well as the Marine Parks and Marine Reserves Regulations would significantly help conserve the CWD, and hence serves as an effective mitigation measure for the loss of CWD habitat arising from these projects. With this committed measure, the residual impact (and cumulative impact) to CWD, in terms of permanent habitat loss, would therefore be acceptable.

10.7.4.8 As part of the ecological EM&A programme, a comprehensive dolphin monitoring survey programme will be conducted during the pre-construction, construction and post-construction of the Projects, which will cover the waters in North and West Lantau waters including Brothers Islands. In addition to the long-term monitoring data collected by AFCD, the additional quantitative data collected from this comprehensive dolphin monitoring programme (covering approximately 6 years) can be used to determine the most suitable location for establishing the marine park for CWD.

10.7.4.9 The project proponent will assist AFCD in the designation of the marine park. The implementation will also involve consultation with green groups, relevant Government departments, and other stakeholders.

10.7.5 Mitigation on Operation Phase – Indirect Impacts

Road Surface Runoff

10.7.5.1 Silt-grease traps should be deployed to prevent a direct input of road surface runoff to the marine waters.

Chemical spillage

10.7.5.2 A Maritime Oil Spill Response Plan (MOSRP) has been developed by Marine Department to deal with oil spill and their potential hazard to the Hong Kong waters. The main objective of the MOSRP is to ensure a timely and effective response to oil spillages and/or their potential treats in the Hong Kong waters.

10.7.5.3 Similar to the Shenzhen Western Corridor project, a contingency plan will be formulated to deal with the accidental event of the serious spillage of oil or other harmful chemicals. A contingency plan in this regard will be primarily for safety issues and water quality, but could also help to safeguard the dolphin population. Following the example of Shenzhen Western Corridor, it will be specified in the contingency plan that AFCD must be alerted by the Hong Kong Police Force or Fire Service Department in case an accident of spillage of chemical or oil is reported.

Positive effects

10.7.5.4 There are also potential positive effects due to change in marine traffic volume, distribution and pattern in the North Lantau waters during the operation phase of HKLR. After the road opening of HZMB, there will be a decreased demand on marine traffic between Hong Kong and Mainland. Marine traffic to/from Mainland and Macau might reduce. If vessels are less frequently to pass through waters of high dolphin abundance, there might be a reduction in risk of CWD colliding with marine vessels. There might also be speed restrictions/regulations on marine traffic near the bridge. Positive effects on the CWD are foreseen during the operation of the bridge.

10.7.5.5 In the present Project, the potential enhancement effect of the bridge piers has been highlighted in the EIA Study Brief Section 3.4.6.5 (vi) and is discussed in sections below.

10.7.5.6 In most of Hong Kong waters, especially the western waters, hard bottom habitat is scarce and most substrates are larger open expanses of soft mud or muddy sand below water depths of about six metres. This rather homogenous habitat excludes the colonisation of some hard surface epifauna. Creation of hard surface habitats, by deploying artificial reefs or other engineered structures, can increase the complexity of habitats in such environments and provide opportunities for fouling organisms to settle and develop. Fouling organisms such as seaweeds, sea squirts, mussels, barnacles and polychaetes on hard surface habitats can attract scavengers and small predators, which in turn provide food resources for higher predators such as dolphins. New and more complex food webs can be created in this way.

10.7.5.7 It has been demonstrated by studies on artificial reefs that hard bottom structures in shallow waters, especially those of high profile and high complexity, can provide habitats for epifauna and even fishes and are effective devices for attracting and supporting large populations of fish.

10.7.5.8 The concrete structures originally proposed for wave protection at the High Island Dam (dollos) function as an artificial reef. They rise from over 12 metres depth to the sea surface and have developed rich and abundant coral community plus an associated fish community.

10.7.5.9 Emerged pile caps (those above the seabed) can provide larger areas of hard surface habitat than submerged pile caps (those partially or completely beneath the seabed). The piles supporting emerged pilecaps are also exposed and this greatly increases the amount of hard-surface habitat over that available from submerged pilecaps. In terms of ecological and fisheries effects, emerged pile caps are therefore more preferred than submerged pile caps.

10.7.6 Mitigation for Cumulative Impacts

10.7.6.1 There will be another 319 (47 from TMCLKL + 272 from others) ha marine habitat loss in the Western Hong Kong waters due to other concurrent projects.

10.7.6.2 In addition, it is noted that Beyond the HKSAR boundary, the HZMB Main Section would also cause marine habitat loss, in particular 80 ha for two artificial islands near HKSAR boundary and less than 10 ha for the marine piers (about 356 piers, and assuming those piers are of similar sizes as Hong Kong piers, i.e. 200 m^2). Other major marine habitat losses include the Zhuhai BCF and the Macao BCF, which would be located close to the western shore of Pearl River Estuary where the dolphin sightings are much less frequent.

10.7.6.3 The HKBCF reclamation is the main contributor towards the cumulative permanent loss of CWD habitat (Different from the future Tung Chung East and West Development or the LLP extension which are located in areas not frequently used by dolphin, HKBCF is a large reclamation within dolphin habitats, and thus would contribute to the impact in terms of both significance of impacts and area size.). As stated in the above sections of mitigation on permanent marine habitat loss, the HKBCF habitat loss to CWD could be effectively mitigated by setting up a marine park. As such, the severity of cumulative loss of CWD habitat would also be significantly reduced.

10.7.6.4 In view of the above, further specific mitigation measures will not be needed for the cumulative CWD habitat loss.

10.7.7 Precautionary/Enhancement Measures

<u>Pre-construction Dive Survey for Corals</u>

10.7.7.1 As a precautionary measure, a dive survey will be conducted (see **Figure 10.14**) at the marine pier sites nearest to intertidal zone (i.e. the pier sites to the west and to the east of the headland to be spanned over in Sha Lo Wan, and the pier site just offshore to the actual landing point on Airport Island) and along the shore of the HKLR reclamation site, prior to marine construction works in these three locations, to identify any coral colonies suitable for translocation, taking into account the conservation value, the health status and the translocation feasibility. A detailed translocation plan will be prepared if corals (including hard corals, soft corals and octocorals) of conservation importance, in good conditions, and feasible for translocation are identified during the survey.

Provision of Additional Artificial Reefs

10.7.7.2 In addition to the replacement Artificial Reefs mentioned above, additional Artificial Reefs will also be deployed at the same time as compensation to the marine habitat loss. Areas that currently are protected or are restricted would be suitable for deploying the new ARs (both replacement ARs and additional ARs), such as the Sha Chau and Lung Kwu Chau Marine Park or the proposed potential marine park in Fan Lau after its designation, would be possible options for deploying the new ARs._While the replacement ARs would be of the same volume of the existing ARs (i.e. 3,600 m^3), the additional ARs should have at least two times the volume as the existing ARs (i.e. 7,200 m^3).

Fish Fry Release in Artificial Reefs

10.7.7.3 Fish fry release will be conducted at the new ARs (both replacement ARs and additional ARs) as well as the existing ARs in Sha Chau and Lung Kwu Chau Marine Park, to enhance the fish resources in the Western Hong Kong waters. The frequency and quantities of the fish fry to be released will be proposed and agreed by AFCD.

10.7.8 Summary of Measures

10.7.8.1 Mitigation for the construction and operation impacts are summarised in **Table 10-13** below. **Table 10-14** summarised the precautionary/enhancement measures proposed by the Projects.

Table 10-13 Mitigation Measures for Construction and Operation Phase

Impacts	Mitigation measures
Constructional phase	
Potential disturbance on habitat of Romer's Tree Frog	• Good site practices to avoid runoff entering their habitats; • Reinstate works areas; • Avoid stream modification.
Water quality degradation	• Employing Silt curtains; using closed-grab dredging; • Minimised dredging works; limit the works fronts; • Good Site practices; • No dumping policy; • Site runoff control; • Spill response plan; • Reprovision of replacement Artificial Reefs (of the same volume as the existing ARs inside Marine Exclusion Zone).
Sedimentation from Land-based works areas	• Watering to reduce dust generation; • Prevention of siltation of freshwater habitats; • Site runoff should be desilted, • Reducing the potential for suspended sediments, organics and other contaminants to enter streams and standing freshwater.
Terrestrial disturbance	• Good site practices, including strictly following the permitted works hours, using quieter machines where practicable, and avoiding excessive lightings during night time.
Marine disturbance	• Dolphin Exclusion Zone; • Dolphin watching plan.
Marine Noise	• Acoustic decoupling of compressors and other noisy

Impacts	Mitigation measures
	equipment; • Avoidance of percussive piling; • Temporal suspension of drilling bored pile casing onto rock surface during peak dolphin calving season in May and June.
Marine Traffic	• Vessel speed limit for construction vessels; • Skipper training; • Predefined and regular routes for working vessels; avoid Brothers Islands.
Operational phase	
Permanent marine habitat loss	• Setting up of a marine park.
Surface runoff	• Silt-grease traps.
Chemical spillage	• Maritime Oil Spill Response Plan (MOSRP); • Contingency plan.

Table 10-14 Precautionary/Enhancement Measures

Precautionary/Enhancement Measures
• Preconstruction dive survey for corals will be provided. • Additional Artificial Reefs will be provided. • Fish fry release in Artificial Reefs will be provided.

10.8 Residual Impacts

10.8.1 The residual environmental impacts refer to the net environmental impacts after the implementation of mitigation measures, taking into account the background environmental conditions and the impacts from existing, committed and planned projects.

10.8.2 In some instance, measures have been incorporated into the design (e.g. careful sites selection) and construction methods (e.g. avoidance of percussive piling and adoption of vibration piler for sheet piling and bored pile casing) to provide an additional degree of confidence that any residual impacts is not expected to have long term environmental implications.

10.8.3 The loss of 1 ha of grassland/shrubland habitat and some other developed areas on Airport Island is considered acceptable.

10.8.4 With mitigation measures properly implemented, there will be no residual impacts on horseshoe crabs and seagrass beds because the horseshoe crab nursery sites and seagrass habitats (soft shores along Airport Channels) will remain intact. Other residual impacts include the loss of subtidal benthic habitat (168 ha of soft substrate seabed), subtidal hard substrate seabeds (less than 2.5 km along seawalls and remnant rocky shores) and the hard shore intertidal habitat (less than 1 km artificial seawalls and about 1.5 km remnant rocky shores with patchy sandy beaches on Airport Island), and are also considered acceptable.

10.8.5 The marine bridge piers of HKLR (< 3 ha), reclamation of HKLR (27 ha), and reclamation of HKBCF (138 ha) will result in some loss of marine waters habitat, in particular for the Chinese White Dolphin. The total marine habitat loss due to HKLR & HKBCF is about 168 ha. It should also be noted that the 27 ha HKLR reclamation is located in an area not utilised by CWD, while the loss from the marine bridge piers is small and scattered. So the 138 ha HKBCF reclamation is the main contributor of the CWD habitat loss. But setting up a marine park as a functional enhancement would be an effective mitigation. It is envisaged that with the setting up of a marine park, the residual impact due to the marine habitat loss arising from HKLR and HKBCF would be acceptable.

10.8.6 There will be another 319 (47 from TMCLKL and 272 from others) ha marine habitat loss in the Western Hong Kong waters due to other concurrent projects. Although the cumulative marine habitat loss from these projects is possible as these projects are located in the Western Hong Kong waters, the different concurrent projects' contribution towards the issue of permanent loss of dolphin habitat would not be the same. Quite a significant portion of the loss comes from projects in areas not or seldom used by CWD, such as the future Tung Chung East and West Development which is adjacent to the existing Tung Chung town. For the coastal waters, there are very limited dolphin sightings on Tung Chung coastlines except the waters around Sham Shui Kok (see **Section 10.4.3.102** above). Similarly, the LLP extension is also located in coastal waters near Tung Chung town and limitedly used to CWD. Though outside HKSAR, it is noted that 90 ha of marine habitat inside Mainland waters but near HKSAR boundary will be lost due to the artificial islands for HZMB artificial islands (80 ha) and marine piers (10 ha). The HKBCF reclamation is the main contributor towards the cumulative permanent loss of CWD habitat (Different from the future Tung Chung East and West Development or the LLP extension which are located in areas not used by dolphin, HKBCF is a large reclamation within dolphin habitats, and thus would contribute to the impact in terms of both significance of impacts and area size.). As stated in the above sections of mitigation on permanent marine habitat loss, the HKBCF habitat loss to CWD could be effectively mitigated by setting up a marine park. As such, the severity of cumulative loss of CWD habitat would also be significantly reduced, and no specific mitigation measure for cumulative CWD habitat loss is required. .

10.8.7 It is worth to note that three additional enhancement measures would be provided by the Project, which are beneficial to the general marine environment, including pre-construction dive survey for corals, provision of additional artificial reefs, and release of fish fry in artificial reefs.

10.8.8 Cumulative impacts to CWD in terms of disturbance, noise, marine traffic is considered to be minimal as discussed in Section 10.6.7.6 to 10.6.7.10 and the impact is considered to be low, and no residual impact is expected.

10.9 Environmental Monitoring and Audit

10.9.1 An ecological monitoring and audit programme would be needed for the HKLR and HKBCF, to record the conditions of the impact receivers during construction and after construction, to demonstrate the effectiveness of the mitigation measures and to verify the predictions of impact assessment. The monitoring programme provides a mechanism to rectify any non-compliance and exceedance, to propose remedial actions, and to cope with any unforeseen situations.

10.9.2 The monitoring programme will include monitoring of physical parameters such as water quality, and ecological aspects such as CWD and mudflats. The ecological monitoring and audit programme will monitor potential impacts through construction and operation activities, and will verify the assessments which were made in the EIA report.

10.9.3 The monitoring includes the following tasks which are detailed in the EM&A Manual:

10.9.3.1 Dolphin monitoring – A dolphin monitoring programme at North Lantau and West Lantau waters, in particular the dolphin sighting hotspots (e.g. Brothers

Islands) and areas where juveniles have been sighted (e.g. West Lantau waters), should be set up to verify the predictions of impacts and to ensure that there are no unforeseen impacts on the dolphin population during construction phase. The monitoring period should cover the pre-construction phase (baseline conditions), the entire period of construction phase (tentatively 2010 – 2016), and at least one year after the completion of construction works.

10.9.3.2 Construction-phase underwater noise monitoring –The noise level of the bored piling is known to be much lower than that of the percussive piling, but actual data are insufficient. The actual underwater noise level of bored piling will be monitored during the pile construction in Airport Channel for HKLR. This monitoring is to verify the assessment outcome and to collect field data of this construction method.

10.9.3.3 Dolphin acoustic behaviour monitoring – The acoustic behaviour to bored piling and movement near the bored piling sites of CWD should be monitored during bridge construction.

10.9.3.4 Land-based of dolphin behaviour and movement monitoring – Land-based theodolite tracking to study dolphin behaviour near bored piling work site, and examine their north-south movement across the bridge alignment before, during and after bridge construction.

10.9.3.5 Mudflat monitoring – A monitoring programme on the intertidal soft shore habitats on north Lantau coastlines, in San Tau and Tung Chung Bay where horseshoe crab juveniles and seagrass beds have been sighted, should be set up to verify the predictions of impacts. The monitoring period should cover the pre-construction phase (baseline conditions), the entire period of construction phase, and after the completion of construction works. The monitoring should cover the water quality, sedimentation rate, horseshoe crab population, seagrass beds and soft shore intertidal communities.

10.9.3.6 Pre-construction dive survey for corals – As a precautionary measure, a dive survey will be conducted (see **Figure 10.14**) at the marine pier sites nearest to intertidal zone (i.e. the pier sites to the west and to the east of the headland to be spanned over in Sha Lo Wan, and the pier site just offshore to the actual landing point on Airport Island) and along the shore of the HKLR reclamation site, prior to marine construction works in these three locations, to identify any coral colonies suitable for translocation, taking into account the conservation value, the health status and the translocation feasibility. A detailed translocation plan will be prepared if corals (including hard corals, soft corals and octocorals) of conservation importance, in good conditions, and feasible for translocation are identified during the survey.

10.9.3.7 There will be a water quality monitoring programme for the construction and the operation of the Project, with action and limit level criteria to safeguard the marine water quality in the area.

10.10 Conclusions

10.10.1 The Project has avoided impacts on recognised sites of conservation importance (e.g. SSSIs, Country Parks and Marine Parks), and other ecological sensitive areas (e.g. mudflats, mangroves and nursery sites of horseshoe crabs).

10.10.2 The majority of the HKLR and the entire HKBCF would be on newly reclaimed area or piers in sea areas. Less than 1 ha of grassland / shrubland in Scenic Hill will be affected by the land viaduct of HKLR. As the grassland / shrubland are of low ecological value and the affected area size is very small, the impacts on the habitat area considered insignificant and no mitigation is required. Apart from Scenic Hill, no other identified terrestrial site of conservation importance is in the vicinity of the Projects.

10.10.3 Romer's Tree Frog habitat in Scenic Hill would not be affected by the construction HKLR. Strict site practice will avoid most of the potential impact to their habitat in Scenic Hill. Disturbance impacts to terrestrial ecology would be insignificant due to the distance between their footprint and natural habitats in North Lantau.

10.10.4 Whilst the proposed alignment and reclamation fall within habitats used by Chinese White Dolphin in Hong Kong, they are not located in areas with high dolphin density through careful site options and alignments selection.

10.10.5 The waters to the west of Airport currently feature two areas of dolphin-conservation importance, viz the Sha Chau/Lung Kwu Chau Marine Park, and the waters near Tai O Peninsula to Fan Lau. The HKLR alignment passes between two high dolphin-density areas. Impacts to CWD along this alignment can be expected to be less significant than if the alignment is to pass directly through either of the high-density dolphin areas.

10.10.6 HKLR involves both marine (sea viaduct and reclamation for at-grade road) and land-based construction. It will have marine impacts due to piling in open sea as well as within the Airport Channel. The section of the HKLR alignment along the southern edge of the Airport Island and inside the Airport Channel is expected to have an insignificant impact on CWD, as CWD do not generally use this area. There have been no sightings of Chinese White Dolphin in the channel, and there is no evidence to indicate that the channel is currently used by Chinese White Dolphin or any other cetaceans. A pre-construction dive survey at the pier sites nearest to intertidal zone would be conducted to identify any coral colonies suitable for translocation.

10.10.7 HKLR reclamation, along the east coast of Airport Island, is located at a very low-density area for CWD and with very low coverage of common gorgonians. As a result, impacts on CWD in this area should be much less significant. A pre-construction dive survey inside the reclamation site would be conducted to identify any coral colonies suitable for translocation.

10.10.8 The construction and operation of the HKBCF would cause marine habitat loss and potential water quality impacts. The permanent loss of CWD habitat is a moderate impact requiring mitigation. To enhance the CWD habitat, the Administration has made a firm commitment to seek to designate the Brothers Islands as a marine park in accordance with the statutory process stipulated in the Marine Parks Ordinance. A study will be conducted to work out the details of the proposed marine park before the commencement of the statutory procedures as stipulated in the Marine Parks Ordinance. The designation of the proposed marine park would proceed after the completion of these projects. The Administration's commitment to the marine park and subjecting it to control and management in accordance with the Marine Parks Ordinance as well as the Marine Parks and Marine Reserves Regulations would significantly help conserve the CWD, and hence serves as an effective mitigation measure for the loss of CWD habitat arising from these projects. With this committed measure, the residual impact (and cumulative impact) to CWD, in terms of permanent habitat loss, would therefore be acceptable. Dolphin monitoring survey during the construction will also be carried out.

10.10.9 The artificial reefs (ARs) inside Marine Exclusion Area near the eastern and of the northern runway would be impacted by the Project. The ARs is close to the HKBCF reclamation site and might be affected by water quality deterioration. Though not directly encroached, its functions might be compromised.

10.10.10 It is therefore proposed that new ARs will be installed, not only to replace the existing ARs inside Marine Exclusion Area, but also to serve as an enhancement measures. The volume of ARs to be installed will therefore be greater than that of the existing ARs.

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APPENDIX 10A

Hong Kong-Zhuhai-Macao Bridge Hong Kong Section and North Lantau Highway Connection (now renamed as Hong Kong Link Road) – Final 9 Months Ecological Baseline Survey Report, Mouchel Parkman Asia Ltd. 2004

Highways Department
The Government of the Hong Kong Special Administrative Region

Agreement No. MW 01/2003

Hong Kong – Zhuhai – Macao Bridge: Hong Kong Section and the North Lantau Highway Connection

Ecological Baseline Survey

Final 9 Month Ecological Baseline Survey Report

Meinhardt Mouchel Ltd

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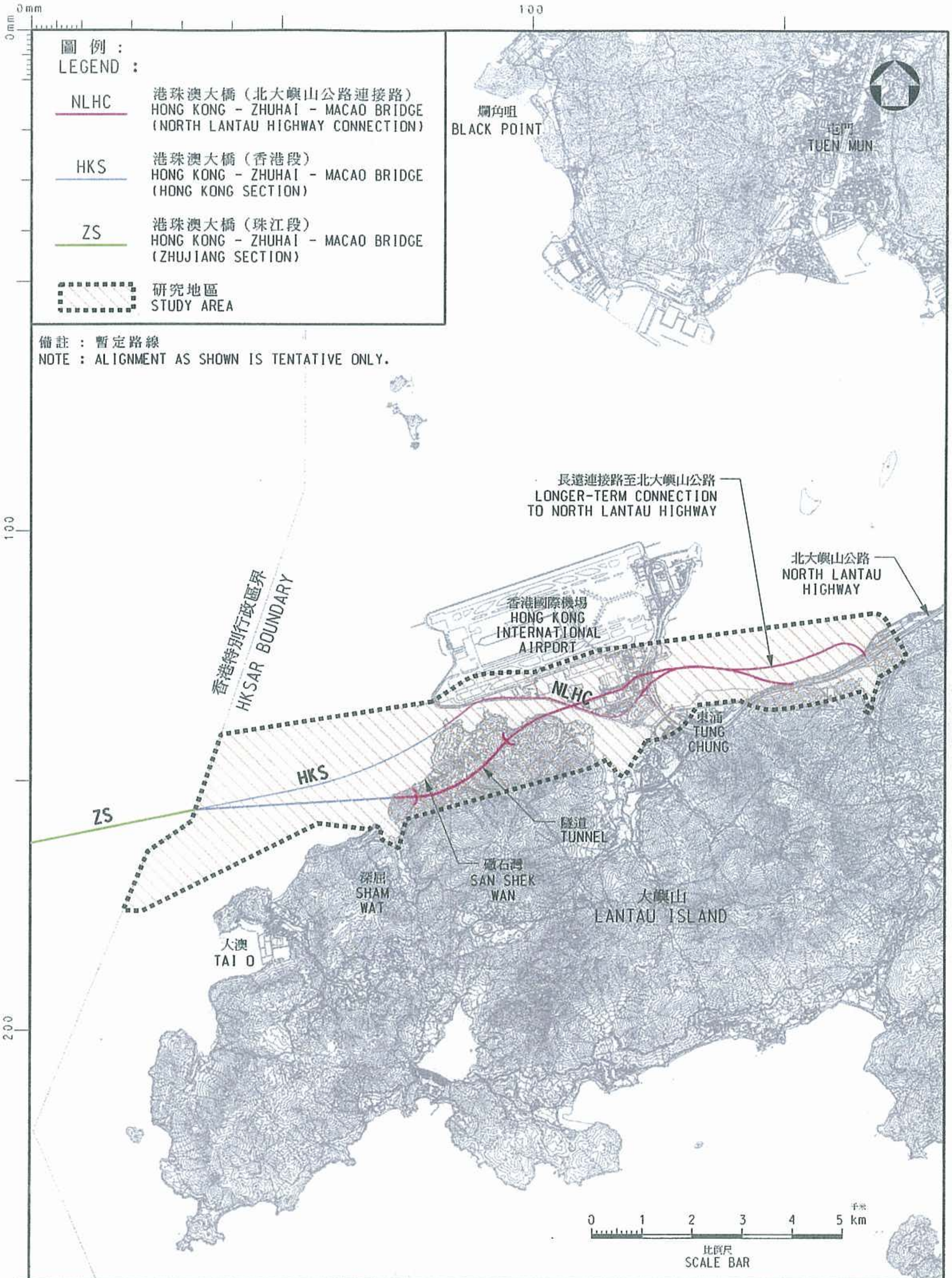
Volume 2 Marine Fisheries Review

1. PROJECT BACKGROUND

1.1 The proposed Hong Kong – Zhuhai - Macao Bridge (HZMB) comprises a dual-3 lane trestle bridge structure that links Hong Kong to the western Pearl River region. The tentative landing point in Hong Kong is either to the north of San Shek Wan comprising overland structure or to the south of San Shek Wan incorporating a tunnel option. The Hong Kong section of the HZMB in the coastal waters is approximately 5km long. A 5km highway (the North Lantau Highway Connection; NLHC) predominantly located to the south of the airport is also required to link the HZMB from the San Shek Wan landing point to the North Lantau Highway. Subsequent to the commencement of the Assignment, a long-term connection linking the NLHC to the existing North Lantau Highway via a reclamation off Tai Ho Wan has also been proposed and will require assessment under the present study. The whole study area to be assessed is presented in *Figure 1*.

1.2 An EIA is required to identify and where necessary recommended mitigation for any impacts from the development on ecologically sensitive species and habitats. The purpose of the present study is to conduct an ecological baseline survey within the Hong Kong SAR in order to provide up to date and accurate ecological data to allow the subsequent identification, prediction and evaluation of potential ecological impacts that may arise due to the construction and operation of the HZMB.

1.3 The Highways Department of the Hong Kong SAR has commissioned Meinhardt Mouchel Ltd to undertake the ecological baseline surveys for the HZMB under Agreement No. MW 01/2003. The present Study commenced on 11 September 2003 and is due for completion in June 2004.



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Ecological Baseline Survey - Study Area

Figure No. 1

2. PURPOSE OF THIS REPORT

2.1 The purpose of this Supplementary Ecological Baseline Survey Report is to report the results of the nine months ecological field surveys conducted during the period 11 September 2003 until the end of May 2004. The ultimate purpose of this assignment is to obtain adequate data to allow accurate prediction of the project's likely impacts upon the ecology of the study area, particularly those aspects identified for special attention in Para. 6.1(c) of the Study Brief namely the vicinities along marine portion of the Project which are frequented by the Chinese White Dolphin; the Site of Special Scientific Interest (SSSI) at San Tau and the proposed Lantau North (Extension) Country Park. An assessment of the ecological characteristics of the proposed connection of the NLHC to Tai Ho is also required. As required under Para 6.1(g) of the Brief, the ecological baseline survey should investigate and describe the existing wildlife uses of the various habitats including but not limited to inter-tidal mudflat; mangrove; seagrass bed; woodlands; natural stream courses and rivers; vertebrates (avifauna, mammals, fish, herpetofauna); macroinvertebrates (e.g., insects, crustaceans); intertidal and sub-tidal benthic faunal communities; horseshoe crabs; Lantau North Country Park and Proposed Lantau North (Extension) Country Park; any other habitats and wildlife groups identified as having special conservation interest during the ecological field surveys. The programme of field study has been designed to meet these requirements.

2.2 Field work began in September 2003 and initially a 6 month survey was commissioned until early March 2004. A further additional 3 months of survey were conducted from March to May 2004. The scheduled field works carried out during this reporting period are presented in *Appendix A*. Surveys carried out during the whole reporting period have included the following key faunal and floral groups and accordingly, the report is broken down into the following sections for discussion purposes:

- freshwater and estuarine fish;
- freshwater macroinvertebrate;
- marine benthic macrofauna;
- intertidal flora and fauna (hard and soft shores);
- coral;
- horseshoe crab;
- cetaceans;
- avifauna;
- terrestrial mammal;
- insect;
- herpetofauna; and
- habitats and vegetation including seagrass and mangroves.

2.3 Details of the marine fisheries in the Northwestern waters of Lantau are provided in Volume 2.

3. LITERATURE REVIEW

3.1 Background

3.1.1 The purpose of the literature review is to identify existing information on the habitats and species present within the study area. Various reports and studies were consulted to extract relevant data on the flora and fauna present in the study area. Relevant books and scientific papers were also consulted and these have been cited where appropriate although the most recent reports were generally relied upon to provide contemporary information of the ecological characteristics of the study area.

3.1.2 Relevant scientific publications and EIA reports have been reviewed. The EIA and EM&A studies reviewed include:

- *New Airport Master Plan* (Greiner-Maunsell ,1991);
- *Remaining Development in Tung Chung and Tai Ho Comprehensive Feasibility Study* (Mott, 1998);
- *Environmental Impact Assessment Report for Lantau North-South Road Link between Tai Ho and Mui Wo* (Mouchel, 2000);
- *EIA Construction of an International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructure* (Scott, 2000)
- *Hong Kong-Pearl River West Link Preliminary Environmental Review* (Scott, 2002)
- *Final EIA for Permanent Aviation Fuel Facility* (Mouchel, 2002b);
- *Environmental Monitoring and Audit for Contaminated Mud Pit IV at East of Sha Chau* (Mouchel, 2002c, 2003a, 2004a, b, ongoing);
- *Improvement to Tung Chung Road between Lung Tseng Tau and Cheung Sha EIA* (Mouchel, 2002a); and
- *Tung Chung Cable Car Project EIA* (Mott, 2003).

3.1.3 The aforementioned EIAs and EM&A provide a wealth of relevant information on the ecology of the study area. The ongoing EM&A at the East of Sha Chau mud pits (ESC) also collects benthic macrofauna samples to the west of the airport and fisheries are trawled just off San Shek Wan and approximately 4km North of Tai Ho Wan in both the wet and dry seasons each year (Mouchel, 2003a). Such recent data are invaluable to the benthic fauna and marine fisheries baseline and have been reviewed for this study.

3.1.4 The existing literature also provides a good baseline for species assessments. Other relevant literature reviewed included:

- *Porcupine! (Newsletter of the Department of Ecology and Biodiversity, Hong Kong University);*
- *Hong Kong Biodiversity (AFCD Newsletter);*
- *Hong Kong Dragonflies* (Wilson, 1995);
- *Field Guide to the Dragonflies of Hong Kong* (Wilson, 2003);
- *Butterfly Watching in Hong Kong* (Young and Yiu, 2002);
- *A Field Guide to butterfly watching in Hong Kong* (Yiu, 2004);
- *Hong Kong Mangroves* (Tam and Wong, 2000);
- *The Avifauna of Hong Kong* (Carey, *et al*., 2001);

- *Checklist of Hong Kong Plants* (AFCD, 2001);
- *Rare and Precious Plants of Hong Kong* (AFCD, 2003);
- *Freshwater Fish in Hong Kong (*Lam 2002);
- *The Sea Shore Ecology of Hong Kong* (Morton and Morton, 1983);
- *Port Survey of 1996/97* (AFCD, 1998) *and Port Survey of 2001/02* (AFCD website)*;*
- *Marine Benthic Communities in Hong Kong* (CCPC, 2002);
- *Ecological Status and Revised Species Records of Hong Kong's Scleractinian Corals* (AFCD, 2004); and
- *A Conservation Strategy for Lantau* (Green Lantau Association, 1998).

3.1.5 AFCD's studies on *Marine Benthic Communities in Hong Kong* (CCPC, 2002) provide baseline condition of marine benthic communities in Hong Kong's waters while the *Port Survey*s of 1996/97 and of 2001/02 provided information about fisheries resources of Hong Kong. *The Sea Shore Ecology of Hong Kong* (Morton and Morton, 1983) provides useful information on the coastal ecology of Hong Kong while *Hong Kong Mangroves* (Tam and Wong, 2000) includes relatively recent surveys of the coastal areas of Northwestern Lantau. Jefferson and Leatherwood (1997), Jefferson (2000) and Hung (2003) provided information about cetaceans in Hong Kong waters.

3.1.6 The existing literature provides a good baseline for species assessments of vascular plants (Siu, 2000; Wu and Lee, 2000; Xing et *al*., 2000) and AFCD (2001) presents an updated list of the Hong Kong flora.

3.1.7 Standard references for the groups which were the subject of the present study include Goodyer (1992) and Reels (1996) for mammals; Karsen *et al.* (1998) and Lau and Dudgeon (1999) for herpetofauna; Chong and Dudgeon (1992) and Lam (2002) for freshwater fishes; Wilson (1995, 1997, 2003) and Wilson and Reels (2001) for odonates; Walthew (1997), Reels and Walthew (1998), Young and Yiu (2002) for butterflies; and Carey *et al*. (2001) and Viney *et al*. (1994) for avifauna.

3.1.8 An attempt to provide information on the conservation status of certain local fauna has been made by Fellowes *et al*. (2002). This paper is designed to facilitate ecological evaluations based on faunal species of concervation concern, objectively and can assist in assessments conducted in accordance with the Technical Memorandum (TM) of the Environmental Impact Assessment Ordinance (TMEIAO). The paper examines the local (Hong Kong), regional (southern China) and global restrictedness of native fauna species occurring in a wild state in Hong Kong, combined with an assessment of the vulnerability of populations, using the most reliable and up to date information available, and assigns a rating to each species accordingly. Thus, a species of 'Local Concern' may not be particularly threatened globally or regionally, but is rare or restricted in Hong Kong. A species of 'Regional Concern' may not be particularly threatened globally, but is rare or restricted in the region, while a species of 'Global Concern' is globally restricted to Hong Kong and southern China. Some species are regarded as being of 'Potential Regional Concern' or 'Potential Global Concern'. The paper was adopted in the present study in order to complement the species evaluations derived from other the published literature.

3.2 Freshwater and Estuarine Fish

3.2.1 The freshwater streams present on north Lantau are generally unaffected by pollution and support comparatively diverse aquatic communities (Chong and Dudgeon, 1992; EPD, 2000; Mouchel, 2002a). The lowland freshwater streams and their resident fauna are considered one of the most endangered habitats in Hong Kong and those present within the study area require careful assessment.

3.2.2 Approximately 140 species of freshwater fish have been recorded in Hong Kong (Lam, 2002). Of these 140 species, 63 are obligate freshwater species, 39 marine vagrants, 32 are brackish water fish, 3 are catadromous (i.e., migrate from fresh to marine water for breeding) and 3 are amphidromous (i.e., migrate between fresh and marine water unrelated to breeding; Lam, 2002). A short overview of local freshwater fish ecology is provided in Dudgeon and Corlett (1994). An informative source of species present in Hong Kong is the comprehensive checklist produced by Chong and Dudgeon (1992) which provides details of 96 indigenous fish species, including some information on distribution and conservation status. A recent publication *Freshwater Fish in Hong Kong* (Lam, 2002) provides useful information on species identification (39 commoner species are fully described), distribution and conservation status of the 140 predominantly freshwater fish species recorded locally.

3.2.3 Freshwater fish have been relatively well-studied in the north Lantau area. Chong and Dudgeon (1992) reported that the Tai Ho (46 species recorded between 1980-1991) and Tung Chung (23 species recorded between 1980-1991) streams are the first and second most species-rich streams in Hong Kong, respectively. The locally rare Ayu *Plecoglossus altivilis* was first described in Hong Kong from the Tai Ho stream (Chong and Dudgeon, 1992) and is listed in the China Red Data Book of Endangered Animals. The catadromous Giant Mottled Eel *Anguilla marmorata* has also been recorded in Tai Ho stream (Chong and Dudgeon, 1992) and is also listed in the China Red Data Book of Endangered Animals. Owing to the high diversity of fish, the Tai Ho stream has been designated as a SSSI.

3.2.4 Extensive surveys conducted between June 2001 and January 2002 along the broad corridor between Lantau and Sunset Peaks (encompassing both north and south Lantau) revealed the presence of 18 freshwater fish species (Mouchel, 2002a). Of these, four species were considered to be of conservation interest and three were present in streams and/or tributaries in north Lantau adjacent to the present study area. The three species of conservation interest comprised the Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis*, Philippine Neon Goby *Stiphodon atropurpureus* and Ricefish *Oryzias curvinotus*.

3.2.5 The Beijiang Thick-lipped Barb was abundant in the Tung Chung Stream and tributaries (Mouchel, 2002a) and has also been recorded in the nearby Wong Lung Hang Stream (Chan, 1998). The Beijiang Thick-lipped Barb is restricted locally but distributed throughout Guandong Province (Lam, 2002).

3.2.6 The Philippine Neon Goby was also present in Tung Chung Stream (Mouchel, 2002a). It was only very recently discovered in Hong Kong and was previously known to occur in only one other site locally (Chan, 1999). It has also recently been recorded in Tong Fuk and Pui O (Mouchel, 2002a).

3.2.7 The Ricefish was recorded in the Fong Yuen Marsh (Mouchel, 2002a). This species is globally-restricted and highly endangered locally (and endangered globally; Chong and Dudgeon, 1992). *O. curvinotus* is distributed throughout southeast China and has been recorded locally from Chi Ma Wan on Lantau, Sam A Tsuen in the northeast New Territories (Chong and Dudgeon, 1992), Sai Kung and reservoirs in North District and Tuen Mun (Lam, 2002; Mouchel, 2002a).

3.3 Freshwater Macroinvertebrate

3.3.1 The streams on north Lantau are generally unaffected by pollution inputs and support comparatively diverse aquatic communities (Chong and Dudgeon, 1992; EPD, 2000; Mouchel, 2002a). Wilson (1995) and Mouchel (2002a) also reported the presence of several endemic odonates on Lantau and the larval stages are completed in uncontaminated freshwater. The streams of Hong Kong are known to support a diverse group of freshwater macroinvertebrates some of which are endemics (e.g., certain odonates and water beetles). The recently published China Water Beetle Trilogy (Jach and Ji, 1995, 1998, 2003) reported that some of the water beetles in Hong Kong are probably endemic as they have thus far not been recorded in other parts of Mainland China. These include *Sinonychus lantau* (Elmidae) from Ngau Kwu Long near to Tai Ho.

3.4 Marine Benthic Macrofauna

3.4.1 The macro-fauna consist of the invertebrate organisms larger than 1mm living within the sediment (predominantly in the upper well-oxygenated layers). The major conclusion from the previous work in the Northwestern waters (review mostly based on Greiner-Maunsell, 1991; Mouchel, 2001a; 2002c) as summarised in Mouchel (2002b) was that benthic macrofauna present are impoverished and relatively similar throughout the Northwestern waters and are representative of the general study area.

3.4.2 The monitoring results in the Northwestern waters have tended to indicate that the benthic community recorded over approximately the past ten years has remained of similar composition and as with most benthic communities polychaetes are numerically abundant comprising between 44-71% of individuals present and molluscs, crustaceans and echinoderms are also well represented components of the soft-bottom community (Mouchel, 2002b). Echinoderms are, however, not always recorded in the study area (Greiner-Maunsell, 1991) as the larvae of these organisms are often stenohaline (Nicholson, 2001) and unlikely to tolerate the wide salinity fluctuations associated with freshwater discharges from the Pearl River in the wet season.

3.4.3 Infauna diversity in the study area is relatively low ($H' < 2$) compared to other areas in Hong Kong. The impoverished assemblages present is likely due to the proximity of Pearl River Estuary (estuarine areas are often less diverse owing to their highly dynamic physical and chemical nature) and possibly due to the predominantly silt-clay composition of the seabed that tends not to support high diversity (Shin, 1998; Mouchel, 2002b, 2004a; CCPC, 2002).

3.4.4 There is no known macrofauna species of conservation interest in Hong Kong, other than the cephalochordate *Branchiostoma belcheri*. The species is regarded as a living fossil link in the evolution of marine invertebrates to vertebrates and is, therefore, considered a potentially important species. The species, however, is typically recorded in the eastern waters of Hong Kong (CCPC, 2002) although these were also recently recorded to the south of Cheung Chau (Mouchel, 2003b).

3.5 Intertidal Flora and Fauna (Hard and Soft Shores)

3.5.1 The intertidal ecology of Hong Kong is well studied (Morton and Morton, 1983). There were also recent publications that are particularly relevant to the intertidal fauna and flora within areas covered under this Project and these included Mouchel (2000, 2002a), Tam and Wong (2000), Williams (2003) and Chan and Caley (2003).

3.5.2 Various studies of the coastal areas of Northern Lantau (ERM, 2000; Mouchel, 2000, 2002b; Tam and Wong, 2000; Mott, 2003) have revealed that the intertidal fauna and flora present are typical of other locations in Hong Kong although important species such as horseshoe crabs and seagrasses are present within certain bays in the study area. A review of these groups is addressed separately in this Report.

3.6 Coral

3.6.1 Hard corals are protected in Hong Kong by the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187) which includes the protection of all stony (hard) corals. The distribution of hermatypic corals is largely controlled by the requirements of their photosynthesising zooxanthellae which require strong light and hence shallower water, whereas many of the soft corals that do not possess symbiotic algae can survive at greater depths (Morton and Morton, 1983; Morton, 1994). Corals are usually adversely affected by reduced salinity (hyposalinity) and high levels of suspended solids and significant hermatypic coral communities appear to be absent from the study area.

3.6.2 Hard corals have been recorded in the wider study area. The coral communities are, however, sparse compared to rocky reefs of similar depth in the oceanic eastern and southern waters of Hong Kong. A few solitary hermatypic corals (thought to be *Balanophyllia* or *Phyllangia* sp.) have been recorded in the vicinity of The Brothers and soft corals, sea pens and gorgonian corals (sea fans) are also present throughout the Northwestern waters (Mouchel, 2002b, 2003a). Solitary corals have also been reported from Sham Tseng and Tsing Lung Tau adjacent to Castle Peak Road (Mouchel, 2001a). A number of ahermatypic cup corals, pale-blue gorgonian (*Euplexaura* sp.), occasional *Dendronephthya* sp. colonies, isolated sea pens (*Virgularia* or *Pteroides* sp.) and one hermatypic coral *Oulastrea crispata* were also recently recorded at Sham Tseng and Tsing Lung Tau (Mouchel, 2001b). There are also records of hard corals at Sha Chau. Dive surveys conducted in late 1994 at locations around Sha Chau revealed the presence of protected hard corals (Faviidae) in subtidal areas (ERM, 1995). The hard coral species recorded in the Northwestern waters are generally common in local waters (Scott, 1984) although are more abundant in the eastern waters and the study area (comprising Northwestern waters) may represent their westernmost distribution in Hong Kong.

3.6.3 It is notable that the ahermatypic cup coral (*Balanophyllia* or *Phyllangia* sp.) and the pale-blue gorgonian (*Euplexaura* sp.) have only rarely been recorded in the oceanic eastern and southern waters of Hong Kong and it is likely that these species are adapted to the hyposaline waters of the study area (Mouchel, 2001b). The presence of the hermatypic (containing zooxanthellae) coral *Oulastrea crispata* is unusual owing to the prevailing hydrological conditions although total cover was sparse (<1%) and many individuals were in poor condition (Mouchel, 2001b).

3.7 Horseshoe Crabs

3.7.1 Horseshoe crabs are an ancient and taxonomically isolated group (class Merostomata). Three species have been reported in Hong Kong waters namely *Tachypleus tridentatus*, *T. gigas* and *Carcinoscorpius rotundicauda*. The conservation status of the three Indo-Pacific species is listed as "Data Deficient" by the IUCN, indicating that existing knowledge is insufficient to determine whether they are threatened or endangered. Horseshoe crabs have only recently been identified as a species of potential conservation concern in Hong Kong and are not presently protected under local law. All three species appear to be undergoing rapid population declines and are thought to be under severe pressure in the South China Sea, including Hong Kong waters, due to habitat loss, pollution and over exploitation (Huang, 1997; Chiu and Morton, 1999, 2003; Chiu, 2003; Morton and Lee, 2003).

3.7.2 In an extensive study of the distribution of horseshoe crabs in Hong Kong conducted between March 1995 and June 1998 *Tachypleus gigas* was not recorded and its local status is uncertain. It is likely that only two species of horseshoe crab (*T. tridentatus* and C. *rotundicauda*) are currently widely distributed in Hong Kong as no recent records of *T. gigas* are available (Chiu and Morton, 1999; Mouchel, 2002b). Liao *et al.* (2001) also did not record *T. gigas* in their extensive surveys (September 1994 to June 1998) of the South China Sea (from Hainan to Xiamen).

3.7.3 Within the study area, *T. tridentatus* and *C. rotundicauda* have been recorded at Tai Ho Wan, Tung Chung Wan, San Tau and Sha Lo Wan and Sham Wat (Huang, 1997; Chiu and Morton, 1999; Fong, 1999b; Mouchel, 2000, 2002b; Mott, 2003). Specimens of horseshoe crabs collected in the vicinity of the study area during March to September 1996 (ERM, 1997), records mostly from March 1995 to June 1998 (Chiu and Morton, 1999) and between May and January 2004 (Mouchel, ongoing) are presented below in *Table 5.12*.

3.8 Cetaceans

3.8.1 There are fifteen recorded cetacean species from Hong Kong waters although only two of these species, the Indo-Pacific Humpback dolphin (*Sousa chinensis*) and Finless porpoise (*Neophocaena phocaenoides*) are resident (Parsons *et al*., 1995). Until the early 1990s there were few records of *Sousa chinensis* in Hong Kong waters (Jefferson and Leatherwood, 1997) although construction of the international airport at Chek Lap Kok drew attention to the presence of the Indo-Pacific Humpback dolphin in local waters and intensive research into the distribution and conservation requirements of the species have been ongoing since about the mid 1990s.

3.8.2 Although other cetaceans (Finless porpoise and False killer whale) have been found in the Northwestern waters, these are probably extralimmital records and only the Indo-Pacific Humpback dolphin has so far been consistently reported from the study area where it is widely distributed (Parsons *et al*., 1995; Jefferson and Leatherwood, 1997; Jefferson, 2000). There appears to be only limited overlap in distribution of the Indo-Pacific Humpback dolphin and Finless porpoise in local waters as the dolphin tends to be predominantly distributed in the western waters whereas the porpoise is usually recorded from areas further to the east of Hong Kong (the southern coast of Lantau around Fan Lau and the Soko Islands predominantly marks the western edge for the distribution of *Neophocaena phocaenoides*; Parsons *et al*., 1995; Jefferson, 2000).

3.8.3 Globally, the Indo-Pacific Humpback dolphin is widely distributed throughout shallow (< 20 m) coastal waters of the Indian and Western Pacific Oceans, from South Africa in the west to northern Australia and Southern China in the east (Parsons *et al*., 1995; Jefferson, 2000; Jefferson and Karczmarski, 2001). In Hong Kong, *Sousa chinensis* predominantly frequents the less saline brackish waters around the Pearl River Estuary although loss of habitat to numerous developments, fishing, shipping activity and pollution from various sources have placed increasing pressure on the local Indo-Pacific Humpback dolphin population (Liu and Hills, 1997; Jefferson, 2000). In Hong Kong, the dolphin population is centred in the Northwestern waters. The total size of the Pearl River breeding population is difficult to estimate accurately although has been estimated to comprise at least 1,028 individuals with approximately 100 inhabiting Hong Kong's Northwestern waters (Jefferson, 2000; Hung, 2003).

3.8.4 Groups of Indo-Pacific Humpback dolphin are consistently recorded from waters near Tuen Mun and off Lung Kwu Chau, Sha Chau and around the airport although the distribution in Hong Kong may be presently more restricted than when the population was assumed to contain more individuals in the past (Parsons *et al.*, 1995). It should be noted, however, that no reliable census data are available prior to the construction of the Hong Kong International Airport and the hypothesis that the population was larger in the past is only an assumption. The distribution of the dolphin tends to show a slight seasonal response (possibly related to feeding opportunities, as the species is known to feed predominantly on estuarine fish) as individuals tend to move further to the east of the study area during the summer monsoon when ambient seawater is lower in salinity (Jefferson, 2000). In the dry season (winter and spring) the population tends to be concentrated in the waters around the Sha Chau and Lung Kwu Chau Marine Park and to the north of Chek Lap Kok, although individuals are recorded within the entire study area throughout the year (Jefferson, 2000).

3.9 Avifauna

3.9.1 Hong Kong has over 400 naturally-present bird species, including several that are protected under international legislation (Carey *et al.*, 2001). All native bird species are protected in Hong Kong under the Wild Animals Protection Ordinance (Cap. 170).

3.9.2 Surveys at Tai Ho in 1998 revealed the presence of 68 predominantly wetland-dependent bird species (Mouchel, 2000). The major groups present included egrets, herons, eagles, hawks and kingfishers. Notable species recorded included Little Egret, Crested Serpent Eagle, Japanese Sparrowhawk, Crested Goshawk, Bonelli's Eagle, Chestnut-winged Cuckoo, Broad-billed Roller, Chestnut Bulbul, White's Thrush and Pale-legged Leaf Warbler (Mouchel, 2000).

3.9.3 Bird surveys were conducted recently between May 2001 and January 2002 along the broad corridor between Lantau and Sunset Peaks (encompassing both north and south Lantau) and revealed the presence of 46 species (Mouchel, 2002a). Of these species, three were present on north Lantau and considered to be of conservation interest. The three species of conservation interest comprised the Grey Nightjar (*Caprimulgus indicus*), Lesser Coucal (*Centropus bengalensis*) and Greater Coucal (*Centropus sinensis*) (Mouchel, 2002a). The Grey Nightjar is widespread in China although only a scarce passage migrant and summer visitor in Hong Kong (Viney *et al.*, 1994; Yen *et al.*, 1996; MacKinnon and Phillipps, 2000; Carey *et al.*, 2001). In addition, both the Lesser and Greater Coucals, which although common and widespread in Hong Kong where they frequent degraded habitats, are considered to be threatened in China (Wang *et al.*, 1998).

3.9.4 Several species of coastal birds notably ardeids have been recorded on the intertidal mudflats along the north Lantau coast. Over 40 Little Egret (*Egretta garzetta*) were recorded between October and December 2002 in Tung Chung Bay (Mott, 2003). Egrets are widespread and abundant in Hong Kong although increasingly threatened throughout their global range due to development pressures and loss of habitat. Several Little Egret's have been previously recorded from Tung Chung Bay (Carey *et al.*, 2001) and it appears that this location represents an important habitat for this species.

3.9.5 Other notable bird species that have been comparatively recently recorded in the wider study area include Eurasian Eagle Owl *Bubo bubo*, Bonelli's Eagle *Hieraaetus fasciatus*, White-bellied Sea Eagle *Haliaeetus leucogaster* and Dusky Warbler *Phylloscopus fuscatus* (Mouchel, 2002a; Mott, 2003). Although many of the avifauna species recorded are highly mobile, many have highly specific habitat requirements and/or form dense flocks and the assessment of impacts associated with the project will require to consider such factors.

3.10 Terrestrial Mammals

3.10.1 Studies on the distribution of Hong Kong's large mammal fauna have been conducted by Hills and Phillipps (1981), Goodyer (1992) and Reels (1996). Sightings of large mammal species, such as Barking Deer, Wild Boar, Chinese Porcupine, Chinese Leopard Cat, Seven-banded Civet, Masked Palm Civet, Ferret Badger and Chinese Otter were made across the territory but records of larger mammals are scarce for Lantau (Hills and Phillipps, 1981; Goodyer, 1992; Reels, 1996; Mouchel, 2000, 2002a; Mott, 2003).

3.10.2 A recent study for the EIA for Tung Chung Cable Car reported two visual/aural observations of the Barking Deer *Muntiacus reevsii* in Hau Hok Wan and San Tau Valley (Mott, 2003). Another recent EIA of the Tung Chung Road between Lung Tseng Tau and Cheung Sha (Mouchel, 2002a), recorded a dead Ferret Badger (*Melogale moschata*) and signs of civet activity. In addition, surveys undertaken for the Lantau North-South Road Link EIA (Mouchel, 2000) recorded one civet dropping in the upland area near Wong Kung Tin. All these recent mammal surveys together with other previous studies carried out on Lantau (Goodyer, 1992; Reels, 1996) support the conclusion that large mammals are scarce across Lantau Island.

3.11 Insects (Dragonflies and Butterflies)

3.11.1 The odonate fauna of Hong Kong extends to over 100 species, including several that are endemic. Information on species identification, distribution and conservation status have been described by Wilson (1995, 1997, 2003). Wilson (1997) identified a forested area at 600m altitude on the northern slope of Sunset Peak as one of 23 key dragonfly sites in Hong Kong (two other key dragonfly sites were also located on Lantau, around Keung Shan). Streams on Sunset Peak are known to support populations of the endemic *Rhipidolestes janetae* (for which Sunset Peak is presently the only known site used by this species of damselfly in the world) and the near-endemics *Sinosticta ogatai* and *Drepanosticta hongkongensis*. *S. ogatai* and *D. hongkongensis* were previously considered Hong Kong endemics, but were recently discovered on one mountain in Shenzhen, adjacent to the Hong Kong border (Reels, 2001). Another species known to be present in the wider study area, the damselfly *Agriomorpha fusca*, was previously considered restricted to Hong Kong and Guangdong, but has recently also been recorded from Hainan (Wilson and Reels, 2001). The locally uncommon Marsh Dancer *Onychargia atrocyana* has been recorded in Sha Lo Wan (Wilson, 2003).

3.11.2 Some relevant EIA studies (Mouchel, 2000; 2002a) reported a number of dragonfly species of conservation interest in the vicinity of the study area. These include *Agriomorpha fisca*, *Drepanosticta hongkongensis*, *Leptogomphus elegans hongkongensis*, *Meligomphus moluami*, *Protosticta beaumonti*, *Sinosticta ogatai*, *Stylogomphus chunliuae, Zygonyx iris insignis, Macromia* sp and *Pseudagrion microcephalum*. Another recent study carried out by Chan and Lau (2001) also revealed the presence of a locally rare dragonfly *Diplacodes nebulosa* along the Sham Wat Stream.

3.11.3 Over 200 species of butterfly have been recorded from Hong Kong (Bascombe, 1995; Bascombe *et al.*, 1999). A useful account of the local status of butterfly species in Hong Kong was provided by Walthew (1997) later updated by Reels and Walthew (1998). There are no endemic species and, although data on regional rarity are scant, the majority of local species, including most of those that are considered rare in Hong Kong, appear to be widely distributed within southern China and the Asian tropics (Chou, 1994; Bascombe, 1995; Bascombe *et al.*, 1999). The Birdwing Butterfly *Troides helena* and *Trioides aeacus* are the only species of insect currently protected in Hong Kong. The species is well-established between Po Lin and Tung

Chung (Young and Reels, 1998). San Tau is also considered to be an important site for this protected butterfly species (Yiu, 2004).

3.11.4 Some studies documented a number of notable butterfly species of conservation interest in the proximity of the study area. Surveys conducted for the Tung Chung Road EIA (Mouchel, 2002a) revealed the presence of eight butterfly species of conservation interest. These include Large Branded Swift *Pelopidas subochracea*, Palepalm Dart *Telicota colon*, Common Rose *Pachliopta aristolochiae*, Small Grass Yellow *Eurema brigitta*, Pale Cerulean *Jamides celeno*, Black-veined Sergeant *Athyma ranga*, Gaudy Baron *Euthalia lubentina* and Commander *Moduza procris*. The Lantau North-South Link EIA (Mouchel, 2000) reported two species of conservation interest namely Striped Blue Crow *Delias hyparet and* Chestnut Tiger *Parantica sita.* Records from a more recent study (Mott, 2003) include the rare Dragontail *Lamproptera curius* near San Tau Stream together with the protected Birdwing Butterfly *Troides helena* in the vicinity of Tung Chung.

3.11.5 Yiu (2004) also indicated that San Tau is an important location for rare/uncommon butterfly species such as White Dragontail, Red Lacewing, White-edged Blue Baron, Plains Cupid, Falcate Oak Blue and the protected Golden Birdwing. In addition, Sha Lo Wan is also known to support rare/uncommon species namely Swallowtail, Yellow Orange Tip, Dark Blue Tiger, Red Lacewing, Cornelian and Silver Streak Blue (Yiu, 2004).

3.12 Herpetofauna (Reptiles and Amphibians)

3.12.1 Previous studies on Lantau (Lau and Dudgeon, 1999; Mouchel, 2000; Mouchel, 2002a; Mott, 2003) have revealed the presence of a number of herpetofauna species within or adjacent to the study area, including the endemic Romer’s Tree Frog *Philautus romeri* which has a restricted local distribution (Karsen *et al.*, 1998). Romer’s Tree Frog was previously considered to be restricted to only a few locations in Hong Kong and was threatened by the airport development at Chek Lap Kok encompassing Scenic Hill (Karsen *et al*., 1998). Romer’s Tree Frog from Chek Lap Kok were, however, bred in captivity and released at selected sites in the New Territories in the early 1990s. Recent records of Romer’s Tree Frog in areas adjacent to the study area include Lau and Dudgeon (1999) and Mouchel (2002a). An individual Romer’s Tree Frog was previously recorded on Scenic Hill at Chek Lap Kok (Mouchel, 2002a) and previous study (Mouchel, 2002a) has indicated the high ecological value of Scenic Hill as both habitat (secondary woodland) and species (Romer’s Tree Frog) present are of high value and/or conservation interest. In addition, an adult Romer’s Tree Frog and seven tadpoles were recorded on the northern side of Scenic Hill during a survey conducted by the Agriculture, Fisheries and Conservation Department and an another recent survey (July 2004) also revealed the presence of one adult from the same location (AFCD, pers. comm.). These observations indicate that a remnant population of Romer's Tree Frog is extant on Scenic Hill.

3.12.2 Other less common herpetofauna recorded in the broader Tung Chung area included Large-spotted Cat Snake *Boiga multimaculata* and King Cobra *Ophiophagus hannah* (Chan and Lau, 2001). Chan and Lau (2001) also observed the locally uncommon Three-striped Grass Frog *Rana macrodactyla* in the vicinity of Sham Wat Stream while Mouchel (2002a) recorded the globally restricted Short-Legged Toad *Megophrys brachykolos* at the Tung Chung stream and Chinese Cobra *Naja atra* at Shek Mun Kap. The Chinese Cobra is globally restricted to southern China (Karsen *et al*., 1998) and is a CITES Appendix II species. It is also listed as vulnerable in the China Red Data Book. A list of herpetofauna previously reported in areas adjacent to the study area is included in *Table 3.1*.

Table 3.1 Historical Records of Herpetofauna from the wider Study Area

Common Name	**Scientific Name**	**Area**	Remark
Buff-striped Keelback	*Amphiesma stolatum*	Tung Chung	
Large-spotted Cat Snake	*Boiga multimaculata*	Tung Chung	
Copperhead Racer	*Elaphe radiata*	San Tau	
Chinese Cobra	*Naja atra*	Shek Mun Kap stream	Potential Regional Concern (Fellowes *et al.*, 2002). CITES II
King Cobra	*Ophiophagus hannah*	Tung Chung	
Rat Snake	*Pytas* sp.	Sha Lo Wan	
Asian Common Toad	*Bufo melanostictus*	San Tau, Tung Chung	
Short-legged Toad	*Megophrys brachykolos*	Tung Chung Stream	Potential Global Concern (Fellowes *et al.*, 2002)
Ornate Pigmy Frog	*Mirohyla ornata*	Tung Chung	
Marbled Pigmy Frog	*Mirohyla pulchra*	Tung Chung	
Romer's Tree Frog	*Philautus romeri*	Tung Chung, Tung Chung Stream, Shek Mun Kap stream, Scenic Hill	Considered an endemic. Protected in Hong Kong. Potential Global Concern (Fellowes *et al.*, 2002)
Brown Tree Frog	*Polypedates megacephalus*	Tung Chung	
Three-striped Grass Frog	*Rana macrodactyla*	Sham Wat Wan, Tung Chung	
Chinese Bullfrog	*Rana rugiosa*	Tung Chung	Potential Regional Concern (Fellowes *et al.*, 2002).
Gunther's Frog	*Rana guentheri*	Tung Chung	
Paddy Frog	*Rana limnocharis*	Tung Chung	
Tokay Gecko	*Gekko gekko*	Tung Chung	Regional Concern (Fellowes *et al.*, 2002)
Long-tailed Skink	*Mabuya longicaudata*	Chek Lap Kok, San Tau	

Source: Chan and Lau (2001); Mouchel (2002a); Mott (2003); AFCD (pers. comm.)

3.13 Habitats and Vegetation

3.13.1 A recent checklist of the Hong Kong Vascular Plant was published by AFCD (2001) and provides comprehensive information on species locally found. The conservation status of each plant species recorded was derived primarily from the comprehensive studies by Siu (2000), Wu and Lee (2000), Xing *et al*. (2000) and the AFCD (2003).

3.13.2 Previous studies in the area have revealed that naturally developed woodland was present in the ravines along Tung Chung Road and these wooded areas represented old stands (Mouchel, 1998, Mouchel, 2002a). Rare/protected species recorded during the Lantau North-South Link EIA floral surveys (Mouchel, 2000), included the Pitcher Plant *Nepenthes mirabilis,* the seagrass *Halophila beccarii* and some orchids. Floral surveys conducted between June 2001 and January 2002 along the broad corridor between Lantau and Sunset Peaks (encompassing both north and south Lantau) revealed the presence of 319 plant species (Mouchel, 2002a). Of these, four species of conservation interest, *Liparis viridiflora, Acampe rigida, Pavetta hongkongensis* and *Artocarpus hypargyreus* were identified. A recent floral survey conducted for the Tung Chung Road Cable Car EIA (Mott, 2003) also reported several rare/protected plant species including the shrub *Enkianthus quinqueflorus*, *Camellia euryoides* and two orchids, *Pholidota chinensis* and *Spathoglottis pubescens*. In the EIA study Brief for this project, the rare sedge *Carex leucochlora* was highlighted while the Biodiversity Survey recorded a very rare sedge *Carex tristachya* in Hau Hok Wan (Xing, 2000; Scott, 2002).

3.13.3 Some fung shui woods are present within the study area and these woods are located behind Pak Mong, San Tau and Sha Lo Wan Village. Floral survey (Mott,

1998) recorded the presence of a locally restricted tree species *Ormosia semicastrata* in Pak Mong fung shui woods (Xing *et al*., 2000).

Seagrass and Mangroves

3.13.4 Seagrass beds and mangroves are recognised in the TM (Annex 16, Note 2) as important coastal communities as they provide habitat for several species including fish and spawning and nursery grounds for horseshoe crabs. The San Tau SSSI was established in 1994 (AFCD, 2003) due to the important mangrove, eelgrass and seagrass community present. There is a large amount of existing data on the mangal and seagrass habitats present in the study area (e.g., Fong, 1998, 1999a, 1999c; Tam and Wong, 2000; Mouchel 2002a). Previous studies (Tam and Wong, 2000, Mouchel, 2000, 2002a) revealed the presence of some notable species of conservation interest within the study area. These included the important seagrass species *Halophila beccarii, H. ovata, Zostera japonica*, and restricted species such as *Bruguiera gymnorrhiza*, *Lumnitzera racemosa* and *Thespesia populnea*.

4. Field Survey Methodology

4.1 Background

4.1.1 Field work focussed on habitats and species identified in the literature review where adequate data were not available. Other habitats and species groups were also surveyed to characterise the ecology of the study area and prepare an ecological profile. The surveys comprised both wet and dry seasons between September 2003 and March 2004.

4.1.2 The purpose of the ecological surveys was to focus on the optimal census technique and survey period when each animal group was likely to be encountered. The overall quality of the Study is dependent on selecting the correct survey period and survey technique. The survey effort also focussed on those areas mostly likely to be impacted by the Project such as landing points and tunnel portals.

4.2 Freshwater and Estuarine Fish

4.2.1 Streams distributed in the study area and notably from Sham Wat to Sha Lo Wan, Tung Chung Bay and Tai Ho Wan were surveyed and the fish present identified by direct observation and active sampling. Both methods were used as active sampling was not effective for sensitive species whereas direct observation (with or without a diving mask) was not effective or possible at locations subject to high turbidity. As much of the Study Area is coastal, many of the aquatic habitats present are subject to marine water influence and both the habitat and fish assemblages present are characteristic of estuarine conditions.

4.2.2 Fish surveys were carried out on the 25, 27 September, 22, 23 October, 15, 16 December 2003, 17 and 18 February, 12 and 13 April an 12 May 2004. In order to facilitate the description of species-habitat quality on a stream by stream basis, individual stream courses were numbered for reference (*Figures 2.1 – 2.4*). All fish were identified to species level and abundance recorded.

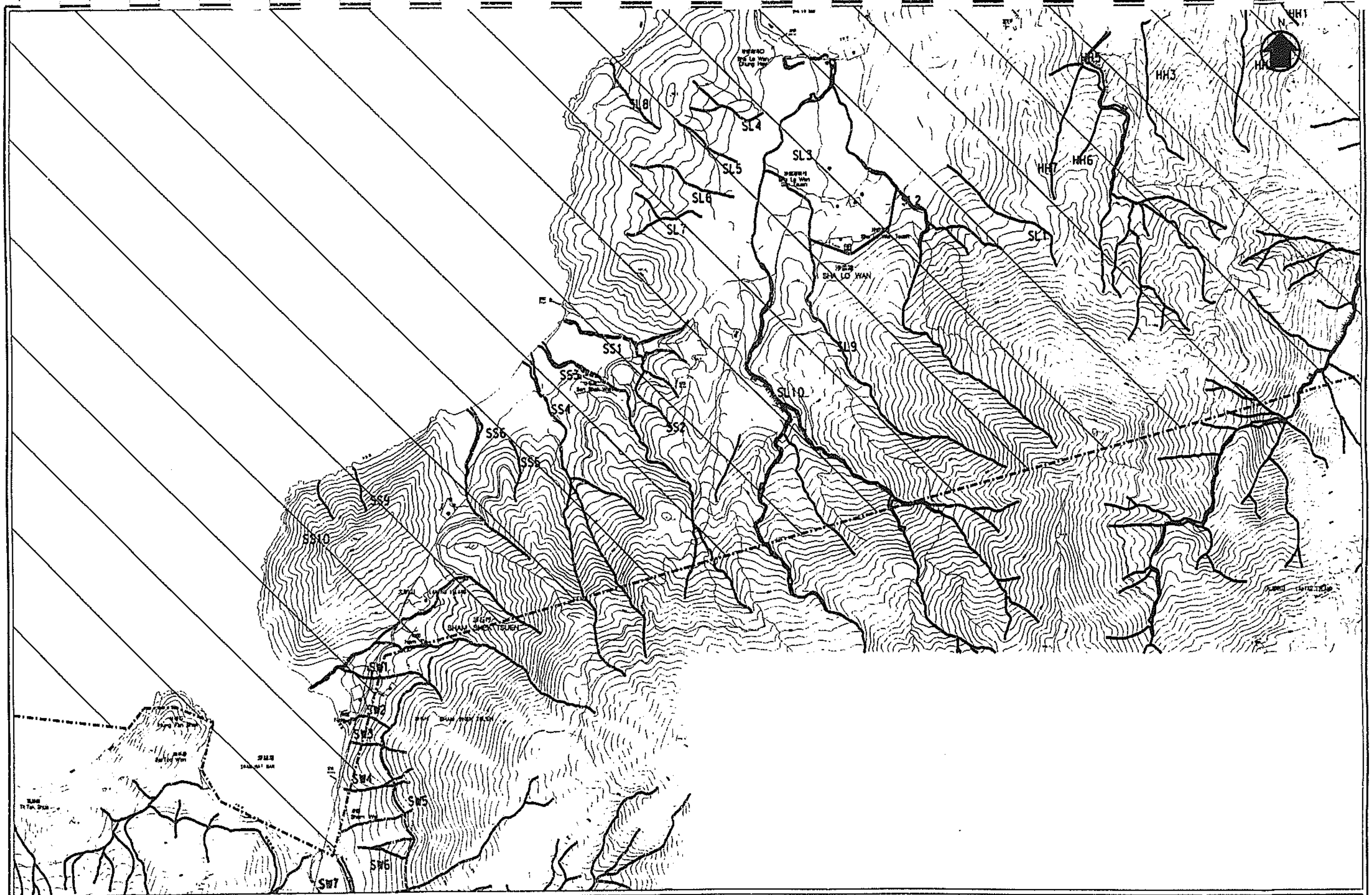
4.3 Freshwater Macroinvertebrate

4.3.1 Freshwater macroinvertebrates were sampled at representative sites (riffle, pool) along each major stream course. Five, 3-minute standardized kick samples were collected at each sampling location. Macroinvertebrates were identified to suitable taxonomic resolution (e.g., Dudgeon, 1999) and habitat quality established through the use of biotic indices (e.g., Abel, 1996).

Biotic Index

4.3.2 Stream water quality was calculated using the Biological Monitoring Working Party (BMWP) biotic index. This index is easily calculated and only requires the fauna present to be identified to the family level. Each family present is assigned a score (based on their relative tolerances to pollution) and the BMWP score is the sum of the individual scores for the families recorded at each sampling location (Abel, 1996). The score does not take into account abundance or the presence of several species from the same family in the sample during the BMWP calculation and the index can, therefore, be rapidly calculated using relatively simple taxonomic resolution.

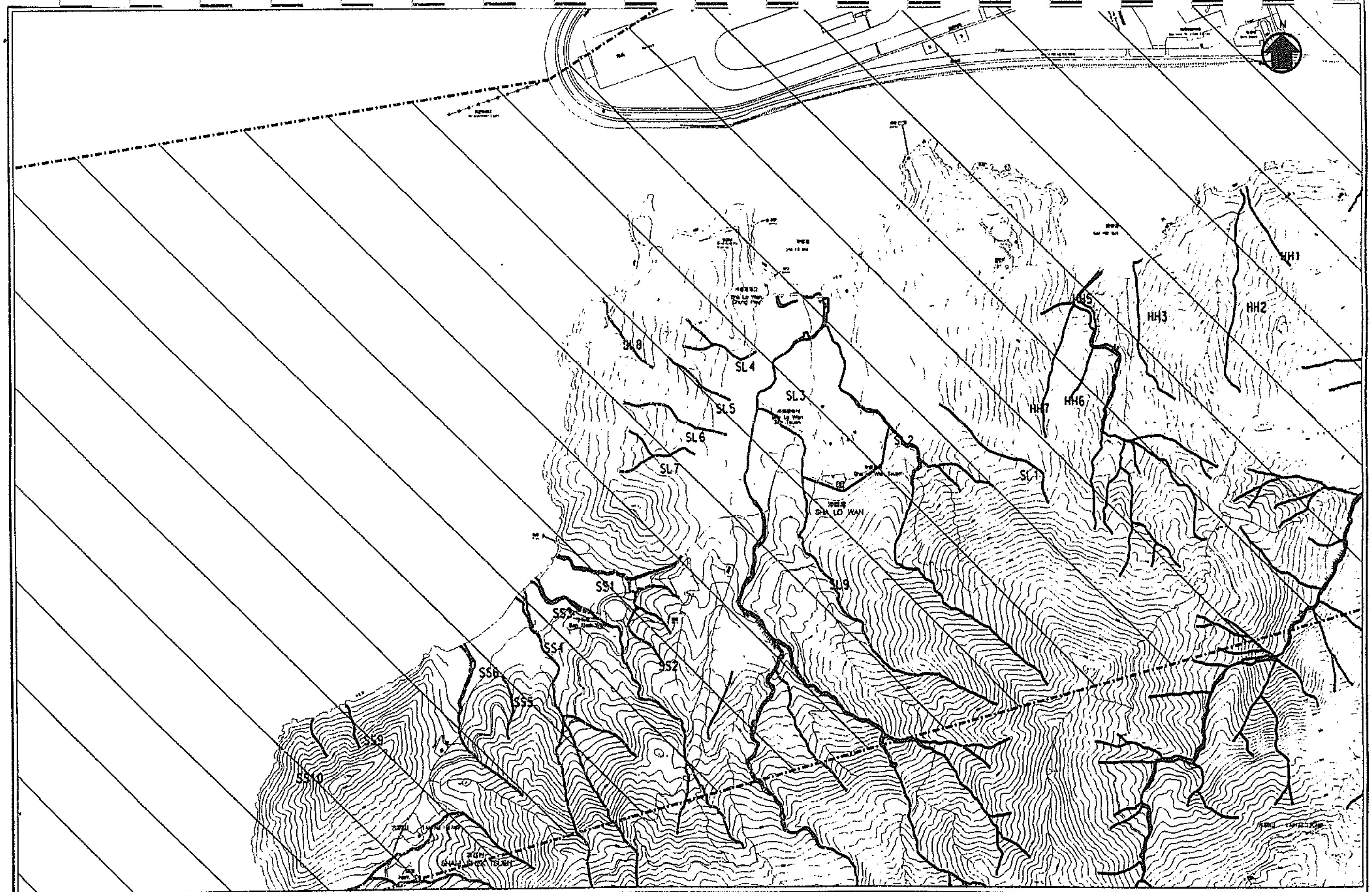
4.3.3 The BMWP score provides a classification (based on pollution tolerance/intolerance) of each sampling location which represents the current ecological condition (health)



Streams and Tributaries Surveyed between September 2003 and May 2004

Meinhardt Mouchel

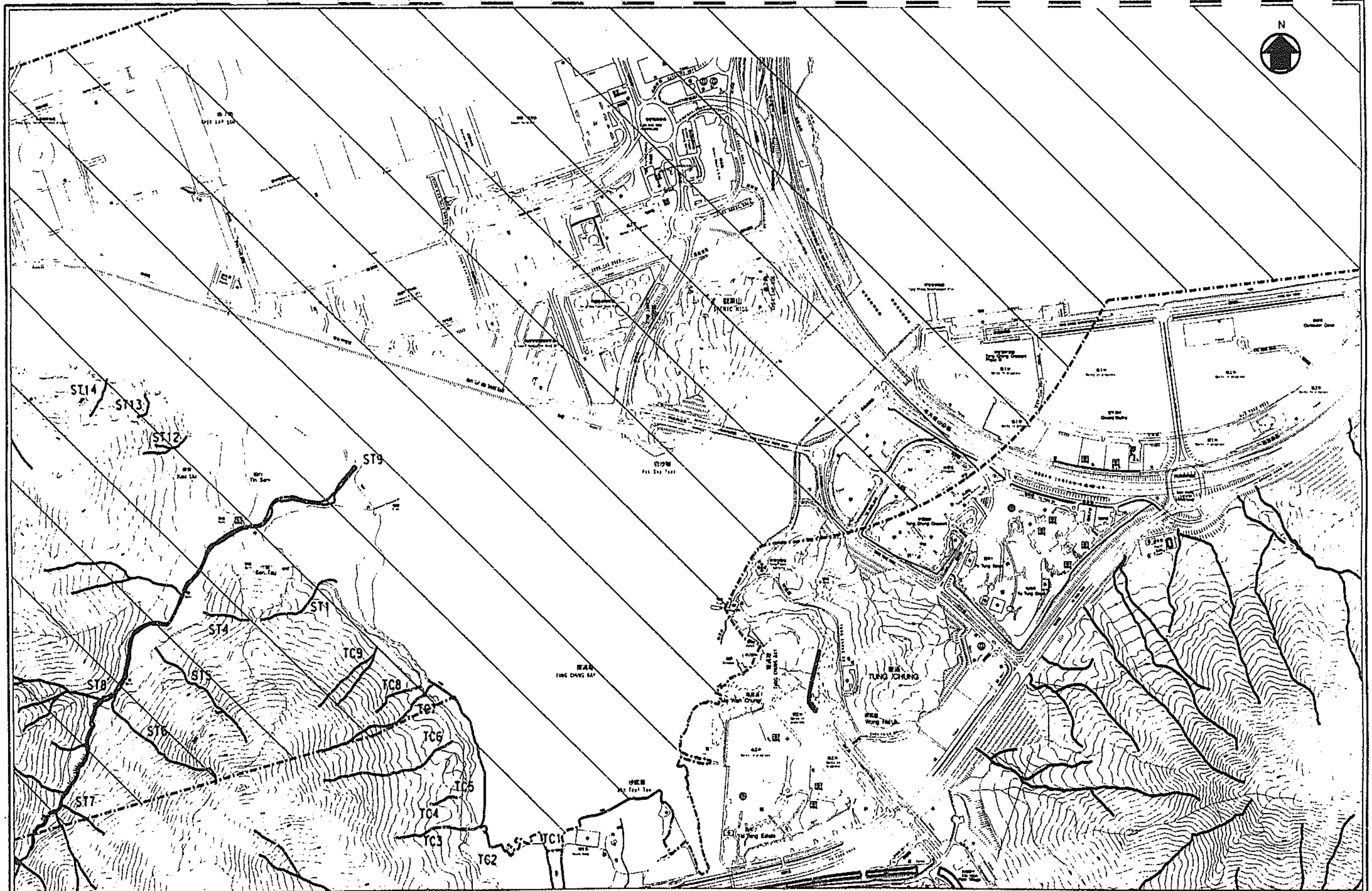
Figure No. 2.1



Streams and Tributaries Surveyed between September 2003 and May 2004

Meinhardt Mouchel

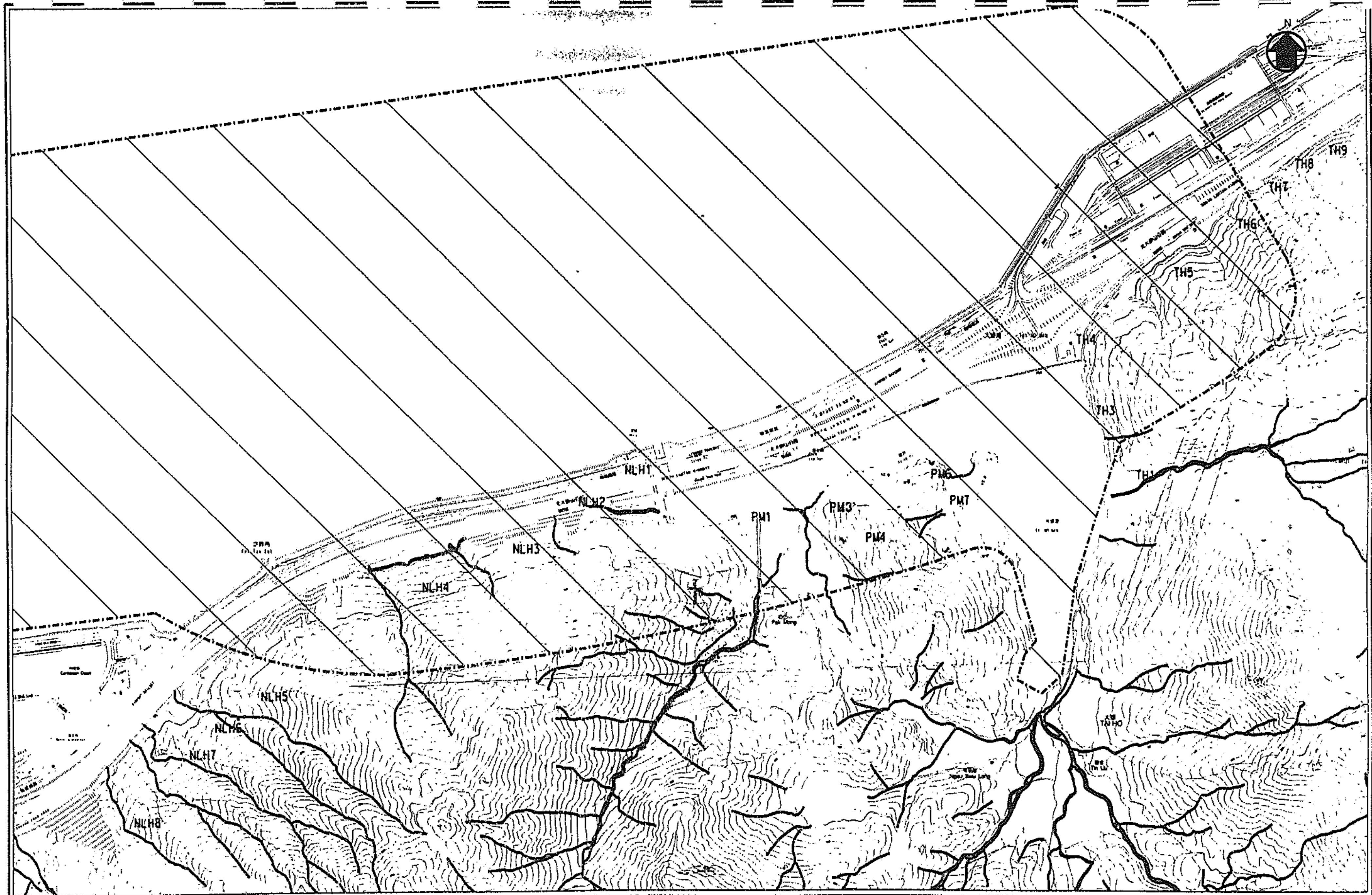
Figure No. 2.2



Streams and Tributaries Surveyed between September 2003 and May 2004

Meinhardt Mouchel

Figure No. 2.3



Streams and Tributaries Surveyed between September 2003 and May 2004

Meinhardt Mouchel

Figure No. 2.4

and also helps to summarise a large amount of ecological information into a single representative value. The BMWP scores are presented in *Table 4.1* below.

Table 4.1 The BMWP Scores used to Calculate the Biotic Index for Freshwater Macrofauna

Family	Score
Siphlonuridae, Heptageniidae, Leptophlebiidae, Ephemerellidae, Potamanthidae, Ephemeridae, Taeniopterygidae, Leuctridae, Capniidae, Perlodidae, Perlidae, Chloroperlidae, Aphelocheiridae, Phryganeidae, Molannidae, Beraeidae, Odontoceridae, Leptoceridae, Goeridae, Lepidostomatidae, Brachycentridae, Sericostomatidae	10
Astacidae, Lestidae, Agriidae, Gomphidae, Cordulegasteridae, Aeshnidae, Corduliidae, Libellulidae, Psychomyiidae, Philopotamidae	8
Caenidae, Nemouridae, Phyacophilidae, Polycentropidae, Limnephilidae	7
Neritidae, Viviparidae, Ancylidae, Hydroptilidae, Unionidae, Corophiidae, Gammaridae, Platycnemididae, Coenagriidae	6
Mesovelidae, Hydrometridae, Gerridae, Nepidae, Naucoridae, Notonectidae, Pleidae, Corixidae, Haliplidae, Hygrobiidae, Dytiscidae, Gyrinidae, Hydrophilidae, Clambidae, Helodidae, Dryopidae, Elminthidae, Chrysomelidae, Curculionidae, Hydropsychidae, Tipulidae, Simuliidae, Planariidae, Dendrocoelidae	5
Baetidae, Sialidae, Piscicolidae	4
Valvatidae, Hydrobidiae, Lymnaeidae, Physidae, Planorbidae, Sphaeriidae, Glossiphoniidae, Hirudidae, Erpobdellidae, Asellidae	3
Chironomidae	2
Oligochaeta (whole class)	1

4.3.4 A total of six macroinvertebrate stream surveys were carried out between September 2003 and January 2004. The sampling locations are presented on *Figure 3*.

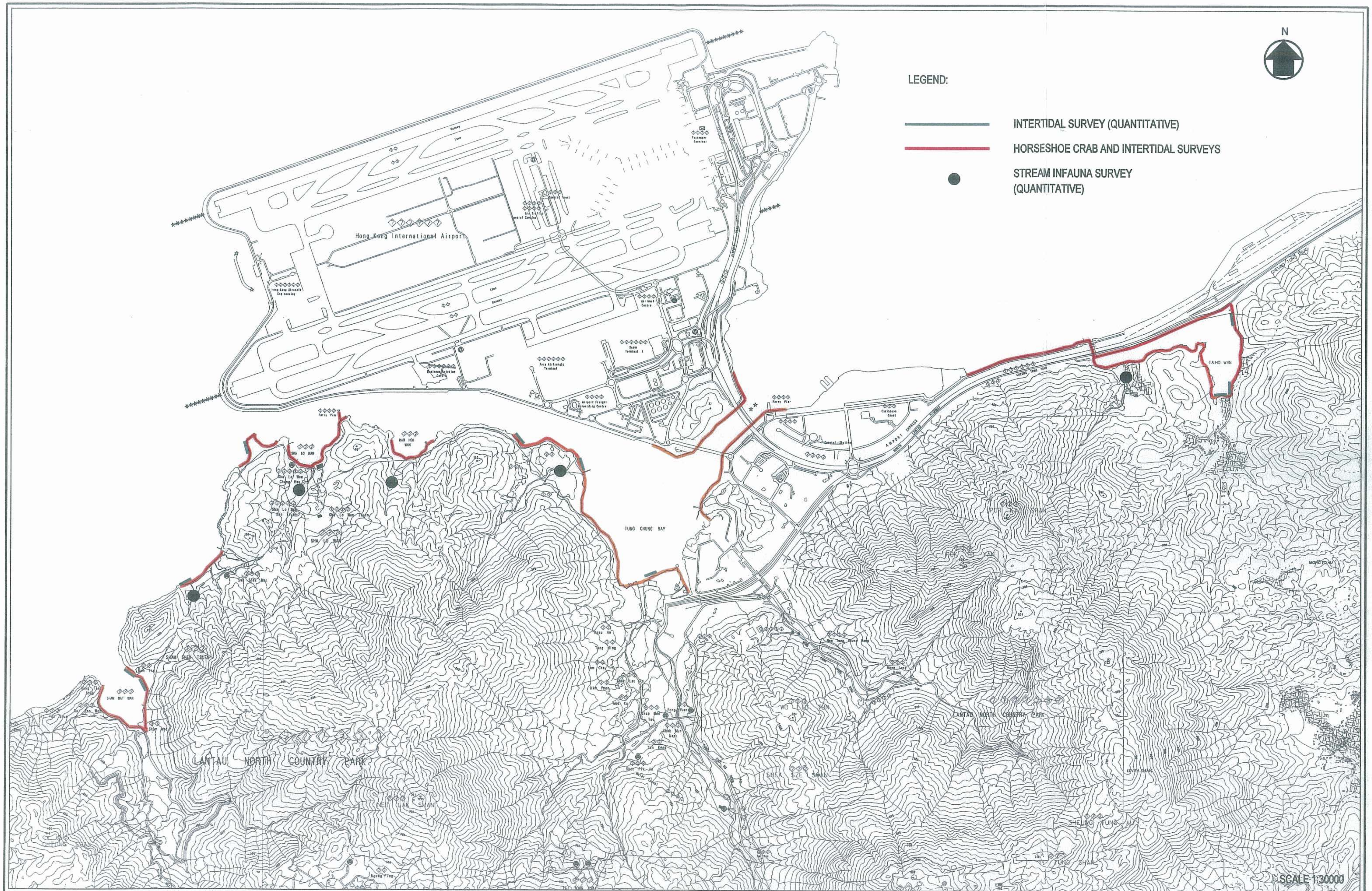
4.4 Marine Benthic Macrofauna

4.4.1 Marine benthic sampling was carried out in both the wet (2 October 2003) and dry season (7 January 2004) using a modified van veen grab (capacity of ~11.3 litres; top surface area ~30 x 32 cm^2). Five grab samples were collected in each of three areas namely the Hong Kong Section (HKS1-HKS5), Tung Chung Channel (NLHC1-NLHC5) and Tai Ho Wan (THW1- THW5). The locations of the benthic macro-fauna sampling stations are presented in *Figure 4*. The stations are delineated into three areas, comprising the following:

- Hong Kong Section (HKS1 – HKS5);
- Tung Chung Channel (NLHC1 – NLHC5); and
- Tai Ho Wan (THW1 – THW5).

4.4.2 Sampling methodology, design and analysis are discussed in the following sections. During this reporting period, a suite of biological-based assessments were carried out to determine the macrofaunal community structure of the study area. The sampling stations were located in areas likely to be disturbed by the project and were mostly located directly under the alignment.

Sampling Design and Analysis

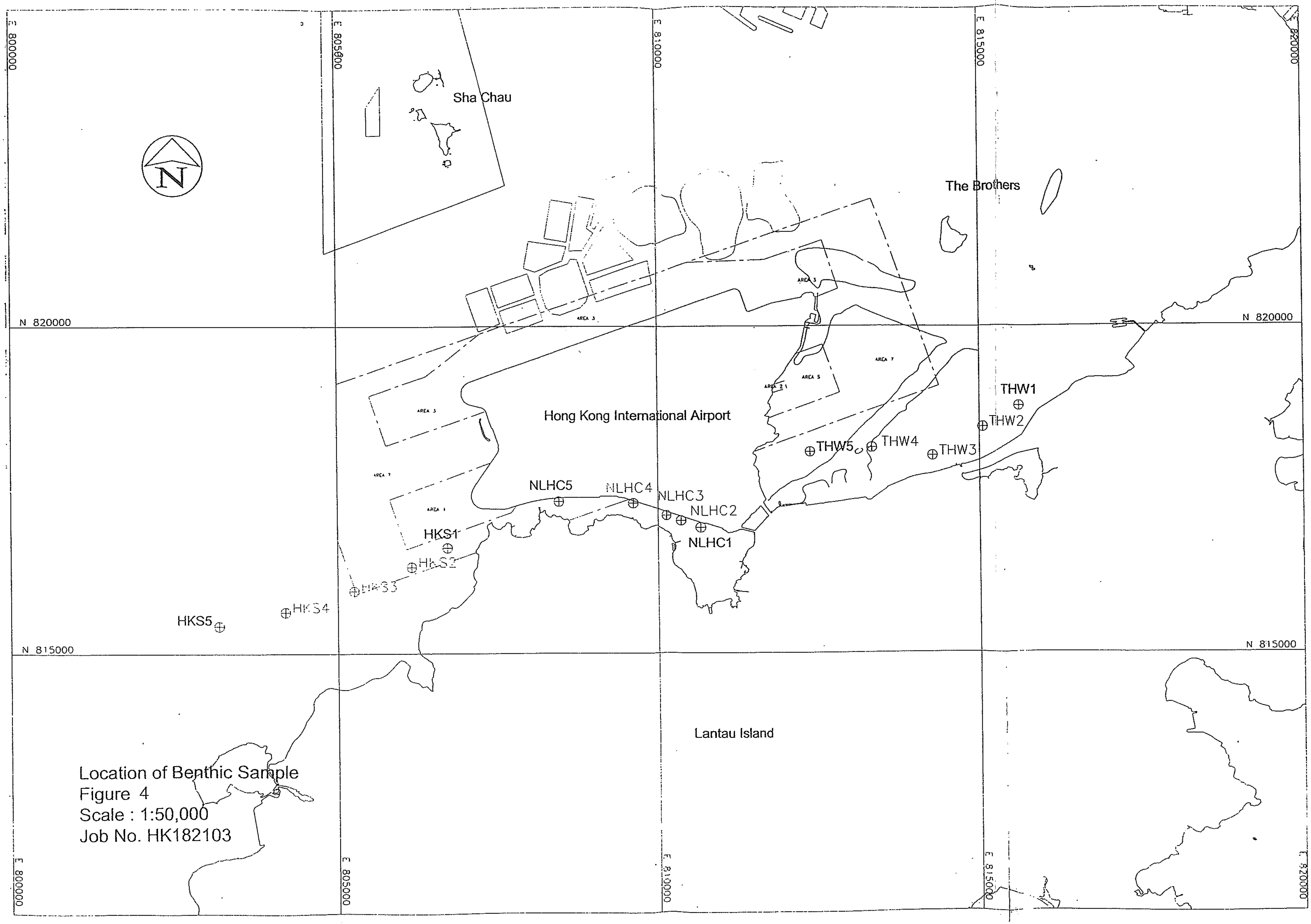


Location of Intensive Intertidal, Horseshoe Crab and Stream Macrofauna Survey Sites

Meinhardt Mouchel

Figure No. 3

K:\F90929\REPORT\SUPPLE FINAL BASELINE\FIG_3.DGN



Location of Benthic Sample
Figure 4
Scale : 1:50,000
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4.4.3 The benthic macrofauna samples were analysed for a suite of biological characteristics including composition and number of individuals present. The community diversity of benthic assemblages was also calculated. The distribution of biomass amongst the benthic macrofauna present were also plotted because ecological theory suggests that the distribution of numbers of individuals among species in macrobenthic communities are unbalanced through pollution and disturbance (Warwick, 1986). By plotting the abundance and biomass of the macrofaunal organisms present (abundance biomass comparisons referred to as ABC plots), it is possible to determine the prevailing level of disturbance at each location. The ABC plots were constructed using PRIMER (version 4.0) software. The macrofauna present were also used to derive a biological index (biotic index) of sediment quality in the three areas. The following major biological parameters were determined from the benthic macro-fauna samples:

- Faunal abundance;
- Faunal biomass;
- Faunal diversity;
- Species composition; and
- Trophic structure.

Field Sampling Procedures

4.4.4 Following accurate positioning of the survey vessel (using the dGPS navigation system), a modified van Veen grab sampler was deployed at each of the sampling locations. A replicate grab sample was obtained at each station (5 Hong Kong Section; 5 Tung Chung Channel; 5 off Tai Ho Wan; $\sum n = 15$). Any grab sample showing uneven penetration into the seabed or only partially filled with sediment was rejected. Sediment subsamples (approximately 1 kg) were also collected for particle size and total organic carbon analysis (only samples from selected stations HKS1, HKS5, NLHC1, NLHC5, THW1 and THW5 were analysed) and the remaining sediment was processed for benthic macrofauna.

4.4.5 For preliminary sediment processing on the survey vessel, each sample was gently sieved through a 1.0 mm and 0.5 mm mesh sieve and carefully worked through the sieves using seawater. The material retained on each of the sieves was then washed gently into labelled, double-bagged plastic Ziploc bags and the contents fixed in 5% buffered formaldehyde in seawater containing Rose Bengal (the Rose Bengal vital stain assisted the differentiation of organisms from non-living material when processed in the laboratory because biota stains pink).

Laboratory Procedures

4.4.6 Adequate fixation of the benthic organisms was achieved through holding samples for a minimum of 24 hours in formaldehyde. Following fixation, the samples were gently rinsed with freshwater to remove excess formaldehyde into a 250 μm sieve. All faunal material retained in the sieve was then preserved in a 70% ethanol solution and placed in Petri dishes labelled with the original label from the time of collection. The organisms were then sorted from the sediments by twice scanning the samples held in the Petri dish under a dissecting microscope. The benthic organisms were identified in the laboratory to the lowest possible taxonomic level (usually genus although dominant macrofauna were identified wherever possible to species) and identification of smaller organisms was conducted using a high power compound microscope. Following sorting and identification, organisms were retained in labelled vials and preserved in 70% ethanol. Biomass was determined by taking the blotted wet mass of each taxon.

Statistical Techniques and Pattern Searching Tools

4.4.7 A suite of univariate statistical techniques were used to determine any statistically significant differences in community attributes such as abundance, biomass and species diversity present in the benthic faunal assemblages between areas. These techniques are discussed further below.

Analysis of Variance (ANOVA)

4.4.8 Analysis of variance (ANOVA) was adopted to compare the univariate benthic parameters of the three areas. Where statistically significant differences were detected between areas, multiple comparison procedures (Student-Newman-Keuls) were employed to determine which areas support significantly different community attributes. For the purposes of this Investigation, a significant difference was considered apparent at a significance level of 0.05 (i.e., $\alpha \leq 0.05$).

Diversity Index

4.4.9 Diversity indices are reasonably useful in determining the benthos condition (health) and provide a numerical value that is derived from both the number of species present in the community and also from the distribution of individuals between those species. Generally, the more stable the environment the higher the community diversity although note that there are exceptions. Diversity was assessed at the species/genus level and analysed using the Shannon-Wiener index ($\log_{10}$).

ABC Plots and *W* Statistic

4.4.10 The Abundance-Biomass Comparison (ABC) curve is a technique that plots abundance and biomass data for each station on the same graph and provides useful information on the prevailing ecological condition. When conditions are stable, interspecific competition results in a community composed of *k*-dominated species (i.e., those species that are typically of a larger size, long-lived and have a population that is reasonably constant in time). When the prevailing conditions are unstable such as due to pollution, *r*-selected (opportunist) species dominate and these organisms tend to be of a smaller size, have shorter life-spans and undergo wide fluctuations in their population size. By plotting the abundance and biomass of the macrofaunal organisms along the x-axis of the graph and cumulative percentage dominance on the y-axis, it is possible to determine the pollution status of each area.

4.4.11 The *W* statistic is calculated from the ABC procedures and can also serve as a useful measure of disturbance and/or pollution. The *W* statistic also reduces each plot to a single summary statistic that is helpful for interpretation of impacts in marine benthic communities by non-specialists. The *W* statistic has a range of –1 to 1 with the former value representing transposition of the abundance and biomass curve (i.e., the abundance curve overlies the biomass curve) representative of gross pollution whereas the latter value represents even abundance and biomass dominated by a single species although it is unlikely that either limit is reached in practice (Clarke and Warwick, 1994).

Multivariate Techniques

4.4.12 Multivariate statistical techniques analyse numerous variables simultaneously and are important tools in assessing environmental disturbances and pollution. These pattern searching techniques are useful in assessing impacts as they measure and compare biological and environmental variance in the large and complex data sets generated by the monitoring programme and plot the similarity (and dissimilarity) of monitoring station attributes into easily understood diagrams (maps). The non-metric form of MDS has been used extensively in marine benthic ecological studies and is useful because it maximises the agreement between ranks of pairwise dissimilarities and the ranks of the distances in the ordination plot rather than actual distance and dissimilarity values. An advantage of the non-metric MDS is that because ranks rather than actual distances are used, outliers (that are frequently observed in macrofaunal assemblages) are not allowed to dominate the ordination.

Biotic Index

4.4.13 Biotic indices are useful in determining sediment quality because they rely on the individual tolerances of the benthic macrofauna present to both natural stressors such as wide salinity fluctuations and anthropogenic pressure including pollution. The biological index used in this study is based on the model proposed by Borja *et al*. (2000, 2003). The biological indicator model is based on the sensitivity of ecological groups and the index is easily calculated based on the percentage of each group collected in each sampling location. The results obtained provide a classification (based on pollution tolerance/intolerance) of each area which represents the current ecological condition (health) and also helps to summarise a large amount of ecological information into a single representative value.

4.4.14 The calculated index is used to derive a series of single values from 0 to 7 with 0 representing a healthy benthic community while 7 represents an azoic situation (no macrofauna present possibly due to highly polluted nature of the sediment). Where species are not assigned to an ecological group, they are omitted from the model calculation. The interpretation of the measured biotic index is based on the groupings presented below in *Table 4.2.*

Table 4.2 Biotic Index for Soft-bottom Marine Macrofauna

Pollution Classification	Calculated Range of Biotic Indices (BI)	Biotic Index	Dominant Ecological Group	Benthic Community Condition (Health)
Unpolluted	$0.0 < BI \leq 0.2$	0	I	Normal
Unpolluted	$0.2 < BI \leq 1.2$	1		Impoverished
Slight pollution	$1.2 < BI \leq 3.3$	2	III	Unbalanced
Mean pollution	$3.3 < BI \leq 4.3$	3		Transitional to polluted
Mean pollution	$4.3 < BI \leq 5.0$	4	IV-V	Polluted
Heavy pollution	$5.0 < BI \leq 5.5$	5		Transitional to heavily polluted
Heavy pollution	$5.5 < BI \leq 6.0$	6	V	Highly polluted
Extreme pollution	Azoic	7	Azoic	Azoic

Adapted from Borja *et al*. (2000, 2003).

4.5 Intertidal Flora and Fauna (Hard and Soft Shores)

4.5.1 Marine intertidal biota show distinct patterns of zonation on the shore. The species present on the lower shore are typically marine-dependent whereas those species found higher up the shore are better adapted to a terrestrial habitat and this results in distinct patterns of distribution on intertidal shores. In addition to showing zonation patterns, intertidal shore flora and fauna are also typically patchily distributed. In order to survey the shoreline accurately, belt transects were placed at different vertical heights up the shore and quadrats randomly placed along the transects in order to ensure that an accurate (non-biased) assessment was made of the species present.

4.5.2 Two 10m belt transects were laid (perpendicular to the shoreline) at approximate 1mCD intervals up the shore being surveyed. Ten $0.25m^2$ quadrats were placed randomly along each transect. Substrate type, faunal species abundance and percentage cover of macroalgae was recorded within each quadrat. A total of ten intertidal surveys were conducted on 18, 25, 26 September, 21, 22 October and 18, 19 November 2003, and 7, 15, 16 January 2004 together with an additional half-day survey conducted on 2 October 2003. The locations of intertidal survey sites are presented in *Figure 3*.

4.6 Coral

4.6.1 A qualitative dive survey (October 2003) was used to determine the presence of corals. The survey technique used a tiered methodology to assess sub-littoral benthic communities, in particular, corals, in the proposed landing areas. The survey design consisted of a suite of three standardised 'nested' survey methods: spot-check dives, Rapid Ecological Assessment (REA) and video transects. In an effort to increase survey efficiency the spot-check dives was used to determine if more detailed quantitative surveys, i.e., REA and video assessments, are necessary.

Spot-check reconnaissance dives

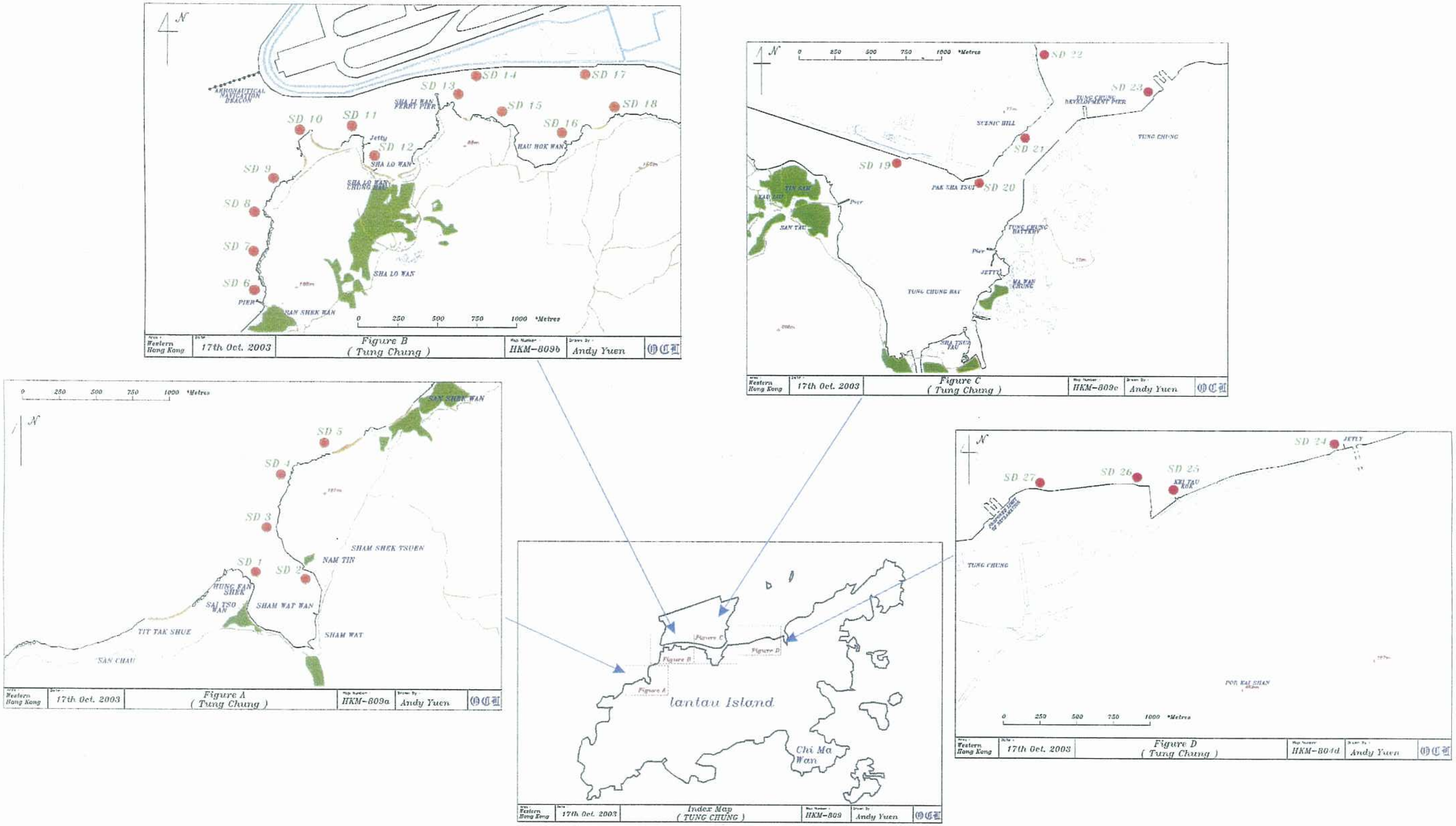
4.6.2 A SCUBA diver assessed the substrate and other marine benthos for the presence of coral communities. These 'spot-check' dives were distributed in and around each survey area at a density that was sufficient to locate any major coral areas and to reliably assess the type of benthos existing in each survey area. The starting location and direction were chosen to ensure most of the area within the specified depth zone (to the end of the hard substrate) was examined. For each dive the following information was recorded:

- location (GPS);
- depth range;
- visibility;
- estimate of % hard coral and soft coral cover;
- substrate type;
- distance surveyed;
- coral species and other invertebrates present.
- health of any corals located.

4.6.3 In this way, areas with significant quantities of corals were located and suitable locations to carry out further surveys determined. In order to decide upon areas where REA and video surveys were necessary, the estimate of hard and soft coral was classified into one of four levels: no coral cover, less than 5% cover, between 5% and 10% cover and over 10% cover. At the start of the project, a coral survey was conducted on 15 October 2003. A total of twenty-seven spot dives were conducted along the coastline of the study area as shown in *Figure 5.* As only a few corals were recorded in the study area and they were of low ecological value, no further surveys using REA and video transects were suggested.

4.7 Horseshoe Crabs

4.7.1 Walk over surveys concurrent with the intertidal surveys were conducted to assess the presence of horseshoe crabs notably in Sham Wat, San Shek Wan, Sha Lo Wan, Hau Hok Wan, San Tau, Tung Chung Bay and Tai Ho Wan. Approximately 1-2 hours of survey effort was allocated at each bay during every survey. Survey effort was, however, later (April and May 2004 surveys) increased to approximately six hours per survey to focus on localities considered to be nursery grounds including



Locations of Coral Surveys

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Figure No.

5

Sham Wat, Tung Chung Bay and Tai Ho Wan. These areas are known nursery grounds or that appeared to provide suitable habitat (typically well-aerated sediment substrates near to seagrass beds; substratum adjacent to streams).

4.7.2 Horseshoe crab surveys were conducted on 18, 25, 26 September, 21, 22 October, 18, 19 November 2003, 7, 15, 16, January, 11, 23 March, 23 April and 5, 6 May 2004. Additional surveys, with a duration of approximately 30 minutes to 5 hours, were undertaken on 2 and 25 October 2003, 25 January and 17 February 2004. The location of the horseshoe crab sites surveyed between September 2003 and May 2004 is presented in *Figure 3.*

4.8 Avifauna

4.8.1 The majority of avifauna surveys were conducted in the early-morning onwards as bird activity is generally higher during this period and both activity and singing decrease later in the day, particularly during hotter periods (Gibbons *et al*., 1996). Standardised line transects were used to accurately and rapidly survey the avifauna present in the study area. In addition, night surveys were conducted in order to assess the activity of nocturnal species. It should be noted, however, that most bird species are active during the day and only a limited number of nocturnal species such as owls, nightjars and species that frequently call at night were likely to be encountered.

4.8.2 As the study area was comparatively large, standardised line transects were used to assess the bird species present. Point counts (Bibby *et al*., 1992) were not considered to be the optimal census technique owing to the wide spatial range of the study area. Standardised line transects are preferred for rapid ecological assessment and were undertaken in habitats representative of the whole study area such as coastal areas, mudflats, woodland, plantation woodland and shrubland. Location of these line transects are presented in *Figure 6a*.

4.8.3 The rationale for conducting the avifaunal surveys during the wet and dry seasons was to ensure that resident species, autumn migrants and winter visitors were detected (note that these seasonal terms are used for reference only and although they follow the terminology used in the majority of local bird studies, they are not strictly correct in Hong Kong where the terms wet or dry season are applicable). The periods of the year that are notable for avifauna activity and/or migration patterns in Hong Kong are detailed below (adapted from Viney *et al*., 1994) and adjusted to reflect patterns in shrubland and forest from observations by Kwok (1996), Leven (2001) and previous surveys on Lantau Island (Mouchel 2000, 2002a):

- January-March: wintering species are present and cold weather can lead to the migration of birds from Mainland China. Both numbers and diversity of bird species in shrubland and forest declines progressively.
- April- May: spring passage of many migrant bird species. By mid-April the breeding season of resident species and newly-arrived summer visitors is underway.
- June-July: hot and humid period; numbers of local breeding birds are highest but overall species diversity is at its annual low point.
- August-October: autumn passage of birds starts in mid-August and continues until early November. Arriving winter visitors are present from mid-October.
- November-December: resident and wintering species are present and species diversity in shrubland and forest is highest.

4.8.4 Daytime surveys of the study area were conducted on 24 and 30 September, 20, 21, 24 and 29 October, 5, 19 and 28 November, 19 and 22 December 2003, 26, 27 January, 18, 23 February, 17, 31 March, 15, 30 April and 11, 12, 27 May 2004 together with an additional half-day survey on 2 October 2003. In order to accurately

Location of Line Transects for Avifauna Survey

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Figure 6a

assess the presence of nocturnal species, night surveys were conducted on 23, 28 and 30 October, 5 and 27 November 2003, 17 and 19 February 2004, 19 and 27 April and 27 May 2004 with binoculars and a powerful search light. A map showing the area surveyed for birds over the period of September 2003 until May 2004 is presented in *Figure 6b*.

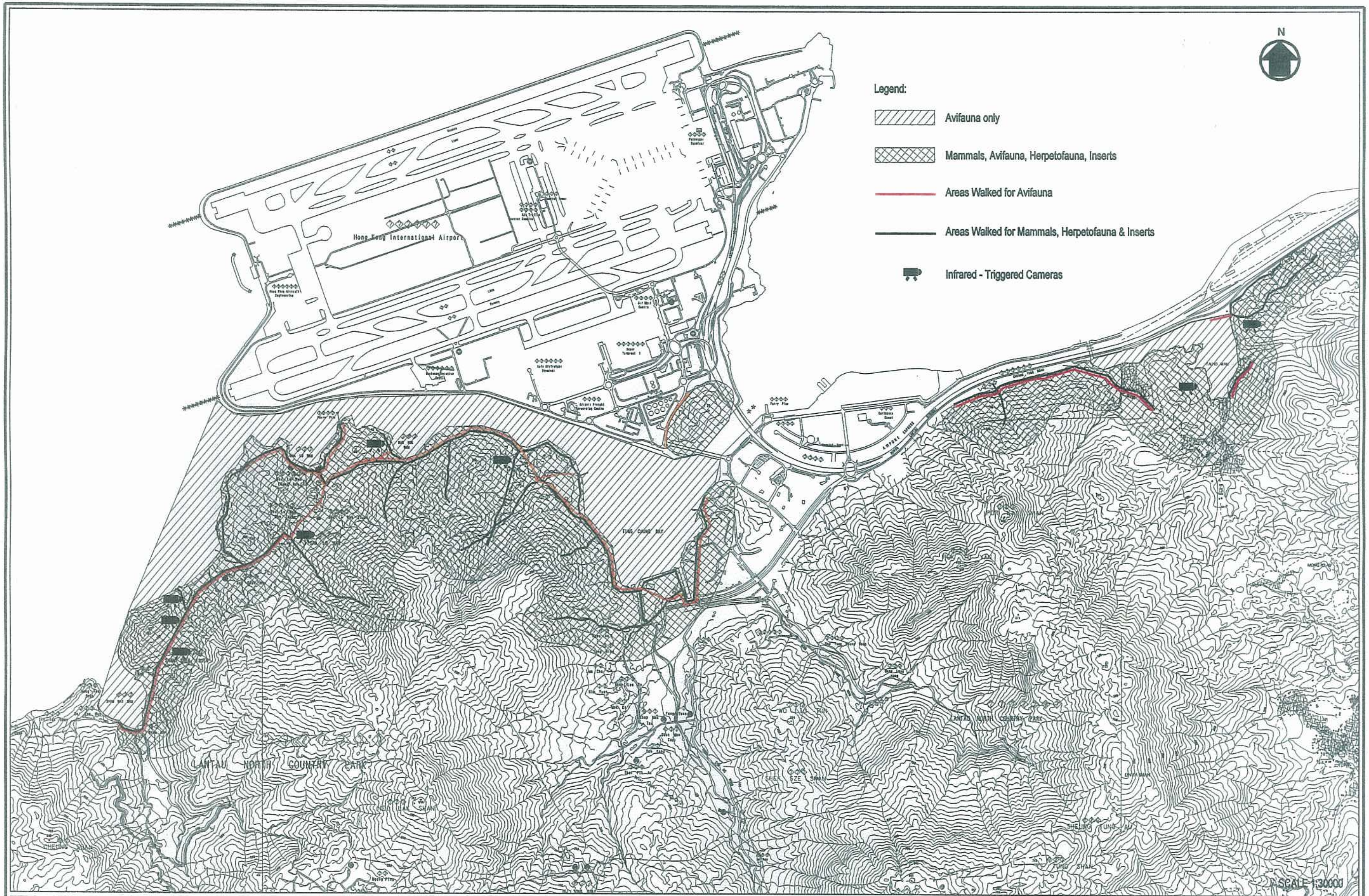
4.8.5 The following literature were consulted to provide information on the status of existing avifauna present in the study area and provide an indication of the rarity of species present both in Hong Kong and Southern China.

- Birds of Hong Kong and South China (Viney *et al*., 1994);
- A Field Guide to the Birds of China (Yen *et al*., 1996);
- A Field Guide to Birds of China (MacKinnon and Phillipps, 2000); and
- The Avifauna of Hong Kong (Carey *et al*., 2001).

4.9 Terrestrial Mammals

4.9.1 Mammal surveys did not include any element of trapping, since this is an intrusive and potentially harmful technique, and the main conservation interest lies in larger mammals, that appear to be scarce on Lantau (Goodyer, 1992; Reels, 1996; Mouchel, 2002a). Day-time searches for mammal activity (prints, burrows and scats) were used and night-time spot-lighting or auditory detection of larger mammals (most of which are primarily nocturnal) were adopted. In addition, passive surveys by the use of a Trailmaster combined camera and infra-red monitoring apparatus was set up in appropriate habitat locations within the study area. The camera was operated for 5-day periods and mammal species photographed were identified.

4.9.2 There were fourteen active day-time surveys, covering the wet and dry seasons, and were undertaken on 20 and 25 September, 2, 8, 24, 27 and 28 October, 5, 25 and 26 November 2003, 22 and 27 January, 16 and 17 March, 9, 12 and 18 May 2004. Night surveys were undertaken on 22 and 25 September, 5, 8, 23 and 27 October, 5 November and 10, 15 December 2003, 17 and 19 February, 20, 27 April and 9, 18 May 2004. Passive surveys were also carried out by setting up infra-red triggered camera sets and four surveys were undertaken between 20 and 25 September, 8 and 13 October, 10 and 15 December 2003 and 22 and 27 January 2004. A map showing the area surveyed for mammals from September 2003 to May 2004 is presented in *Figure 6b*.



Areas Surveyed for Avifauna, Mammals, Herpetofauna and Insects (September 2003 to May 2004)

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Figure No. 6b

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4.10 Insects (Butterflies and Dragonflies)

4.10.1 The focus of the insect surveys was on dragonfly, damselfly and butterfly groups. These insect groups are generally known to be indicators of a high quality habitat and the dragonflies and damselflies require clean freshwater for the successful completion of the larval stages of their lifecycle (Mouchel, 2002a). Special attention was given to habitat often frequented by dragonflies such as streams and riparian shrubland/woodland. Within these broad habitats, various micro-habitats (riffles, pools, small cut-off ponds, mossy banks, seepages, and overhanging vegetation) support different dragonfly species and all these micro-habitats were investigated. Dragonflies were identified with the aid of binoculars, and a telescopic hand net was also used to capture specimens for identification in the hand (when necessary).

4.10.2 Butterfly surveys were conducted in tandem with the dragonfly surveys, using similar methodology. Although most butterflies are readily observed, some species are cryptic and stay close to the ground in shady wooded areas. Others tend to stay on top of the canopy, making only short rapid flights before settling out of view. Accordingly, both of these microhabitats were investigated, by ground searching and by sweeps with a long-handled (5m) butterfly net.

4.10.3 The qualitative insect surveys were spread throughout the 6 month survey period covering both the wet and dry seasons. Late wet season data were collected on 20 and 25 September and 2, 8, 23, 24, 27 and 28 October 2003. Dry season data were collected on 5, 25 and 26 November 2003, 10 and 15 December, 22 and 27 January, 17 and 19 February 2004. Additional early wet season surveys were conducted on 16 and 17 March, 9 and 12 May 2004 during the day-time and 20, 27 April, 9, 13, 18 May 2004. A map showing the area surveyed for insects from September 2003 to May 2004 is presented in *Figure 6b*

4.11 Herpetofauna

4.11.1 Reptiles and amphibians surveys were conducted by active searching in all habitats, with particular attention given to potential shelters sites and hiding places such as streams and watercourses. Frogs and toads were surveyed by auditory as well as visual detection. As most of the amphibian species are more active during night time, surveys were also conducted at night.

4.11.2 The herpetofauna surveys were spread throughout the 9 month survey period covering both the wet and dry seasons. Late wet season data were collected on 20 and 25 September and 2, 8, 24, 27 and 28 October 2003 during the day-time and 22, 25 September, 5, 8, 23, 27 October 2003 during the night-time. Dry season data were collected on 5, 25 and 26 November 2003, 22, 27 January and 17, 19 February during day-time and 5 November and 10, 15 December during night-time. Additional early wet season surveys were carried out on 16, 17 March and 9, 12, 18 May 2004 during the day-time and 20, 27 April and 9, 18 May during the night-time.

4.12 Habitats and Vegetation

4.12.1 A habitat survey was conducted to identify and delineate the distribution of different ecological habitats found within the study area, making use of the latest available aerial photographs from the Lands Department and supplemented by a reconnaissance field survey. Reconnaissance field surveys were undertaken to field check and verify the information with focus on those areas to be directly affected by the HZMB. General habitat attributes such as vegetation type, structural complexity, or degree of disturbance will be noted and photographs taken during the field study. A habitat map of the study area was prepared at a scale of 1:15000.

4.12.2 A floral survey was conducted to identify the presence within the study area of any plant species of conservation interest. Surveys were conducted by using a stratified sampling technique and covering all representative habitat types found during the habitat mapping. Stratified sampling involved dividing the study area into sub-areas (strata) that differ in vegetation density and then these sub-areas are randomly surveyed. The sub-area is selected prior to the field investigation through preliminary data and aerial photographs. This method is an efficient means of sampling habitat types present and provides better results than by simple random sampling.

4.12.3 During the floral surveys, the location of rare or protected plant species were noted, and the number of individuals present counted. Floral characteristics including species list and relative abundance were provided. To date, seventeen field surveys have been conducted on 25 September and 16, 26, 28 October and 2, 4, 15, 29, 30 November and 2 December 2003, 26, 28 January and 22, 25, 26 March and 6, 7 May 2004.

5. Baseline Ecological Conditions

5.1 Freshwater and Estuarine Fish

5.1.1 The surveyed streams supported native upstream species (primary freshwater fish), migratory species (diadromous fish that migrate between freshwater and saltwater systems) as well as coastal species (brackish water fish). During field surveys, it was noted that many of stream courses within the study area were found to be seasonal (such as TH3-4, TH6-9, PM4, PM6-7) and these streams are, therefore, expected to have limited fish fauna due to insufficient discharge to support fish life on an annual basis. These surveyed streams pass through various vegetated habitats such as woodlands, shrubby grasslands and cultivated fields. In order to facilitate the description of species-habitat quality on a stream by stream basis, individual streams were numbered for reference (*Figures 2.1-2.4*).

5.1.2 During the course of the surveys, 67 fish species were recorded and these are presented below in *Table 5.1*. Survey results confirmed that the Tai Ho, Tung Chung and Sham Wat streams in particular, support high fish diversity and species of conservation interest. Details of the survey results are presented in *Appendix B*.

Table 5.1 Freshwater and Estuarine Fish Species Recorded in the Study Area between September 2003 and May 2004

Species name	Occurence[1]	Location[2]					
		Sep 03	Oct 03	Dec 03	Feb 04	Apr 04	May-04
Acanthopagrus berda (Forsskål, 1775)	8			SW7, SL3, PM1	SW7, TC2, PM1, PM3	SL3, TC2, PM1	SW7, SL3, ST9, TC1, TC2, PM1, TH1
Acanthopagrus latus (Houttuyn, 1782)	6			PM1	PM1, PM3	SL3, PM1	SW7, SL3, TC1, PM1, PM3, TH1
Acentrogobius caninus (Valenciennes, 1837)	6	ST9		ST9	ST9		SL3, ST9, TC1, PM1, PM3, TH1
Acentrogobius viridipunctatus (Valenciennes, 1837)	5	ST9		SW1	SW1		ST9, TC1, PM1, TH1
Acrossocheilus beijiangensis (Wu & Lin, 1977)	1			TC1			
Ambassys gymnocephalus (Lacepède, 1802)	7	SW7, SL3, TC1	SW1, SL3, TC1, PM1, TH1	SW1, SW7, SL3, TC1, TH1	SW1, SW7, SL3, TC1, PM1, TH1	SW7, SL3, TC1, TH1	SW1, SW7, SL3, ST9, TC1, PM1, TH1
Anguilla japonica (Temminck & Schlegel, 1846)	9	SW1, ST9	SW1, SL3, ST9, TC1, PM1, TH1	SW1, SS4, SL3, ST9, TC1, PM1, TH1	SW1, ST9, TC1, PM1, TH1	ST9, TC1, TH1	SW1, SW7, SL3, ST9, TC1, PM1, TH1
Anguilla marmorata (Quoy & Gaimard, 1842)	2			SW7			TH1
Bathygobius meggetti (Hora & Mukerji, 1936)	13	SW1, SL3, ST9, TC1	SW1, SW7, SS1, SS3, SS4, SS6, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS1, SS3, SS4, SS6, SL3, ST9, TC1, PM1	SW1, SW7, SS1, SS3, SS4, SS6, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS1, SS4, SS6, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS1, SS4, SS6, SL3, HH5, ST9, TC1, PM1, PM3, TH1
Butis butis (Hamilton, 1822)	7	SL3	SL3, PM1, PM3, TH1	SW1, SW7, SL3, TC1, TH1	SW1, SW7, SL3, PM1, PM3, TH1	SW1, SW7, SL3, PM1, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Butis koilomatodon (Bleeker, 1849)	4	ST9		SW1, SW7, SL3	SL3		ST9
Capoeta semifasciolata (Günther, 1868)	6	SL3, TC1		SW1, SW7, TC1, PM1	SW1, SW7, TC1, PM1	SW1, SW7, SL3, TC1, PM1	SW1, SW7, SL3, TC1, PM1, TH1
Channa asiatica (Linnaeus, 1758)	5			SW7	SW7, TC1		SL3, TC1, PM1, TH1
Chelon subviridis (Valenciennes, 1836)	8		SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Cirrhinus molitorella (Valenciennes, 1844)	1	TC1		TC1			
Clarias fuscus (Lacepède, 1803)	7			SW1, SL3, TC1, TC3, PM1	SW1, TC1	SW1, SL3	SW7, SL3, TC1, PM1, TH1
Eleotris acantopoma acanthopoma (Bleeker, 1853)	8	SW1, SW7, SL3, ST9	SW1, SW7, SL3, ST9, PM1, PM3, TH1	SW1, SW7, SL3, ST9, PM1, TH1	SW1, SW7, SL3, ST9, PM1, PM3, TH1	SW1, SW7, SL3, ST9, PM1, PM3, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Eleotris melanosoma (Bleeker, 1852)	3	SL3, TC1		SL3, TC1	SL3, TC1	TC1	TC1, TH1

Species name	Occurence[1]	Location[2]					
		Sep 03	Oct 03	Dec 03	Feb 04	Apr 04	May-04
Eleotris oxycephala (Temminck & Schlegel, 1845)	5	SL3	PM1	SW7, SL3, PM1	SW7, SL3, PM1	SL3, PM1	SL3, ST9, PM1, TH1
Gambusia affinis affinis (Baird & Girard, 1853)	6	SL3, TC1, TC2, TC3	SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1
Gerres filamentosus (Cuvier, 1829)	6			SW7, SL3, TC1, TH1	SW7, SL3, TC1, PM1, PM3, TH1	SW7, SL3, PM1, PM3, TH1	SW7, SL3, TC1, PM1, PM3, TH1
Gerres poeti (Cuvier, 1829)	8			SW1, SW7, SL3, TC1, PM1, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Glossogobius giuris (Hamilton, 1822)	9	SW1, SW7, SL3, ST9, TC1	SW1, SW7, SL3, ST9, TC1, PM1, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1
Glossogobius olivaceus (Temminck & Schlegel, 1845)	9			SW1, SW7, SS1, SL3, HH5, TC1, PM1, TH1	SW1, SW7, SS1, SL3, TC1	SW1, SL3, TC1	SW1, SL3, ST9, TC1, TH1
Lateolabrax japonicus (Temminck & Schlegel, 1843)	2			SW7			SW7, TC1, TH1
Lates calcarifer (Bloch, 1790)	2			SW7		SL3	SL3, TH1
Liniparhomaloptera disparis disparis (Lin, 1934)	9	SL3, ST6, ST7, ST8		SW7, SL3, ST6, ST7, ST8, ST9, PM1	SL3, SL10, ST8, PM1	SL3, ST6, ST7, ST8, ST9, PM1	SL3, ST6, ST7, ST8, ST9, PM1, TH1
Luciogobius guttatus (Gill, 1859)	14	SW1, TC1	SW1, SS1, SS6, SL3, ST9, TC1, PM1	SW1, SW7, SS1, SS3, SS4, SS6, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SS1, SS6, SL3, ST9, TC1, PM1, PM3	SS1, SL3, ST9, TC1, PM1	SW1, SW7, SS1, ST9, TC1, PM1, PM3, TH1
Lutjanus argentimaculatus (Forsskål, 1775)	8	SW1, SW7, SL3, TC1	SW1, SW7, SL3, TC1, PM1, PM3	SW1, SW7, SL3, TC1, PM1, PM3	SW1, SW7, SL3, TC1, PM1, PM3	SW7, SL3, TC1, PM1, TH1	SW1, SW7, SL3, ST9, TC1, PM1, TH1
Lutjanus russellii (Bleeker, 1849)	3			SW7		SL3	SL3, TH1
Macropodus opercularis (Linnaeus, 1758)	1			TC1	TC1		
Misgurnus anguillicaudatus (Cantor, 1842)	8			SW7, ST6, ST7, ST8, TC1, PM1			SW7, SL3, TH1
Momopterus albus (Zuiew, 1793)	2			SL3			PM1
Mugil cephalus (Linneaus, 1758)	7	SW1, SW7, SL3, TC1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Mugilogobius abei (Jordan & Snyder, 1901)	11	SW1, SW7, SL3, ST9, TC1	SW1, SW7, SS6, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS3, SS4, SS6, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS6, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS6, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SS6, SL3, HH5, ST9, TC1, PM1, PM3, TH1
Mugilogobius chulae (Smith, 1932)	8	SW1, SL3, TC1	SW7, SL3, ST9, TC1, PM1, PM3, TH1	SW7, SL3, ST9, TC1, PM1, PM3	SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1
Mugilogobius obliquifasciatus (Wu & Ni, 1985)	2	TC1, TC2		TC1, TC2	TC1, TC2	TC1, TC2	TC1, TC2
Nicholsicypris normalis (Nichols & Pope, 1927)	2		SW1	SW1, SW7	SW1	SW1	SW1
Oreochromis mossambicus (Peters, 1852)	7	TC1, TC2, TC3	SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1	SW7, SL3, TC1, TC2, TC3, PM1, TH1	SW7, SL3, TC1, TC2, TC3, PM1, TH1
Oreonectes platycephalus (Günther, 1868)	8	SL3		SW1, SW7, SL3, ST6, ST7, ST8, PM1	SW1, ST8	SW1, ST6, ST7, ST8, PM1, PM3	SW1, SW7, SL3, ST6, ST7, ST8, PM1
Orizias curvinotus (Nichols & Pope, 1927)	1	TC1		TC1	TC1		
Paralichthys olivaceus (Temminck & Schlegel, 1846)	2			SW7, TC1	SW7, TC1		
Parazacco spilurus (Günther, 1868)	9	SL3, ST6, ST7, ST8, TC1	SL3, ST6, ST7, ST8, TC1, PM1	SW7, SL3, ST6, ST7, ST8, TC1, PM1	SW7, SL3, ST8, TC1, PM1	SW7, SL3, ST6, ST7, ST8, TC1, PM1	SW7, SL3, ST6, ST7, ST8, TC1, PM1, TH1
Pisodonophis boro (Hamilton, 1822)	2						TC1, PM1
Pisodonophis cancrivorus (Richardson, 1848)	5	SW7, SL3, TC1		TC1, PM1	TC1, TH1		
Plecoglossus altivelis (Temminck et Schlegel, 1846)	1						TH1

Species name	Occurence[1]	Location[2]					
		Sep 03	Oct 03	Dec 03	Feb 04	Apr 04	May-04
Plotosus anguillaris (Bloch, 1794)	5			SL3, TC2			SW7, SL3, TC1, TH1
Pseudogastromyzon myersi (Herre, 1932)	7	SL3, ST6, ST7, ST8		SW7, SL3, ST6, ST7, ST8, PM1	SL3, ST8, PM1	SL3, ST6, ST7, ST8, PM1	SL3, ST6, ST7, ST8, PM1, TH1
Pseudogobius javanicus (Bleeker, 1856)	9	SW1, SW7, SL3, ST9, TC1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1
Rhinogobius duospilus (Herre, 1935)	17	SL3, ST9	SL3, NLH4, NLH5, NLH6, NLH7, NLH8, PM1, TH1, TH5	SW7, SS2, SS3, SS4, SS6, SL3, HH5, NLH4, NLH5, NLH6, NLH7, NLH8, PM1, PM3, TH1, TH5	SW7, SS2, SS3, SS4, SS6, SL3, HH5, NLH4, NLH5, NLH6, NLH7, NLH8, PM1, PM3, TH1, TH5	SW7, SS2, SS3, SS4, SS6, SL3, ST9, NLH4, NLH5, NLH6, NLH7, NLH8, PM1, PM3, TH1, TH5	SW7, SS2, SS3, SS4, SS6, SL3, ST9, NLH4, NLH5, NLH6, NLH7, NLH8, PM1, PM3, TH1, TH5
Rhinogobius giurinus (Rutter, 1897)	7	ST9		SW7, PM1, TH1	SW7, PM1, TH1	SW7, PM1, TH1	SW7, SL3, ST9, TC1, PM1, PM3, TH1
Rhynchorhamphus georgii (Valenciennes, 1847)	7		SL3, TC1, PM1, PM3, TH1	SW7, SL3, TC1	SW7, SL3, TC1, PM1		SW1, SW7, SL3, TC1, PM1, TH1
Scatophagus argus (Linnaeus, 1766)	6	SW1, SW7, SL3	SW1, SW7	SW1, SW7, SL3, TC1, PM1, TH1	SW1, SW7	SL3	SL3
Schistura fasciolata (Nichols & Pope, 1927)	10	SL3, ST6, ST7, ST8		SW1, SW7, SL3, ST6, ST7, ST8, ST9, PM1	SW1, SL3, SL10, ST8, PM1	SW1, SL3, ST6, ST7, ST8, PM1	SW1, SW7, SL3, ST6, ST7, ST8, PM1, TH1
Siganus fuscescens (Houttuyn, 1782)	9			SW1, SW7, SL3	SW1, SW7, SL3, HH5		SL3, ST9, TC1, PM1, PM3, TH1
Sillago japonica (Temminck & Schlegel, 1843)	7			SW1, SW7, SL3	SW1, SW7		SW1, SW7, ST9, TC1, PM1, PM3
Sillago shihama (Forsskål, 1775)	5			SW1, SW7, SL3	SW1, SW7, SL3, PM1, TH1	SL3, TH1	SW1, SW7, SL3, PM1, TH1
Silurus cochinchinensis (Valenciennes, 1840)	6	SL3	SW1, SL3, TC1, PM1	SW1, SL3, TC1, PM1	SW1, SL3, TC1, PM1	SW1, SL3, PM1	SW1, SW7, SL3, PM1, TH1
Takifugu niphobles (Jordan & Snyder, 1901)	8	SL3, TC1		SW7, TC1, TH1	SW7, TC1, PM1, PM3, TH1	SW1, SW7, TC1, PM1, PM3, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Takifugu obscurus (Abe, 1949)	6			SW7, TC1, TH1		SW7, SL3, ST9, PM1, TH1	SW1, SW7, SL3, ST9, TC1, PM1, TH1
Takifugu ocellatus (Linnaeus, 1758)	5			SW7, ST9, TC1, PM3, TH1	ST9	ST9	
Terapon jarbua (Forsskål, 1775)	8	SW1, SW7, SL3, TC1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, TC1, PM1, PM3, TH1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1
Tridentiger bifasciatus (Steindachner, 1881)	9	SW1, SW7, SL3, ST9, TC1	SW1, SW7, SL3, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1
Tridentiger trigonocephalus (Gill, 1859)	9			SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW1, SW7, SL3, HH5, ST9, TC1, PM1, PM3, TH1	SW7, ST9, TC1, PM1	SW7, ST9, TC1, PM1
Tylosurus strongylurus (Van Hasselt, 1823)	3			SW7, TC1	TH1		SW7, TH1
Xiphophorus hellerii (Heckel, 1848)	2			SW7, TC1			
Xiphophorus variatus (Meek, 1904)	2	TC1		SW7, TC1			

[1]This refers to the total number of stream courses (as listed in the location columns) where the species was recorded; [2]HH = Hau Hok Wan; PM = Pak Mong; SL = Sha Lo Wan; SS = San Shek / Sham Shek Tsuen; ST = San Tau; SW = Sham Wat; TC = Tung Chung; TH = Tai Ho.

5.1.3 Notable fish species of conservation interest recorded in the streams include the *Acrossocheilus beijiangensis*, (Tung Chung Stream), *Anguilia marmorata* (Sham Wat Stream and Tai Ho Stream), *Channa asiatica* (Pak Mong Stream, Sha Lo Stream, Sham Wat Stream, Tai Ho Stream and Tung Chung Stream), *Oryzias curvinotus* (Tung Chung Stream), *Plecoglossus altivelis* (Tai Ho Stream), *Takifugu ocellatus* (Pak Mong Stream, San Tau Stream, Sham Wat Stream, Tai Ho Stream and Tung Chung Stream). Among these, *Acrossocheilus beijiangensis*, *Anguilia marmorata* and *Oryzias curvinotus* are of global concern and the remaining two species are considered locally/regionally restricted. The locations where these fish were recorded are shown in *Figures 2.1-2.4.*

5.1.4 Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis* was recorded in Tung Chung Stream (TC1) during the survey in December 2003. This species was first reported in Hong Kong by Chong and Dudgeon (1992) and was until recently known only from Tung Chung Stream within the Territory (Mouchel, 2002a). However, this fish has also recently been recorded in the Wong Lung Hang Stream (Chan, 1998) and is considered to be of conservation interest (global concern; Fellowes *et al*., 2002).

5.1.5 The locally common Predaceous Chub *Parazacco spilurus* was recorded in a number of streams including Sha Lo Wan (SL3), Sham Wat (SW7), Pak Mong (PM1), Tung Chung (TC1), Tai Ho (TH1) and San Tau (ST6, ST7 and ST8) and this species was recorded during all fish surveys. This species is listed as "Vulnerable" in the China Red Data Book. However, this is more a reflection of lack of fish research in the region than of the real vulnerability of the species (Mouchel, 2002a).

5.1.6 The Giant Mottled eel *Anguilla marmorata* was recorded in Sham Wat (SW7) and Tai Ho (TH1) during the surveys conducted in December 2003 and May 2004. The population of *Anguilla marmorata* was reported to be in marked decline locally and considered a species threatened globally (Fellowes *et al*., 2002). This species is also listed in the China Red Data Book.

5.1.7 The Chinese Moon Snakehead *Channa asiatica* were recorded in Sham Wat Stream (SW7), Tung Chung Stream(TC1), Sha Lo Stream (SL3), Pak Mong Stream (PM1) and Tai Ho Stream (TH1) during December, February and May 2004 surveys. The overall population of this species has been in marked decline and this species is considered to be of local concern (Fellowes *et al*., 2002). The species is, however, distributed in several streams in Hong Kong and also cultured for food (Lam, 2002).

5.1.8 The Ricefish *Oryzias curvinotus* was recorded in Tung Chung Stream (TC1) during the fish surveys in September, December 2003 and February 2004. This species was recorded in a few locations in Lantau including the Fong Yuen Marsh (Mouchel, 2002a) and Mong Tung Hang Stream (Scott, 2000). This species is threatened globally (Fellowes *et al*., 2002) and highly endangered locally (Chong and Dudgeon, 1992).

5.1.9 During the May 2004 survey, the Ayu *Plecoglossus altivelis* was recorded in the Tai Ho Stream (TH1). Declining population of this species were reported locally, regionally and globally. This species is ideintifed as of immediate regional concern (Fellowes *et al*., 2002) and only recorded once during the course of the surveys.

5.1.10 The Archpatch Puffer *Takifugu ocellatus* is rated of local concern and thought to be in population decline (Fellowes *et al*., 2002). During the December 2003, February and April 2004 surveys, this species was recorded in Sham Wat Stream (SW7), San Tau Stream (ST9), Tung Chung Stream (TC1), PaK Mong Stream (PM3) and Tai Ho Stream (TH1).

5.2 Freshwater Macroinvertebrate

5.2.1 Six macroinvertebrate stream surveys were conducted between September 2003 and January 2004 and the fauna recorded are presented in *Appendix C*. The sampling locations are presented on *Figure 3*. A total of twelve freshwater macroinvertebrate families/suborders consisting of 83 individuals were recorded during the surveys.

5.2.2 The number of macrofauna recorded in each stream was generally low (except the stream at San Shek Wan) although this is likely to be due to lower water flow during the dry season. During the January 2004 survey, many of the water courses with low flows during the wet season were completely dried out. The water levels at courses with significant flows during the wet season were found to be lowered substantially, including sections of the Hau Hok Wan and San Tau streams. This seasonal variation, however, is typical of streams in Hong Kong (Dudgeon and Corlett, 1994).

The lower section of the San Tau Stream was recently realigned and the sampling site was highly disturbed and quantitative kick sampling was not conducted.

5.2.3 In order to determine the relative quality of each water course, a biotic index was calculated for each stream. It should be noted that the BMWP index was developed for northern European rivers and not all subtropical macroinvertebrate representatives have been ascribed a score and as such some caution is required when applying the index to Hong Kong datasets.

5.2.4 The BMWP scores were calculated for each stream and the derived biotic index for Pak Mong, Hau Hok Wan, Sha Lo Wan and San Shek Wan are 8, 0, 2 and 34, respectively. The biotic index indicated that there were large variations in the habitat quality of the streams within the study area. This, however, could be a reflection of stream flow variability and the percentage of taxa that does not have a score rather than pollution/disturbance. The macroinvertebrates and calculated biotic index are summarised in *Table 5.2* below.

Table 5.2 The Number of Macroinvertebrate Individuals of each Family Recorded and BMWP Scores

Family	Common Name	Pak Mong	Hau Hok Wan	Sha Lo Wan	San Shek Wan
Gammaridae[1]	Amphipod	1 (6)			
Hydropsychidae	Caddisflies				1 (5)
Euphaeidae	Damselflies				1 (0)
Libellulidae	Dragonflies				10 (8)
Corydalidae	Fishflies				1 (0)
Baetidae	Mayflies				9 (4)
Euphemeridae	Mayflies				1 (0)
Leptophlebiidae	Mayflies				24 (10)
Chironomidae	Trueflies (Non-biting midge)	14 (2)		7 (2)	4 (2)
Nematocera[1]	Trueflies		1 (0)		
Gyrinidae	Water Beetle				3 (5)
Psephenidae	Water Beetle				6 (0)
Grapsidae	Small Shore Crab[2]	1 (0)			
Total Abundance (BMWP Index)		**16 (8)**	**1 (0)**	**7 (2)**	**60 (34)**

Note: The BMWP scores are presented in brackets. A value of zero was assigned to families that do not have a BMWP score; [1]Suborder; [2] Estuarine fauna.

5.3 Marine Benthic Macrofauna

Results - Faunal Characteristics

5.3.1 The benthic sampling event in October 2003 (late wet season) resulted in the collection of 15 sediment samples containing 362 macro-faunal specimens belonging to 31 families comprising 5 different phyla. The total recorded biomass was 11.5 g although this was largely due to the high mass of crustaceans (arthropods), echinoderms and molluscs collected (*Table 5.3*). The dry season survey in January 2004 resulted in the collection of 459 macrofaunal specimens belonging to 56 families comprising 8 different phyla. The total recorded biomass was 31.07 g although this was largely due to the high mass of molluscs, crustaceans (arthropods) and polychaetes (annelids) collected.

5.3.2 As noted in *Table 5.3* below, higher number, biomass and fauna diversity of macro-faunal were recorded during the dry season survey. The macrofauna data obtained together with the ANOVA tables are appended in *Appendices D1* and D*2* of this Report.

Table 5.3 Summary of the Macrofauna Collected in October 2003 and January 2004

Phylum	Wet Season (October 2003)			Dry Season (January 2004)		
	Number of Identified Families	Total Number of Individuals	Total Biomass (g)	Number of Identified Families	Total Number of Individuals	Total Biomass (g)
Annelida	16	288	1.20	32	340	2.62
Arthropoda	7	54	5.31	10	85	9.55
Coelenterata	0	0	0	2	3	0.08
Echinodermata	2	5	2.60	2	14	0.43
Echiura	0	0	0	1	1	0.60
Mollusca	5	14	2.40	7	13	17.77
Plathyelminthes	0	0	0	1	1	0.01
Sipuncula	1	1	0.0003	1	2	0.01
Grand Total	**31**	**362**	**11.5**	**56**	**459**	**31.07**

5.3.3 An exploratory analysis of the dataset was conducted to ascertain further information on the biological attributes in each area. An assessment of the data by area revealed large differences in terms of both the number of individuals and biomass present. During the wet season survey, the macrofaunal density recorded from the areas off Tai Ho Wan (32.6 individuals grab^{-1}) and the Hong Kong Section (30.6 individuals grab^{-1}) were fairly similar while the Tung Chung Channel contained the lowest faunal density (9.2 individuals grab^{-1}). The average biomass ranged from 1.49 g grab^{-1} in the Hong Kong Section (HKS) to 0.05 g grab^{-1} in the Tung Chung Channel (NLHC).

5.3.4 During the dry season survey, the macrofaunal density recorded from the areas off Tai Ho Wan (23.0 individuals grab^{-1}) and the Hong Kong Section (22.6 individuals grab^{-1}) were similar while the Tung Chung Channel contained the highest faunal density (46.2 individuals grab^{-1}). The average biomass ranged from 4.10 g grab^{-1} in the Hong Kong Section (HKS) to 0.54 g grab^{-1} in the Tai Ho Wan (THW). The macrofauna characteristics recorded from each area during both the wet (October 2003) and dry season (January 2004) surveys are presented below in *Table 5.4*.

Table 5.4 Summary of the Macrofauna Collected from Each Area

Area (*n*=5)	Total Number of Taxa[1]	Total Number of Individuals	Total Biomass (g)	Number of Taxa[1] Grab^{-1}	Number of Individuals Grab^{-1}	Biomass (g) Grab^{-1}
Wet Season (October 2003)						
HKS	19	153	7.47	3.8	30.6	1.49
NLHC	12	46	0.23	2.4	9.2	0.05
THW	23	163	3.80	4.6	32.6	0.76
Total	**36**	**362**	**11.5**	**7.2**	**72.4**	**2.3**
Dry Season (January 2004)						
HKS	28	113	20.50	5.6	22.6	4.10
NLHC	49	231	7.87	9.8	46.2	1.57
THW	28	115	2.70	5.6	23.0	0.54
Total	**69**	**459**	**31.07**	**13.8**	**91.8**	**6.21**

Notes: Hong Kong Section (HKS); Tung Chung Channel (NLHC); Tai Ho Wan (THW). [1]Taxa refers to the lowest taxonomic level identified (i.e., either species or genus).

5.3.5 Six species were considered dominant in terms of abundance in the grab samples (dominance is defined as greater than 10 individuals of the same species in each grab). The dominant species recorded in October 2003 and January 2004 and the corresponding stations are presented below in *Table 5.5*. Of the dominant species recorded, almost all were annelids (worms). The capitellid *Mediomastus californiensis* and spionids *Prionospio* spp. and crustacen decapod *Neoxenophthalmus obscurus* were the most dominant species and more than 10 individuals of these species were recorded in both the wet and dry seasons.

Table 5.5 Summary of the Dominant (> 10 Individuals in Each Grab) Macrofauna Species Collected (October 2003 and January 2004)

Phylum	Class	Order	Family	Species	Wet Season	Dry Season
Annelida	Polychaeta	Capitellida	Capitellidae	*Mediomastus californiensis*	HKS-5; TWH-4	NLHC3
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio queenslandica*	THW-1	NLHC-2; NLHC-3; THW-5
Arthropoda	Crustacea	Decapoda	Pinnotheridae	*Neoxenophthalmus obscurus*	HKS-4	HKS2
Annelida	Polychaeta	Eunicida	Eunicidae	*Eunice indica*	-	NLHC-2; LHC-3
Annelida	Polychaeta	Spionida	Poecilochaetidae	*Poecilochaetus serpens*	THW-1	-
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio cirrifera*	HKS-3; HKS-4	-

5.3.6 Further biological information on the taxa present at each station is also useful in addition to reporting the dominant species above in *Table 5.5*. The datasets for the wet (October 2003) and dry (January 2004) benthic macro-fauna have also been presented in order to complement the information presented above for the dominant species. Summaries of the benthic macro-fauna families present during the wet and dry season surveys in each area are presented below in *Tables 5.6* and *5.7*, respectively. During the wet season, the most abundant number of individuals recorded in each family present were the spionidae (85 individuals), pilargiidae (63 individuals) and capitellid (57 individuals) annelids. During the dry season, the most abundant number of individuals recorded in each family present were the spionidae (79 individuals), capitellidae (71 individuals) and eunicidae (55 individuals) annelids.

Table 5.6 Summary of the Macrofauna Families (number of individuals) Collected in each area in October 2003

Phylum	Family	HKS	NLHC	THW	Total
Annelida	Capitellidae	26	12	19	57
	Cirratulidae	1	2	7	10
	Cossuridae	3	6		9
	Glyceridae			6	6
	Hesionidae	4			4
	Lumbrineridae			5	5
	Magelonidae			1	1
	Nephtyidae	5	4	4	13
	Nereidae			4	4
	Phyllodocidae			3	3
	Pilargiidae	21	12	30	63
	Poecilochaetidae			23	23
	Polynoidae	1		2	3
	Spionidae	40	6	39	85
	Syllidae	1			1
	Trichobranchidae			1	1
Arthropoda	Callianassidae	1			1
	Corophiidae	4	1	10	15
	Gonedacidae	2		2	4
	Goneplacidae			1	1
	Penaeidae			1	1
	Pinnotheridae	28	1	1	30
	Processidae	1		1	2
Echinodermata	Amphiuridae	3		1	4
	Synaptidae			1	1
Mollusca	Lasaeidae	1			1
	Nassariidae	9			9
	Semelidae	1	1		2
	Solenidae			1	1
	Tellinidae	1			1
Sipuncula	Phascolosomatidae		1		1
Grand Total		**153**	**46**	**163**	**362**

Table 5.7 Summary of the Macro-fauna Families (number of individuals) Collected at each area in January 2004

Phylum	Family	HKS	NLHC	THW	Total
Annelida	Ampharetidae			1	1
	Amphinomidae	1			1
	Capitellidae	34	23	14	71
	Chrysopetalidae		1		1
	Cirratulidae		2	1	3
	Dorvilleidae			1	1
	Eunicidae	1	53	1	55
	Glyceridae		12	7	19
	Goniadidae	1	2		3
	Hesionidae	2	7	2	11
	Heterospionidae		2		2
	Lacydoniidae		1		1
	Lumbrineridae	2	1	9	12
	Magelonidae		1	2	3
	Maldanidae		1		1
	Nephtyidae	6	6	7	19
	Nereidae		1		1
	Onuphidae		1		1
	Opheliidae	1			1
	Orbiniidae	1	3	1	5
	Paraonidae		1		1
	Phyllodocidae		4		4
	Pilargiidae	10	10	9	29
	Poecilochaetidae		2	1	3
	Polynoidae	1	4		5
	Sabellariidae		1		1
	Sabellidae		1		1
	Sigalionidae		1		1
	Spionidae	7	42	30	79
	Sternaspidae	1			1
	Syllidae		2		2
	Terebellidae			1	1
Arthropoda	Alpheidae		8	2	10
	Bodotriidae	1			1
	Corophiidae		12	13	25
	Goneplacidae	2	2		4
	Leucosiidae		1		1
	Luciferidae	1			1
	Pilumnidae		1	3	4
	Pinnotheridae	29	4		33
	Porcellanidae		3		3
	Portunidae		1	2	3
Coelenterata	Actiniidae		1	1	2
	Virgulariidae	1			1
Echinodermata	Amphiuridae	4	2	4	10
	Temnopleuridae	2	2		4
Echiura	Echiuridae		1		1
Mollusca	Calyptraeidae		3		3
	Muricidae	1			1
	Semelidae	1			1
	Tellinidae			1	1
	Thraciidae			1	1
	Ungulinidae		1		1
	Veneridae	2	2	1	5
Plathyelminthes	Stylochidae	1			1
Sipuncula	Phascolosomatidae		2		2
Grand Total		**113**	**231**	**115**	**459**

Statistical Analysis

Univariate Statistical Results of Benthic Macro-fauna

5.3.7 The wet season results of the statistical analyses of the biological parameters (number of species, faunal abundance, faunal biomass and diversity) measured in the different areas are summarised in *Figures 7.1 – 7.4* and in *Table 5.8* below. In general, more species, individuals, biomass and higher species diversity were recorded from the Hong Kong Section (HKS) and Tai Ho Wan (THW) areas while the lowest values were recorded in the sheltered Tung Chung Channel (NLHC).

5.3.8 The dry season results of the statistical analyses of the biological parameters (number of species, faunal abundance, faunal biomass and diversity) measured in the different areas are summarised in *Figures 7.5 – 7.8* and in *Table 5.8* below. In general, the univariate benthic community characteristics recorded in the Hong Kong Section (HKS), Tung Chung Channel (NLHC) and Tai Ho Wan (THW) were similar.

Table 5.8 Summary of the Macrofauna Statistical Analyses

Biological Parameter	Area[2]	Comments
Wet Season		
Number of Species	* THW=HKS>NLHC	There were significant differences in the number of species present. The mean number of species recorded in the Tai Ho Wan and Hong Kong Section were significantly higher than the Tung Chung Channel (*Figure 7.1*).
Number of Individuals	NS	There were no significant differences between the number of individuals present in each area (*Figure 7.2*).
Biomass	NS	There were no significant differences in biomass between areas (*Figure 7.3*).
Diversity[1]	** THW HKS NLHC	There were significant differences in diversity present between areas. The mean diversity recorded at Tai Ho Wan (THW) was significantly higher than the Tung Chung Channel (NLHC) (*Figure 7.4*).
Dry Season		
Number of Species	NS	There were no significant differences in number of species between areas (*Figure 7.5*).
Number of Individuals	NS	There were no significant differences between the number of individuals present in each area (*Figure 7.6*).
Biomass	NS	There were no significant differences in biomass between areas (*Figure 7.7*).
Diversity[1]	NS	There were no significant differences in diversity between areas (*Figure 7.8*).

Notes: NS = Non significant; *=$P<0.05$; **= $P<0.01$; NLHC = Tung Chung Channel; HKS = Hong Kong Section; THW = Tai Ho Wan. ANOVA was used to test the spatial differences between areas; [1]Diversity is at the species/genus level and analysed using the Shannon-Wiener index ($\log_{10}$); [2]Where ANOVA revealed significant differences between the areas, the pattern of significant spatial differences are presented in the second row. Areas that are underlined are not significantly different.

Abundance Biomass Plots and *W* Statistic

5.3.9 The ABC plots for each area showed that the curves were indicative of stable communities in both the wet and dry seasons. When the biomass curve is above the abundance curve for its entire length (thereby indicating higher numbers of organism diversity than biomass diversity) it indicates that a stable community is present that is considered to be unaffected by disturbance or pollution (Warwick, 1986). The *W* statistic reduces each ABC plot to a single summary statistic that is helpful for interpretation of benthic communities by non-specialists. A negative *W* statistic indicates gross disturbance or pollution.

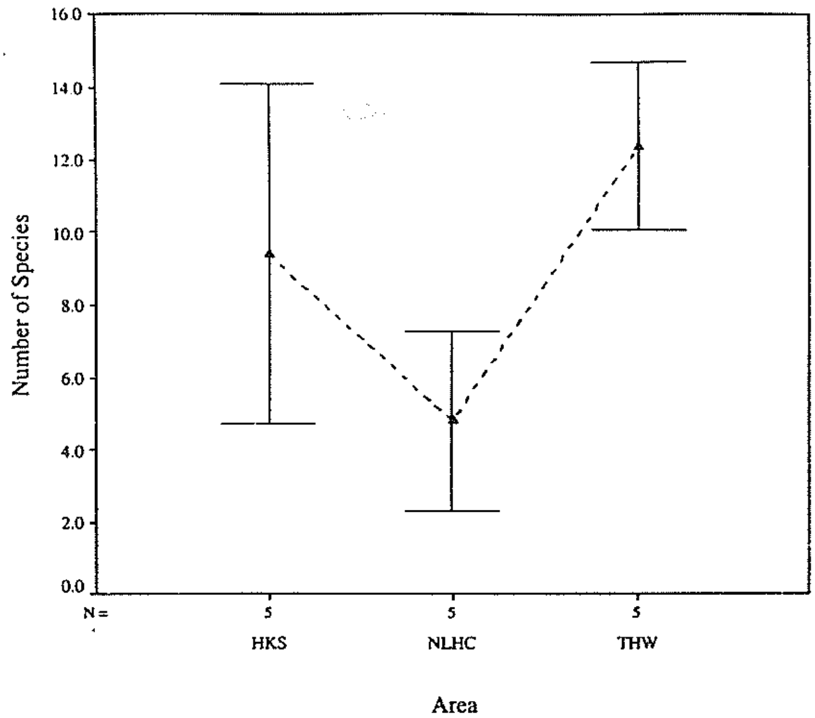


Figure 7.1 ***Mean (± SD; per grab) number of macro-faunal species present in each area during the October 2003 wet season survey.***

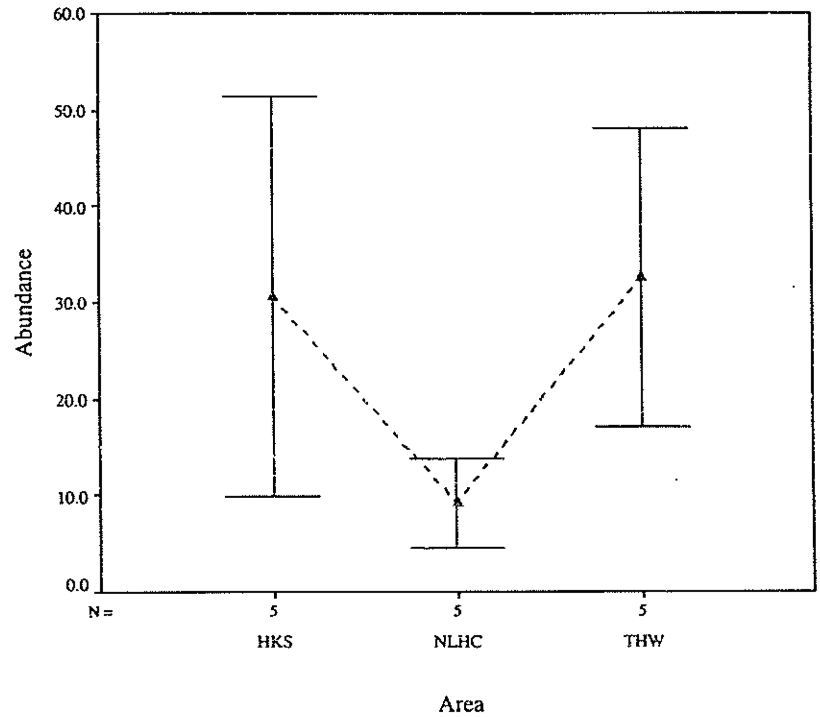


Figure 7.2 ***Mean (± SD; per grab) number of macro-faunal individuals in each area during the October 2003 wet season survey.***

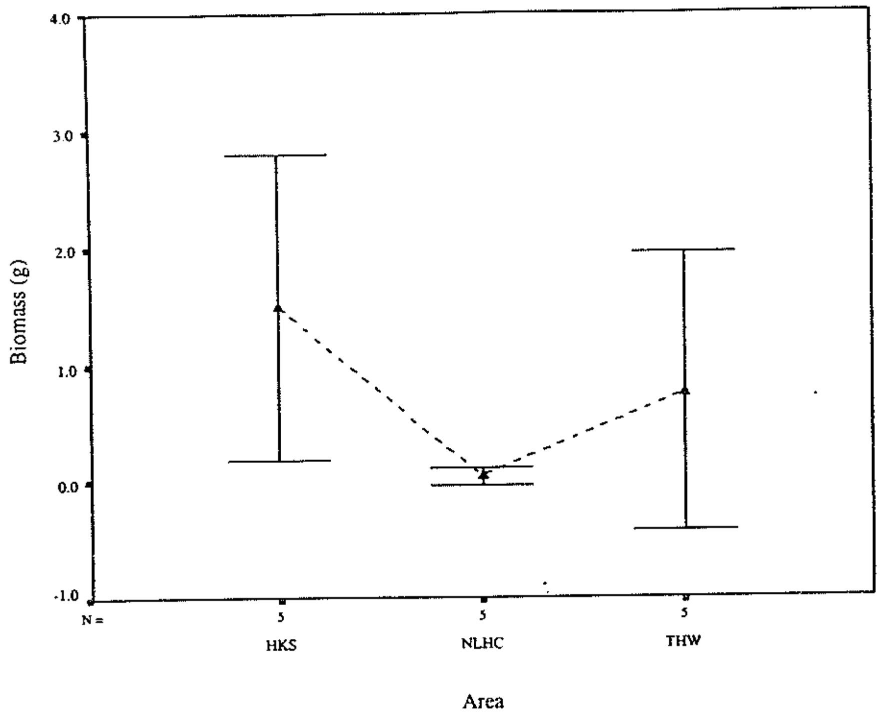


Figure 7.3 ***Mean (± SD; per grab) biomass of macro-faunal individuals in each area during the October 2003 wet season survey.***

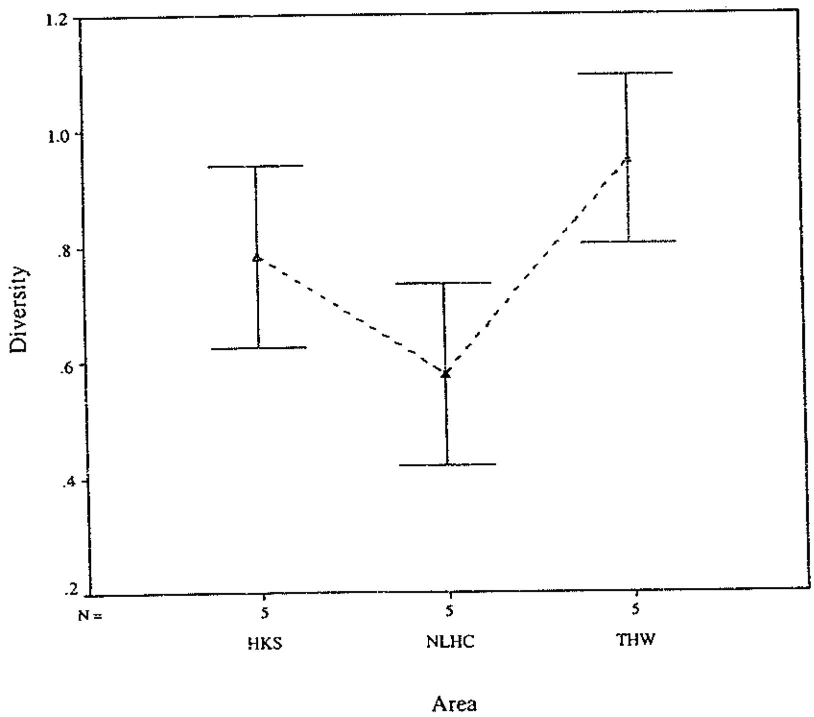


Figure 7.4 ***Mean (± SD; per grab) diversity of macro-faunal in each area during the October 2003 wet season survey.***

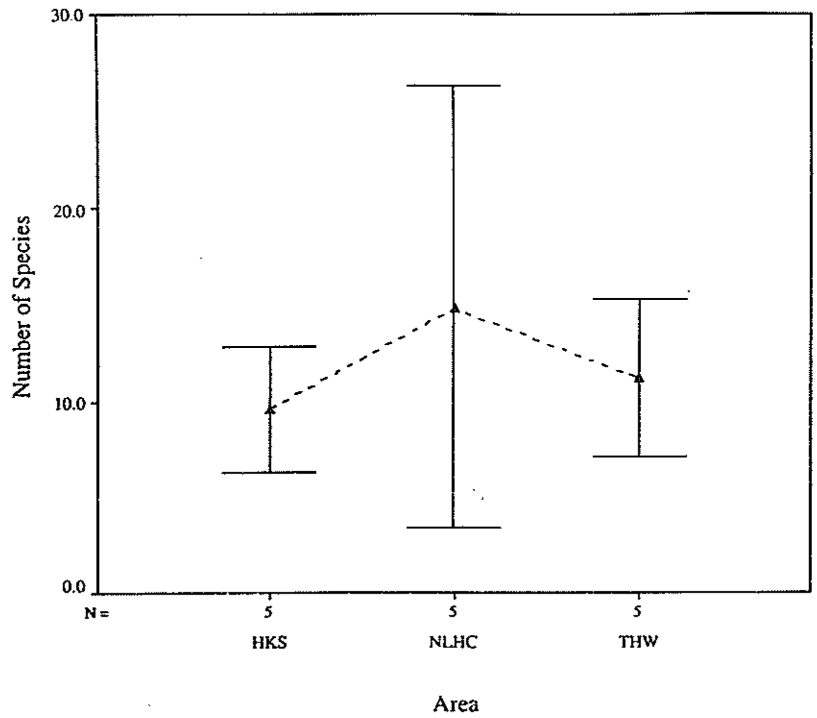


Figure 7.5 ***Mean (± SD; per grab) number of macro-faunal species present in each area during the January 2004 dry season survey.***

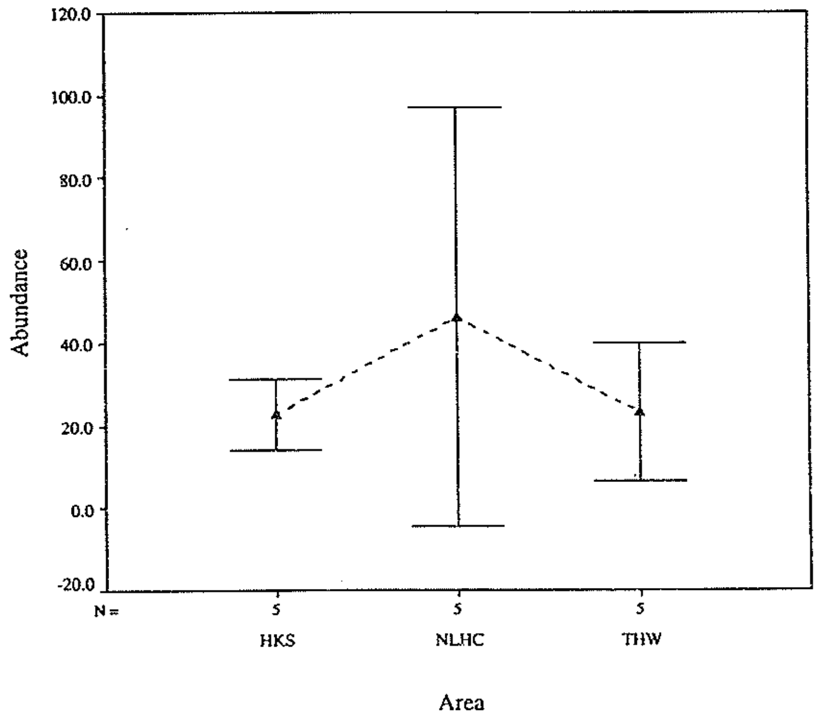


Figure 7.6 ***Mean (± SD; per grab) number of macro-faunal individuals in each area during the January 2004 dry season survey***

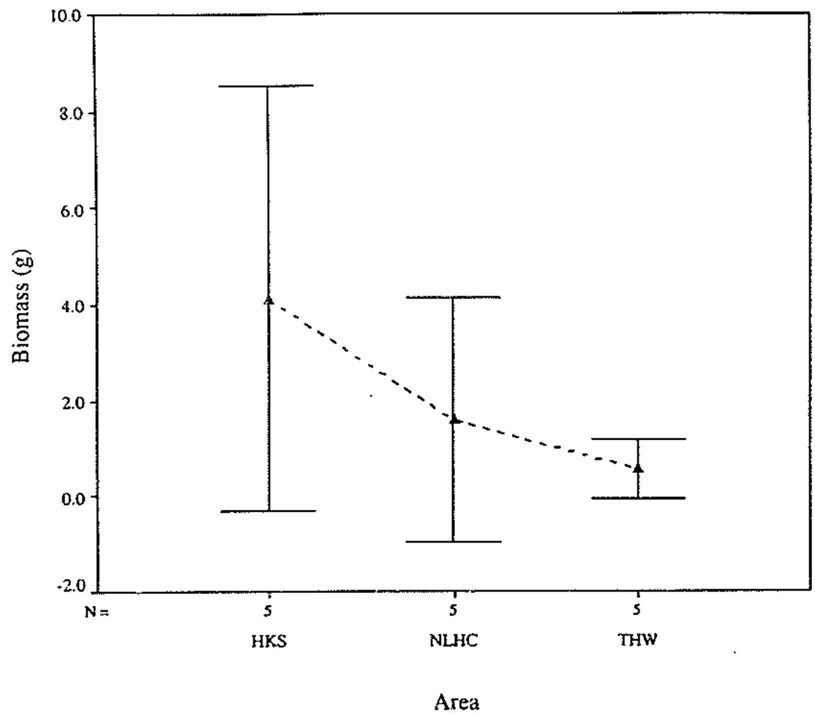


Figure 7.7 ***Mean (± SD; per grab) biomass of macro-faunal individuals in each area during the January 2004 dry season survey.***

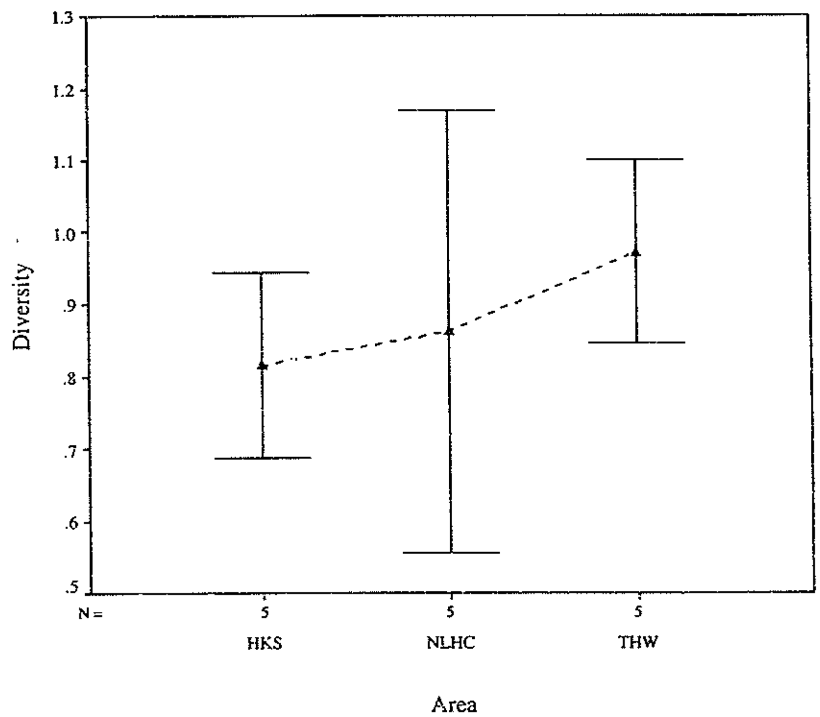


Figure 7.8 ***Mean (± SD; per grab) diversity of macro-faunal in each area during the January 2004 dry season survey.***

5.3.10 The *W* statistics for the three areas during the wet season were all positive and reasonably similar (HKS: 0.227; NLHC: 0.315; THW: 0.293). The *W* statistics for the three areas during the dry season were also positive and reasonably similar (HKS: 0.268; NLHC: 0.197; THW: 0.299). The ABC plots for each area during the wet and dry season are presented in *Figures 7.9* and *7.10,* respectively.

Biotic Indices

5.3.11 The biotic indices calculated for macrofauna collected during the surveys are presented in *Table 5.9* below. Results indicated that the biotic indices for the three areas were similar. Although the Tung Chung Channel (biotic index of 3) was slightly higher (i.e., indicative of higher levels of pollution and/or disturbance) than the Hong Kong Section and Tai Ho Wan (biotic index of 2) during the wet season, the difference was not observed in the dry season.

a.

b.

c.

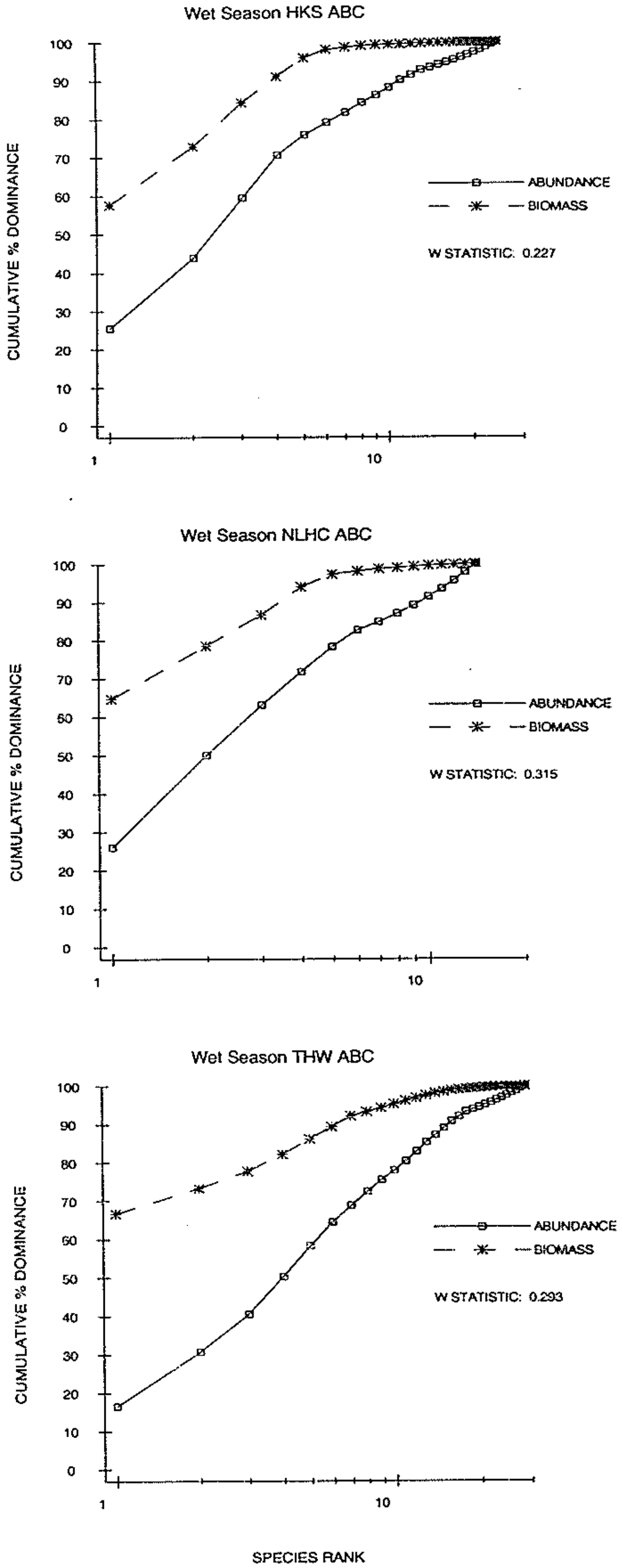


Figure 7.9 ***ABC plots of the benthic macro-fauna from grab samples collected in October 2003 (genus/species level)***

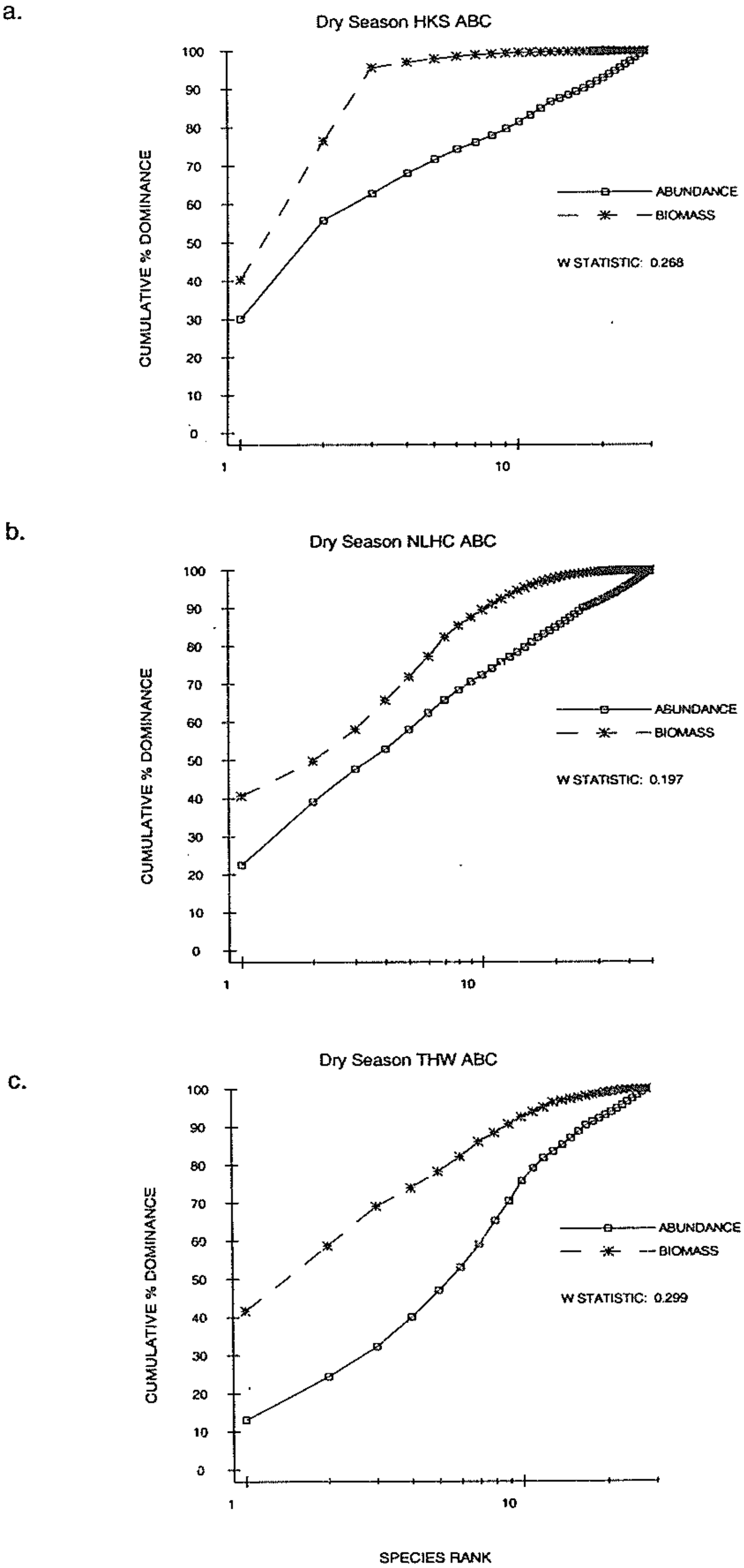


Figure 7.10 ***ABC plots of the benthic macro-fauna from grab samples collected in January 2004 dry season survey (genus/species level).***

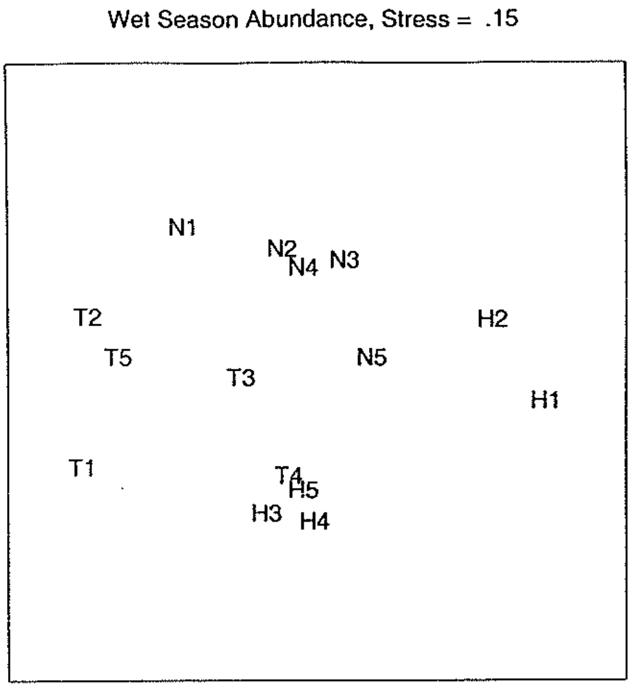


Figure 7.11 ***MDS plot of dissimilarities between the benthic sediment macro-fauna from grab samples collected in October 2003. (H= Hong Kong Section; N= Tung Chung Channel; T= Tai Ho Wan)***

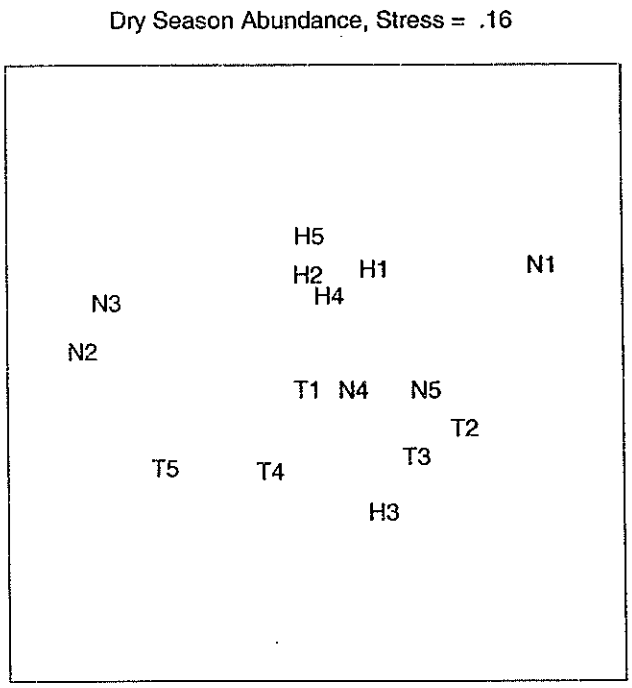


Figure 7.12 ***MDS plot of dissimilarities between the benthic sediment macro-fauna from grab samples collected in January 2004 (H=Hong Kong Section; N=Tung Chung Channel; T=Tai Ho Wan).***

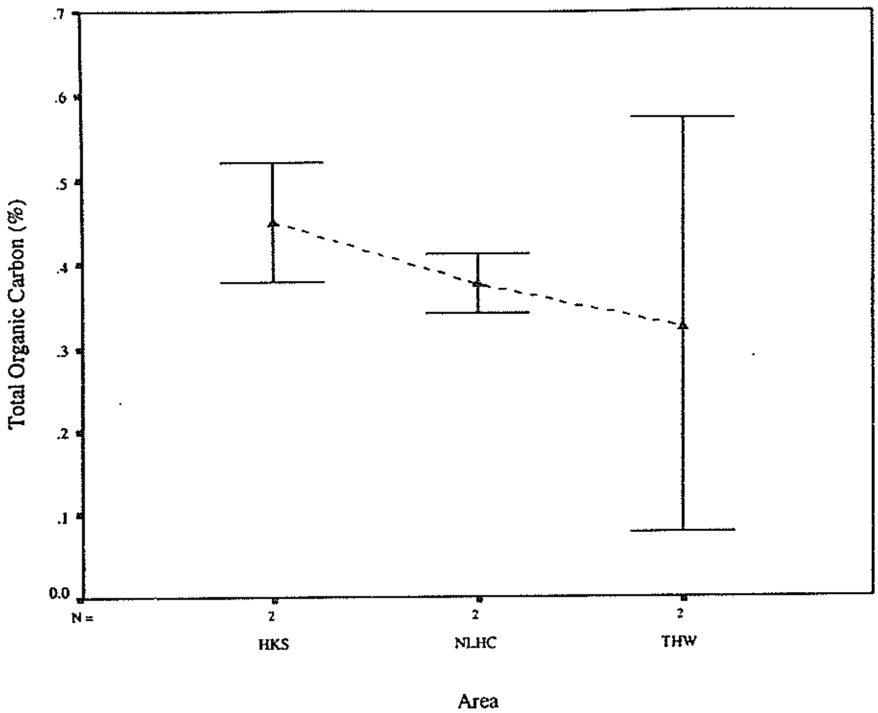


Figure 7.13 **Mean percentage of total organic carbon (%; ± SD) in each area during the October 2003 wet season survey.**

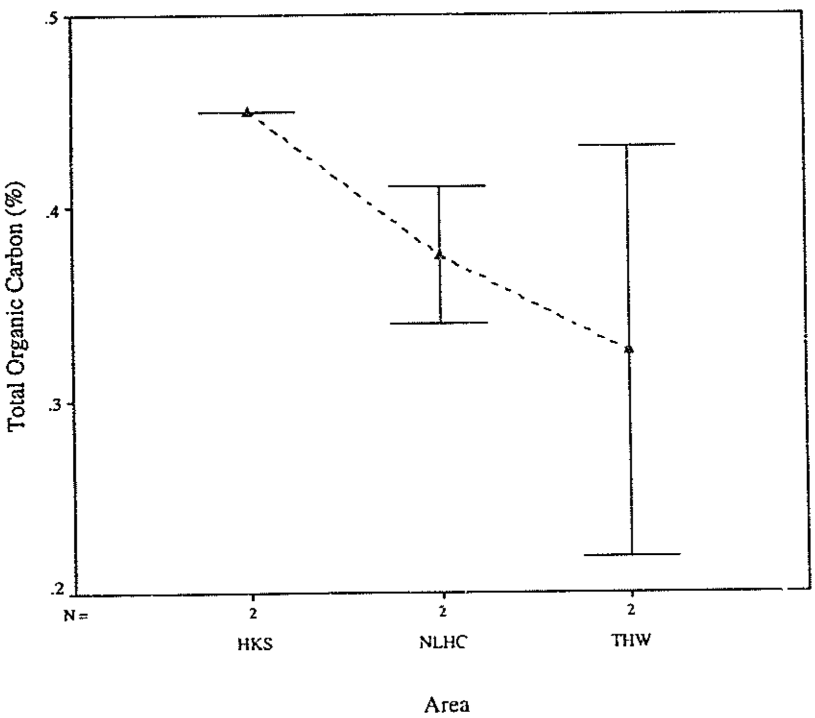


Figure 7.14 **Mean percentage of total organic carbon (%; ± SD) in each area during the January 2004 dry season survey.**

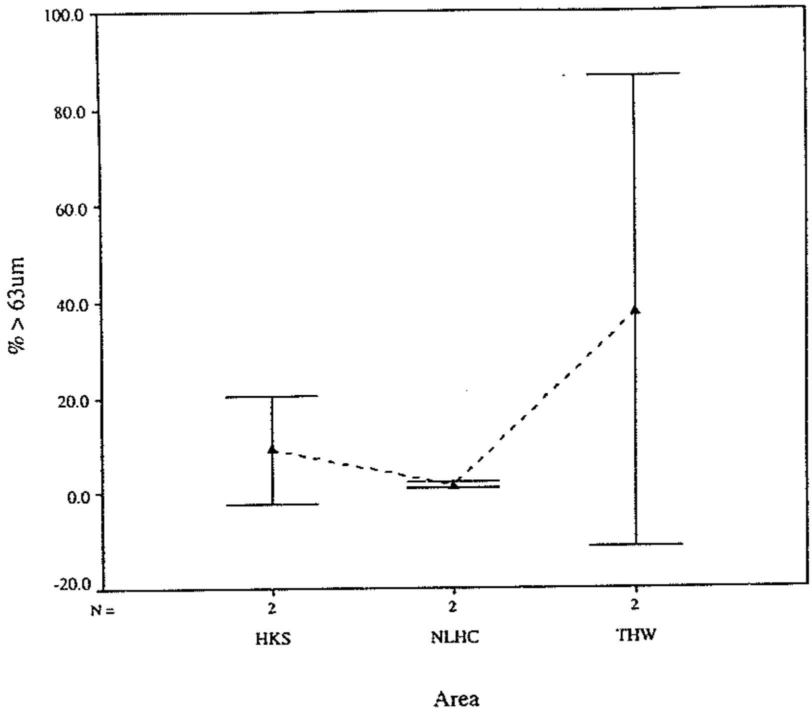


Figure 7.15 ***Mean percentage of coarse grained sediment (> 63 µm; ± SD) in each area during the October 2003 wet season survey.***

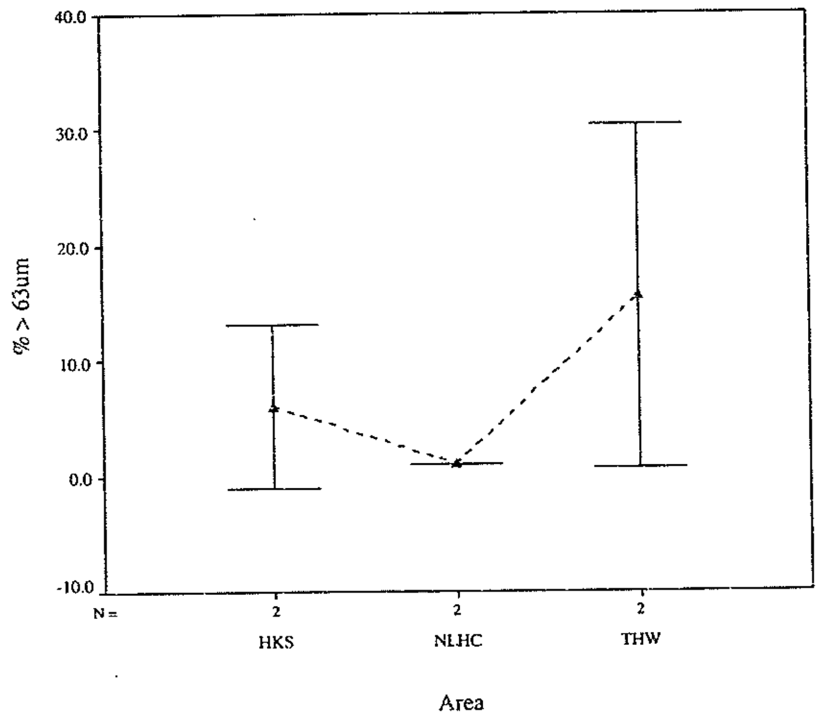


Figure 7.16 ***Mean percentage of coarse grained sediment (> 63 µm; ± SD) in each area during the January 2004 dry season survey.***

Table 5.9 Biotic Indices for the Macro-fauna at each of the Surveyed Areas

Area	Measured Biotic Coefficient	Biotic Index	Pollution Classification	Dominant Ecological Group	% Groups Assigned	Benthic Community Condition (Health)
Wet Season						
HKS	3.24	2	Slight pollution	IV (*Prionospio*)	60.1	Based on the BI, this area has slight pollution or disturbance. The dominant ecological group present, however, indicates that the area is characteristic of a polluted or heavily disturbed benthic community.
NLHC	3.55	3	Mean pollution	III (*Mediomastus*)	47.8	Based on the BI, this area has mean pollution or disturbance. The dominant ecological group is characteristic of an unbalanced benthic community. Only 47.8% of the fauna present were ascribed an ecological group and the BI should be treated with caution.
THW	2.68	2	Slight pollution	I (*Peocilochaetus*)	75.5	Based on the BI, this area has slight pollution or disturbance. The dominant ecological group present indicated that the area is characteristic of a normal benthic community.
Dry Season						
HKS	2.48	2	Slight pollution	III (*Mediomastus*)	51.3	Based on the BI, this area has slight pollution or disturbance. The dominant ecological group is characteristic of an unbalanced benthic community. Only 51.3% of the fauna present were ascribed an ecological group and the BI should be treated with caution
NLHC	2.40	2	Slight pollution	II (*Eunice*)	77.9	Based on the BI, this area has slight pollution or disturbance. The dominant ecological group is characteristic of only slightly stressed benthic community.
THW	2.65	2	Slight pollution	IV (*Prionospio*)	78.3	Based on the BI, this area has slight pollution or disturbance. The dominant ecological group present, however, indicates that the area is characteristic of a polluted or heavily disturbed benthic community.

5.3.12 In summary, the biological indices calculated showed little difference between the three areas although the indices suggested that the Tung Chung Channel (NLHC) was slightly more disturbed during the wet season. During the wet season, the dominant ecological groups present in the Hong Kong Section (HKS) and Tung Chung Channel were mostly second-order opportunists characteristics of an unbalanced environment whereas those from Tai Ho Wan were indicative of an undisturbed benthic community. During the dry season, the dominant ecological groups present in the Hong Kong Section and Tai Ho Wan were mostly second-order opportunists characteristics of an unbalanced environment whereas those from Tung Chung Channel (NLHC) were indicative of only slightly disturbed benthic community. Based on the overall biotic indices there would not appear to be major differences in the benthic communities present in the three areas.

Multivariate Statistical Results of Benthic Macro-fauna

5.3.13 The MDS analysis was based on the number of individuals of all species/genera present at each station. Station groups that are plotted far apart are dissimilar, whereas stations in close proximity are similar.

5.3.14 The MDS plot for the wet season data (*Figure 7.11*) had a relatively high stress value (0.15) and the data points on the plot should be treated with caution. There is no obvious aggregation of stations in the MDS plot, apart from two small clusters, indicating that the monitoring stations were reasonably (dis)similar. The two small clusters (N2, N3 and N4; H3, H4 H5 and T4) in the middle of the plot, however, did suggest some dissimilarity of the stations between areas.

5.3.15 The MDS plot for the dry season data (*Figure 7.12*) also had a relatively high stress value (0.16) and the data points on the plot should be treated with caution. There is no obvious aggregation of stations in the MDS plot, apart from a small cluster, indicating that the monitoring stations were reasonably (dis)similar. The small cluster of Hong Kong Section stations (H1, H2, H4 and H5) in the middle of the plot suggested the benthic communities of the Hong Kong Section (HKS) stations were more similar to each other than stations of the Tung Chung Channel (NLHC) and Tai Ho Wan (THW).

Sediment Characteristics (Grain-Size and TOC)

5.3.16 Selected benthic sediment samples from each area were also analysed to determine their grain size composition and total organic carbon (TOC) content. Sediment grain size characteristics and TOC are important variables in determining the benthic communities capable of inhabiting sediments and organic carbon content also provides a useful indication of potential food resources. The results are summarised below in *Table 5.10* and *Figures 7.13-7.16*.

Table 5.10 Summary of Sediment Characteristics (Grain-size and TOC)

Area (*n*=2)	**TOC** (%)	**Coarse Fraction** (% > 63 µm)
Wet Season		
HKS	0.45	9.0
NLHC	0.37	1.5
THW	0.32	37.5
Dry Season		
HKS	0.45	6.0
NLHC	0.38	1.0
THW	0.33	15.5

Notes: Hong Kong Section (HKS); Tung Chung Channel (NLHC); Tai Ho Wan (THW).

5.3.17 As indicated in *Table 5.10* and *Figures 7.13 – 7.16*, there were little seasonal variation in the level of TOC and percentage of fine-grained particles recorded. The spatial distributions of TOC and sediment grain-size, however, were different. The sediments at Tai Ho Wan contained a large percentage (15.5% - 37.5%) of coarse grained particles while the Hong Kong Section has a higher percentage of TOC (0.45%). As TOC and granulometry are know to affect the macro benthic fauna distribution, these two parameters may have influenced benthic community characteristics recorded in the study area (*Figures 7.1 – 7.8*).

Summary of Marine Benthic Community Results

5.3.18 A suite of biological-based statistical tests and pattern searching tools were conducted to assess the benthic macro-fauna community structure of the study area and these are summarised below in *Table 5.11*. The univariate analyses (number of species, number of individuals, biomass and diversity index), biotic index, ABC plots, *W* statistic and multivariate multidimensional scaling (MDS) all suggested that the communities present in the three areas (Hong Kong Section, Tai Ho Wan and Tung Chung Channel) were similar although the assemblages at Tung Chung Channel were slightly different than the other two areas during the wet season. In terms of disturbance status, both the biotic index and dominant species indicated the whole study area is slightly disturbed.

Table 5.11 Summary of Wet Season Benthic Macrofauna Surveys

Parameter	Hong Kong Section (HKS)	Tung Chung Channel (NLHC)	Tai Ho Wan (THW)
Wet Season (October 2003)			
Number of Species (Number of Taxa grab^{-1})	3.8	2.4	4.6
Statistical Test[1]		THW=HKS>NLHC	
Abundance (individuals grab^{-1})	30.6	9.2	32.6
Statistical Test[1]		NS	
Biomass (wet weight, g grab^{-1})	1.49	0.05	0.76
Statistical Test[1]		NS	
Diversity (H')[2]	0.78	0.58	0.95
Statistical Test[1]		THW HKS NLHC	
ABC Plot	U	U	U
***W* Statistic**	0.227	0.315	0.293
BI[3] (Dominant Ecological Group)	2 (IV)	3 (III)	2 (I)
MDS Analysis	Some stations similar	Some stations similar	Stations dissimilar
Dry Season (January 2004)			
Number of Species (Number of Taxa grab^{-1})	5.6	9.8	5.6
Statistical Test[1]		NS	
Abundance (individuals grab^{-1})	22.6	46.2	23.0
Statistical Test[1]		NS	
Biomass (wet weight, g grab^{-1})	4.10	1.57	0.54
Statistical Test[1]		NS	
Diversity (H')[2]	0.81	0.86	0.97
Statistical Test[1]		NS	
ABC Plot	U	U	U
***W* Statistic**	0.268	0.197	0.299
BI[3] (Dominant Ecological Group)	2 (III)	2 (II)	2 (IV)
MDS Analysis	Most stations similar	Some stations similar	Stations dissimilar

Notes: U= undisturbed; NS= Non-significant (P>0.05); [1]ANOVA followed by SNK when significant differences were detected between areas; [2]Diversity is at the species level and analysed using the Shannon-Wiener index ($\log_{10}$); [3]Calculated using the index of Borja *et al.* (2000, 2003).

5.4 Intertidal (Hard and Soft Shores)

5.4.1 The first wet season intertidal transect surveys focussed on potential landing points and areas potentially affected and were undertaken at San Tau, Sha Lo Wan, San Shek Wan, Tung Chung Bay, Tai Ho Wan and Sham Wat on 18, 25 and 26 September, 21 and 22 October 2003. Dry season transect surveys were undertaken at Kau Liu, Sha Lo Wan, Sham Wat and Tai Ho Wan on 18 and 19 November 2003 and at at Hau Hok Wan, Kau Liu, Sha Lo Wan, San Shek Wan and Tai Ho Wan on 7, 15 and 16 January 2004. A list of species recorded is provided in *Appendix E* and the location of intertidal survey transects are presented in *Figure 3*.

Soft Shore Intertidal

5.4.2 All of the species recorded were typical soft shore intertidal fauna and can be found in similar habitats throughout Hong Kong. Mud snails (*Cerithidea diadjariensis*) were common representatives on the sand-flats of Tung Chung Bay. Survey results obtained at Tai Ho Wan also revealed that the mud snail (*C. diadjariensis*) was dominant. Common species including acorn barnacle (*Balanus* sp.), small shore crab (*Hemigrapsus sanguineus*) and the nerite (*Nerita polita*) were abundant on hard surfaces such as rocks and boulders present on the soft shores of the entire coastal study area. Species abundance during the wet and dry seasons was similar.

Hard Shore Intertidal

5.4.3 Survey results revealed that common gastropods such as freshwater nerite (*Clithon cf. faba*) and top shell (*Monodonta labio*) were dominant on the hard shore of San Tau. While at the hard shore of Kau Liu, common species such as the nerite (*Nerite* spp.) and rock oyster (*Saccostrea cucullata*) were dominant at the lower levels. The littorinid gastropod (*Littoraria articulata*) was also common on the rocky shore. In addition, a few small shore crabs (*Hemigrapsus sanguineus*) and one hermit crab were noted on pebbles or rocky bottom.

5.4.4 At Hau Hok Wan, the rock oyster (*Saccostrea cucullata*) was abundant both on the higher and lower levels of the hard shore together with the gastropods *Nerita polita* and *Clithon* sp. At Sha Lo Wan and San Shek Wan, common hard shore substrate fauna present included nerite (*Nerita polita*), rock oyster (*Saccostrea cucullata*), common whelk (*Thais clavigera*), littorinids including *Nodilittorina radiata* and *Littoraria articulata* and small shore crab (*Hemigrapsus sanguineus*).

5.4.5 The littorinid gastropod (*Littoraria articulata*) was abundant on the hard shore of Sham Wat while the nerite (*Nerita polita*), rock oyster (*Saccostrea cucullata*) and fresh water nerites (*Clithon* sp.) were occasionally seen.

5.4.6 At Tai Ho Wan the hard shore substrate fauna present included acorn barnacle (*Balanus* sp.), *Hemigrapsus sanguineus*, *Nerita polita* and the bivalve *Striarca symrnentrica*.

5.4.7 All soft-bottom and hard-bottom intertidal species recorded are common and characteristics of intertidal habitats throughout Hong Kong.

5.5 Coral

5.5.1 A coral survey was conducted at locations likely to be impacted by the Project on 15 October 2003. Twenty-seven spot dives were conducted along the coastline of the study area as shown in *Figure 5.* For the purpose of the surveys, the study area was subdivided into four areas namely, Sham Wat/San Shek Wan, West Chek Lap Kok Channel, East Chek Lap Kok Channel and East Tung Chung. Results of each spot dive are presented in *Table A2.2* of the Coral Survey Report. The Coral Survey Report is presented in *Appendix F* and a summary is presented below.

5.5.2 In Sham Wat/San Shek Wan, ten spot dives (S1-10) were conducted within this area. Only one hard ahermatypic coral, *Balanophyllia* spp. and one soft coral *Echinomuricea* spp. were found on hard substrate to the east of Chek Lap Kok. However, the abundance and overall percentage cover of the coral were low (i.e., <5%).

5.5.3 In the West of Chek Lap Kok, eight dives were conducted (S11-18). However, no hard or soft coral was found.

5.5.4 In the East of Chek Lap Kok, four dives were conducted (S19-22). Four spot dives (S23-27) were conducted within this area. Only one soft coral *Echinomuricea* spp. was recorded. The soft coral was patchily distributed and the overall percentage cover of the coral was low (i.e., <5%).

5.5.5 At the East of Tung Chung, the soft coral *Echinomuricea* spp, was recorded although overall percentage cover was <5%.

5.5.6 Despite the presence of the ahermatypic cup coral, *Balanophyllia* sp. and the gorgonian soft coral, *Echinomuricea* sp. in certain areas, abundance of these corals was low (cover <5%) and in particular *Echinomuricea* sp. had suffered high levels of partial mortality. Results of the coral survey indicated that the few corals present were of low abundance and poor condition and, therefore, of low ecological importance (which is typical of the northwestern waters). As such, neither higher tier assessments nor further coral surveys were considered necessary.

5.6 Horseshoe Crabs

5.6.1 Horseshoe crabs are known to be sparsely distributed along the coast of Lantau Island and most survey effort was expended at bays within the study area where suitable microhabitats were present (typically well-aerated sediment substrates near to seagrass beds; substratum adjacent to streams). These areas included Hau Hok Wan, Pak Mong, San Shek Wan, San Tau, Sha Lo Wan, Sham Wat, Tai Ho Wan and Tung Chung Bay.

5.6.2 Unidentified juvenile horseshoe crabs (at least ten individuals) were recorded at Sham Wat Wan in October 2003 while the Agriculture, Fisheries and Conservation Department recorded 20 *C. rotundicauda* individuals at Tai Ho Wan during their on-going surveys in December 2003 (AFCD pers. comm.). Apart from Tai Ho Wan, some *C. rotundicauda* have been reported from Tung Chung Bay and Sham Wat (AFCD pers. comm.). The ongoing demersal trawl surveys of the East of Sha Chau contaminated mud pits (Mouchel, 2004b) also recorded a juvenile *T. tridentatus* in the waters north of the Hong Kong International Airport in January 2004. Interviews with the fisherman at Pak Mong in September 2003 indicated juvenile horseshoe crabs were still occasionally netted in the water channel between Pak Mong and the North-Lantau Express Highway; and residents at Sham Wat Wan also reported recent sightings of adult horseshoe crabs. The results of the present surveys together with historical records of the horseshoe crabs in the vicinity of the study area are summarised below in *Table 5.12*.

5.6.3 Ten *Tachypleus tridentatus* and one *Carcinoscorpius rotundicauda* were recorded at San Tau in November 2003. Two *T. tridentatus* and one *C. rotundicauda* were recorded at Hau Hok Wan in the November 2003 survey. In April 2004, one live and three molts of *Tachypleus tridentatus* were recorded at Sham Wat Wan and in May 2004, twenty-six individuals of this species were also recorded between Tung Chung and San Tau. In addition, during a survey in May 2004, fourteen live and three molts of *Carcinoscorpius rotundicauda* were recorded at Tai Ho Wan and Pak Mong. Survey results showed that areas of importance for the horseshoe crab include San Tau, Hau Hok Wan, Sham Wat Wan, Tung Chung Bay, Tai Ho Wan and Pak Mong (*Figures 13a-b*). The raw data from these surveys are presented in *Appendix G*.

Table 5.12 Horseshoe Crab Sightings and Landings in the vicinity of the Study Area

Location	Species and Lifestage	Date	Number of Individuals	Remark
Hau Hok Wan	*Carcinoscorpius rotundicauda* Juvenile	November 2003	1	This Study
	Tachypleus tridentatus juveniles	November 2003	2	
San Tau	Unknown	May 1995	~ 13	Mouchel[1]
	Tachypleus tridentatus and *Carcinoscorpius rotundicauda* juveniles	October 1997-June 1998	~ 15	
	Tachypleus tridentatus 5 males, 6 females	April 1997	11	
	Tachypleus tridentatus juveniles	June 2002	57	Mott[2]
	Carcinoscorpius rotundicauda juvenile	November 2003	1	This Study
	Tachypleus tridentatus juveniles	November 2003	10	
	Tachypleus tridentatus	May 2004	11	
Sha Lo Wan	Unknown juvenile	April 1995	1	Mouchel[1]
Sham Wat	Unknown juvenile	October 2003	> 10	This Study
	Tachypleus tridentatus	April 2004	1 and 3 molts	This Study
Tai Ho Wan	Unknown juvenile	September 1998	1	Mouchel[3]
	Carcinoscorpius rotundicauda juvenile	1999	8	Fong[4]
	Carcinoscorpius rotundicauda mating pair	1999	2	
	Tachypleus tridentatus juveniles	1999	2	
	Carcinoscorpius rotundicauda juveniles	December 2003	20	AFCD[5]
	Carcinoscorpius rotundicauda	May 2004	14 and 3 molts	This Study
Tung Chung Bay	*Tachypleus tridentatus* 18 males, 14 females	April – October 1997	32	Mouchel[1]
	Carcinoscorpius rotundicauda	April 1997	1	Huang[6]
	Carcinoscorpius rotundicauda juveniles	June 2002	2	Mott[2]
	Tachypleus tridentatus	May 2004	15	This Study
East of Sha Chau	*Carcinoscorpius rotundicauda* adult	July 1995	1	Mouchel[1]
	Tachypleus tridentatus juvenile	January 2004	1	Mouchel[7]
The Brothers	Unknown juvenile	April 1995	1	Mouchel[1]
	Tachypleus gigas	June 1996	5	
Northwest Lantau Island (Tai O, Yi O, Sham Wat Wan, Sha Lo Wan)	*Tachypleus tridentatus* 7 males, 12 females	July – August 1997	19	Chiu and Morton (1999)
	Carcinoscorpius rotundicauda 22 males, 31 females	July – August 1997	65	Chiu and Morton (1999)

Note: Although *Tachypleus gigas* has been reported in the wider study area, it may have been misidentified as Chiu and Morton (1999) only recorded the similar *Tachypleus tridentatus* during extensive surveys of the Northwestern waters. [1]Adapted from Mouchel (2002a); [2]Mott (2003); [3]Mouchel (2000); [4]Fong (1999b); [5]AFCD (pers. comm.); [6]Huang (1997); [7]Mouchel (2004b).

5.7 Cetaceans

5.7.1 The cetacean species of primary concern in the study area is the Indo-Pacific humpback dolphin *Sousa chinensis* (Chinese White Dolphin), which occurs in the waters of North Lantau. It is also known to appear seasonally in outer Deep Bay, South and East Lantau and Lamma.

5.7.2 *Sousa chinensis* is listed in the UN Biodiversity Treaty as a protected species and is classified in Appendix I of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES). In Hong Kong, this species is protected under the Wild Animals Protection Ordinance (Cap. 170) 1980 and the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187) 1988.

5.7.3 The dolphins have been the subject of several intensive studies for approximately the past eight years. Thus, there is a great deal of data available from which to make an assessment of the potential impacts of the bridge and to propose mitigation measures for reducing such impacts. In this baseline ecological assessment, a method of assessing the impacts of the bridge construction and operation on the dolphin population has also been developed and this will be invaluable to the EIA.

5.7.4 To estimate the potential impact of the bridge on the dolphin population, an approach based on estimating impacts in 1km^2 grids has been developed using the same methodology adopted for the Permanent Aviation Fuel Facility (PAFF) Environmental Impact Assessment Report (Mouchel, 2002b). To derive the density of dolphins, in each 1km^2 grid, existing data have been used and this has also formed the basis for the assessment of potential impacts. The alignment within the Hong Kong SAR waters has been divided into three sections:

a. Hong Kong Section (HKS) – from the Hong Kong SAR boundary to the bridge's landfall on Lantau at Sha Lo Wan;
b. North Lantau Highway Connection (NLHC) – from the landfall at Sha Lo Wan to the bridge's exit from the eastern side of the airport platform; and
c. Northeast Lantau Section (NELS) – from the eastern edge of the airport platform to its connection to the North Lantau Highway.

5.7.5 An Impact Index (I) for each of these three sections of the proposed bridge has been calculated as follows:

$$I = \sum_{i=1}^{n} (D\ l)$$

where n = number of 1 km^2 grids the bridge alignment passes through;
D = dolphin density in grid I (based on number of on-effort sightings); and
l = length of bridge route in grid *i*.

The higher the Impact Index, the higher the predicted impact on the dolphin population, based on the assumption that human activity in a higher density area for dolphins would have a greater impact than the same activity in a lower density area. The dolphin density in each 1 km^2 grid was calculated by evaluating the number of on-effort (i.e., collected during strict line transect sighting effort surveys) dolphin sightings in that grid. Dolphin sightings were based on the Hong Kong Cetacean Research Project (HKCRP) humpback dolphin sighting database, which covers vessel surveys conducted by the HKCRP (and its predecessor at the Ocean Park Conservation Foundation) since November 1995 (Jefferson and Leatherwood, 1997; Jefferson, 2000). The length of bridge section in each grid was calculated by overlaying a map showing the proposed bridge alignment over a $1km^2$ grid of the study area.

5.7.6 Results revealed that the current proposed bridge alignment (*Figure 8)* passes through sixteen $1km^2$ grids, although five of these are along the southern edge of the airport platform and do not occur over water. Predicted impacts based on the distribution of dolphins in each $1km^2$ grids for each section and alignment are discussed below.

Proposed Alignment

5.7.7 The Hong Kong Section of the bridge passes through seven grids and occurs in a known area of high dolphin density along the northwest coast of Lantau Island. The Impact Index is 24.4 for this approximately 4.8km long section of bridge. The North Lantau Highway Connection section of the bridge runs along the southern edge of the airport platform, and there have been no dolphin sightings in the adjacent channel between the airport and Lantau Island. The Impact Index for the NLHC is therefore, zero. The Northeast Lantau Section of the bridge, approximately 4.1km long, passes through four grids in an area of low dolphin density (the lowest in North Lantau) and the Impact Index is zero. The total Impact Index for the main alignment is, therefore, 24.4.

Alternative Alignment

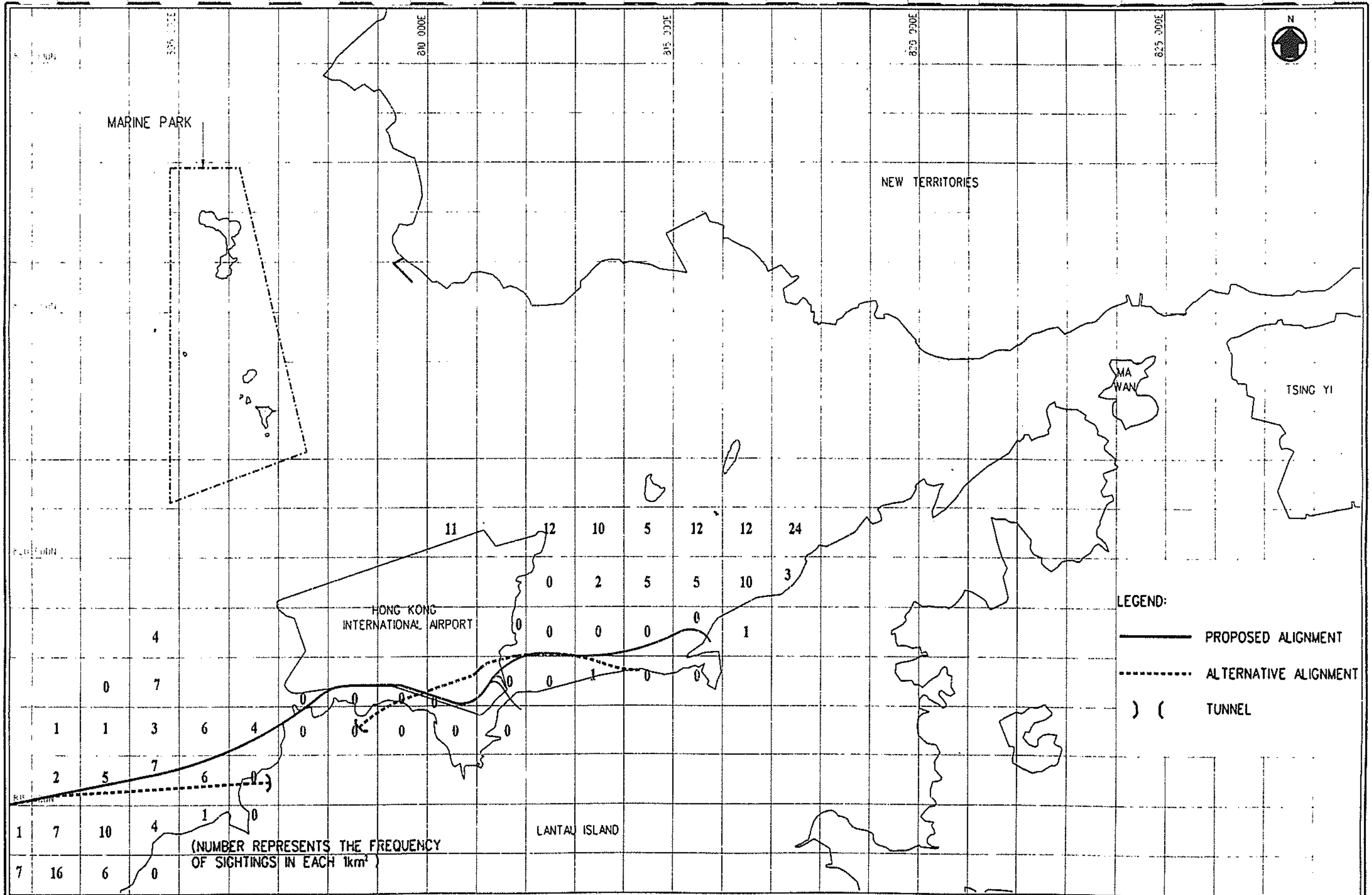
5.7.8 The alternate alignment (as shown in *Figure 8*) runs south of the main alignment and passes through a tunnel on Lantau Island, crosses the airport channel and across the airport platform, exiting east of the airport, and then joins the North Lantau coastline further west than the main alignment. The total Impact Index for the alternative alignment is 20.0. This is largely due to the minimisation of dolphin impacts caused by the larger proportion of the route on land.

Summary/Discussion

5.7.9 The Impact Index analysis described above provides a quantitative indication that the HKS section of the bridge passes through an important area of dolphin habitat. Both the NLHS and NELS sections pass through areas of very low dolphin density. Thus, within Hong Kong waters, the HKS section is likely to have the most significant impact on dolphins.

5.7.10 It should be noted that the entire section of the bridge to be built in Mainland Chinese waters (Zhujiang Section – ZS) passes through a known high-density area for dolphins (see Jefferson, 2000) and it is imperative that potential cumulative impacts along the whole alignment are thoroughly assessed.

5.7.11 Finally, it should also be noted that the Impact Index described above was originally designed to evaluate alternative alignments at the same point in time. As such, it does not take into account changes in dolphin sighting effort and resulting effects on the Impact Index. Although it is possible to scale each Impact Index calculation to the overall current level of sighting effort, and thereby standardise for survey effort, this is not the best way to evaluate before and after changes in dolphin density distribution.



Distribution of Indo-Pacific Humpback Dolphin Sightings in Each 1 km^2

Meinhardt Mouchel

Figure No. 8

5.8 Avifauna

5.8.1 A total of 118 species of birds were recorded within the study area during the scheduled surveys. A summary of the species recorded within the study area is given in *Table 5.13* below and details are presented in *Appendix H*. The surveyed areas are presented in *Figure 6*.

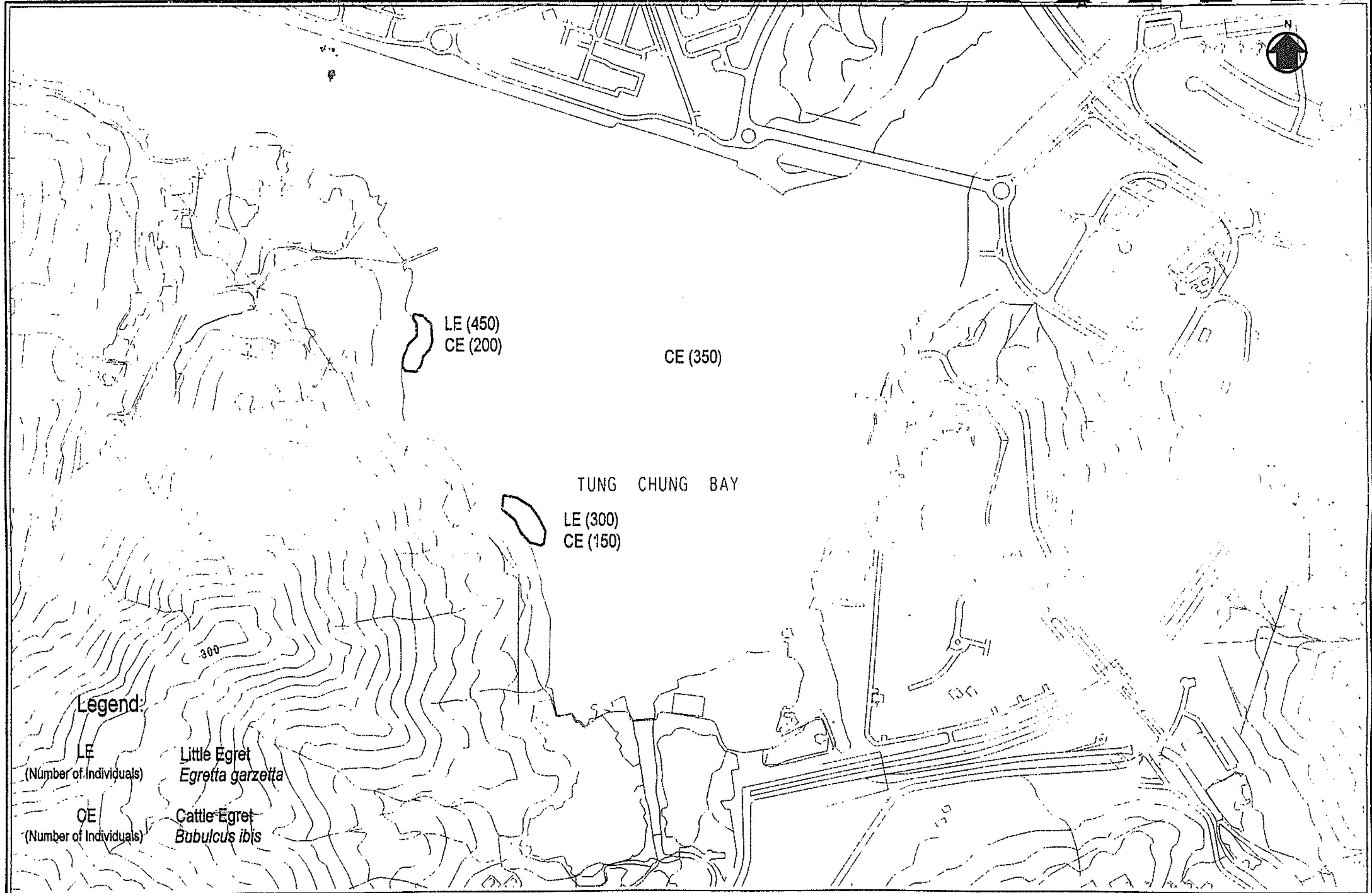
5.8.2 The majority of the bird species recorded are common and widespread and found in similar habitats throughout Hong Kong (Carey *et al*., 2001). There were 32 species that are considered to be of conservation interest (Fellowes *et al*., 2002) including the Black-browed Reed Warbler *Acrocephalus bistrigiceps*, Pacific Swift *Apus pacificus*, Grey Heron *Ardea cinerea*, Chinese Pond Heron *Ardeola bacchus*, Eurasian Eagle Owl *Bubo Bubo*, Cattle Egret *Bubulcus ibis*, Striated Heron *Butorides striatus*, Zitting Cisticola *Cisticola juncidis*, Grey Treepie *Dendrocitta formosae*, Great Egret *Egretta alba*, Swinhoe's Egret *Egretta eulophotes*, Little Egret *Egretta garzetta*, Intermediate Egret *Egretta intermedia*, Pacific Reef Egret *Egretta sacra*, Yellow-breasted Bunting *Emberiza aueola*, Chestnut-eared Bunting *Emberiza fucata*, Peregrine Falcon *Falco peregrinus*, Black-capped Kingfisher *Halcyon pileata*, White-throated Kingfisher *Halcyon smyrnensis*, White-bellied Sea Eagle *Haliaeetus leucogaster*, Grey-tailed Tattler *Heteroscelus brevipes*, Bonelli's Eagle *Hieraaetus fasciatus*, Black-winged Stilt *Himantopus himantopus*, Brown Fish Owl *Ketupa zeylonensis*, Black Kite *Milvus migrans*, Black-crowned Night Heron *Nycticorax nycticorax*, Eurasian Woodcock *Scolopax rusticola*, Crested Serpent Eagle *Spilomis cheela*, Red-Billed Starling *Sturnus sericeus*, White-shouldered Starling *Sturnus sinensis*, Little Grebe *Tachybaptus ruficollis* and Wood Sandpiper *Tringa glareola*.

5.8.3 Of the species of conservation interest recorded, 19 were identified by Fellowes et al. (2002) as local concern while 10 species were of immediate (potential) regional concern. It should be noted that Swinhoe's Egret *Egretta eulophotes* is listed as globally vulnerable by the IUCN and the majority of records in Hong Kong have been from the intertidal mudflats of Deep Bay (Carey *et al*., 2001). Three Swinhoe's Egrets were recorded in Tung Chung Bay during the survey conducted in April 2004. Another noteworthy bird is the Red-billed Starling *Sturnus sericeus* which is also considered a globally threatened species (Fellowes *et al*., 2002). *S. sericeus* was recorded at Tin Sam and Tung Chung Bay during the December 2003 and January 2004 surveys.

5.8.4 Some avifauna species were also listed under CITES Appendices. Seventeen species namely Japanese Sparrowhawk, Crested Goshawk, Besra, Eurasian Eagle Owl, Cattle Egret, Grey-faced Buzzard, Common Buzzard, Liitle Egret, Peregrine Falcon, Common Kestrel, Hwamei, White-bellied Sea Eagle, Bonelli's Eagle, Brown Fish Owl, Black Kite, Collared Scops Owl and Crested Serpent Eagle are classified as threatened species in CITES. Of these avifauna species, all are protected in China except Cattle Egret, Little Egret and Hwamei. In addition, *Centropus bengalensis* and *Centropus sinensis* are also protected species in China. It should, however, be noted that such listings are based mainly on the level of exploitation.

5.8.5 Avifauna surveys conducted at Tai Ho Wan in October 2003 revealed the presence of a pair of Brown Fish Owls which is a species of very high conservation interest and has only been recorded previously in Hong Kong from four other locations mostly in Sai Kung (Carey *et al*., 2001). It is notable that this owl species was also previously recorded at Discovery Bay, Lantau but abandoned the area following habitat loss as a consequence of construction activity. The ecological impact assessment will, therefore, carefully need to determine the potential indirect impacts (notably noise disturbance) associated with any construction near to Tai Ho. Additional night surveys on 28 October and 5, 27 November 2003 at Tai Ho Wan confirmed the presence of the Brown Fish Owls suggesting that they are resident and likely to breed in Tai Ho Wan.

5.8.6 During a survey on 24 September 2003, a high number of Cattle Egret (~700 individuals) and Little Egret (~773 individuals) were recorded in Tung Chung Bay (*Figure 9*). For both species, records are mainly from the northwest and northeast New Territories and there has never been such a high number recorded in Lantau Island (Carey *et al*., 2001) and Little Egret are known to form colonies that are highly concentrated (Fellowes *et al*., 2002). For the Cattle Egret, this is the second highest count in Hong Kong. Results suggested that Tung Chung Bay is likely an important foraging site for the Cattle and Little Egrets. As many feeding habitats for Egrets have been lost in Hong Kong (Carey *et al*., 2001), conservation priority should be given to the Tung Chung Bay during the impact assessment.



Records of Cattle Egret and Little Egret from Tung Chung Bay on 24 September 2003

Meinhardt Mouchel

Figure No. 9

Table 5.13 A Summary of the Avifauna Species Recorded during the Reporting Period

Species name	Common name	Local Abundance	Status	Global Red List category (IUCN)	Global rating	Regional rating	Local rating	Level of concern	Sep - Oct 2003	Nov - Dec 2003	Jan - Feb 2004	Mar- May 2004	Habitat Present
Accipiter gularis (CITES II)	Japanese Sparrowhawk	U	M							+			WL
Accipiter trivirgatus ~ (CITES II)	Crested Goshawk	U	R						+			+	WL
Accipiter virgatus ~ (CITES II)	Besra	S	R									+	WL
Acridotheres cristatellus ~	Crested Myna	A	R						+	+	+	+	C,DA
Acrocephalus bistrigiceps	Black-browed Reed Warbler	C	M			?		LC	+				SHG
Actitis hypoleucos	Common Sandpiper	C/S	WV						+	+	+	+	CT
Aethopyga christinae	Fork-tailed Sunbird	C	R							+		+	WL
Alcedo atthis	Common Kingfisher	C	AM, W, R						+	+	+	+	S, CT
Amaurornis phoenicurus ~	White-breasted Waterhen	C	R						+		+	+	S, CT, C
Anthus hodgsoni	Olive-backed Pipit	C	WV						+	+	+	+	C, SHG, DA, TS, PW
Anthus richardi	Richard's Pipit	C	R M WV						+				W,C
Apus affinis	Little Swift	A-C	R,SpM									+	WL, SHG, TS
Apus pacificus	Pacific Swift	C	SpM,Su					(LC)				+	WL, SHG, TS
Ardea cinerea	Grey Heron	A	W			@		PRC	+	+	+		CT
Ardeola bacchus	Chinese Pond Heron	C	R			@		PRC (RC)	+	+	+	+	CT
Bambusicola thoracica	Chinese Bamboo Partridge	Cat E	Cat E									+	TS
Bubo bubo (CITES II)	Eurasian Eagle Owl	S	R			* #		RC				+	SHG
Bubulcus ibis (CITES III)	Cattle Egret	U-C	R, Su			#		(LC)	+				CT
Butastur indicus (CITES II)	Grey-faced Buzzard	U	SpM									+	TS
Buteo buteo (CITES II)	Common Buzzard	C	WV						+	+	+	+	WL, SHG, TS
Butorides striatus ~	Striated Heron	U- S	Su					LC	+	+		+	S
Caprimulgus affinis ~	Savanna Nightjar	U	Su, ?WV									+	SHG,TS
Centropus bengalensis ~	Lesser Coucal	C	R								+	+	WL, SHG
Centropus sinensis ~	Greater Coucal	C	R						+		+	+	WL, SHG, TS
Cettia diphone	Japanese Bush Warbler	U-C	WV							+	+		DA, SHG
Cettia fortipes	Brownish-flanked Bush Warbler	S	WV								+		SHG
Chalcophaps indica ~	Emerald Dove	S	R									+	WL
Cisticola juncidis	Zitting Cisticola	C	R WV				#	LC	+				SHG
Clamator coromandus ~	Chestnut-winged Cuckoo	U	Su									+	WL
Copsychus saularis ~	Oriental Magpie Robin	A	R						+	+	+	+	CT
Corvus macrorhynchus ~	Large-billed Crow	C	R*						+	+	+	+	WL, CT
Cuculus micropterus ~	Indian Cuckoo	C	Su									+	WL, TS
Cyanoptila cyanomelana	Blue-and-white Flycatcher	S	SpM							+			WL
Delichon dasypus	Asian House Martin	U	M									+	WL,TS

Species name	Common name	Local Abundance	Status	Global Red List category (IUCN)	Global rating	Regional rating	Local rating	Level of concern	Sep - Oct 2003	Nov - Dec 2003	Jan - Feb 2004	Mar-May 2004	Habitat Present
Dendrocitta formosae	Grey Treepie	S-U	R, WV, M					LC	+				WL
Dicaeum cruentatum	Scarlet-backed Flowerpecker	C	R							+			WL, TS
Dicrurus hottentotus ~	Hair-crested Drongo	C	SV*						+			+	WL
Dicrurus macrocercus	Black Drongo	C	M,Su						+			+	CT, WL, SHG, TS
Egretta alba	Great Egret	C- A	R			@		LC	+		+	+	CT
Egretta eulophotes	Swinhoe's Egret	S	SpM	VU	#	# @		GC				+	CT
Egretta garzetta (CITES III)	Little Egret	A	R			@		PRC (RC)	+	+	+	+	CT
Egretta intermedia	Intermediate Egret	C	AM, W			* #		RC	+				CT
Egretta sacra	Pacific Reef Egret	U	R			? $		LC	+	+		+	CT
Emberiza aureola	Yellow-breasted Bunting	U-C	M			? #	#	RC	+				SHG
Emberiza fucata	Chestnut-eared Bunting	S	M				#	LC				+	CT
Emberiza pusilla	Little Bunting	VC -C	WV									+	TS
Emberiza rutila	Chestnut Bunting	C-S	M						+	+		+	SHG
Emberiza spodocephala	Black-faced Bunting	C	WV, M							+	+	+	WL, C, SHG
Eudynamys scolopacea ~	Common Koel	A	Su, R							+	+	+	CT, WL, DA, TS, C
Eurystomus orientalis	Dollarbird	U	M									+	WL
Falco peregrinus (CITES I)	Peregrine Falcon	S	R, WV					LC	+				SHG
Falco tinnunculus (CITES II)	Common Kestrel	C	WV, AM							+	+		SHG
Ficedula mugimaki	Mugimaki Flycatcher	U	M, WV							+			WL
Ficedula parva	Red-breasted Flycatcher	N/A	WV						+				WL
Francolinus pintadeanus ~	Chinese Francolin	C	R									+	TS, SHG
Garrulax canorus ~ (CITES II)	Hwamei	C	R							+	+	+	SHG, WL
Garrulax perspicillatus ~	Masked Laughingthrush	A	R						+	+	+	+	SHG, , DA, TS
Halcyon pileata	Black-capped Kingfisher	C	AM, WV				#	LC	+	+	+	+	CT
Halcyon smyrnensis ~	White-throated Kingfisher	C	AM, WV, R					(LC)	+	+	+	+	CT, S
Haliaeetus leucogaster (CITES II)	White-bellied Sea Eagle	U	R*			*		RC	+	+	+	+	WL
Heteroscelus brevipes	Grey-tailed Tattler	C	M			*	*	LC				+	CT
Hieraaetus fasciatus (CITES II)	Bonelli's Eagle	S	R					RC		+			SHG
Hierococcyx sparveroides ~	Large Hawk Cuckoo	N/A	N/A									+	WL
Himantopus himantopus	Black-winged Stilt	C-U	WV			* @		RC	+				CT
Hirundapus cochinchinensis	White-vented Needletail	U	SpM									+	TS
Hirundo rustica ~	Barn Swallow	A	SpM,Su									+	DA,C
Hypsipetes castanonotus	Chestnut Bulbul	C	R, WV							+	+		WL
Ketupa zeylonensis ~ (CITES II)	Brown Fish Owl*	S	R			* #		RC	+	+			S, CT, WL
Lanius cristatus	Brown Shrike	C	SpM								+	+	TS
Lanius schach ~	Long-tailed	C	R						+	+	+	+	WL, W, C,

Species name	Common name	Local Abundance	Status	Global Red List category (IUCN)	Global rating	Regional rating	Local rating	Level of concern	Sep - Oct 2003	Nov - Dec 2003	Jan - Feb 2004	Mar-May 2004	Habitat Present
	Shrike												SHG
Lonchura punctulata	Scaly-breasted Munia	C	R						+	+	+	+	W, C, SHG, DA
Luscinia calliope	Siberian Rubythroat	C	WV						+	+	+	+	CT, WL, SHG, TS
Luscinia sibilans	Rufous-tailed Robin	U	WV, M							+	+		WL, TS, SHG
Milvus migrans (CITES II)	Black Kite	A	R, WV			@ #		PRC (RC)	+	+	+	+	WL, TS, SHG, CT
Monticola solitarius	Blue Rock Thrush	U	WV, M								+		CT
Motacilla alba ~	White Wagtail	C	WV, M R						+	+	+	+	C, DA, S, CT
Motacilla cinerea	Grey Wagtail	C	WV						+	+	+	+	C, S
Motacilla flava	Yellow Wagtail	C	M,W									+	CT
Muscicapa dauurica	Asian Brown Flycatcher	C-U	M, WV						+				WL, TS
Myophonus caeruleus ~	Blue Whistling Thrush	C	R						+	+	+	+	WL, S, CT
Nycticorax nycticorax	Black-crowned Night Heron	C-A	R					(LC)	+	+	+		S, CT
Orthotomus sutorius ~	Common Tailorbird	A	R						+	+	+	+	W, C, SHG, DA, TS
Otus bakkamoena ~ (CITES II)	Collared Scops Owl	C	R						+		+	+	WL
Parus major ~	Great Tit	A	R						+	+	+	+	CT, WL, C, DA, TS
Passer montanus ~	Eurasian Tree Sparrow	A	R						+	+		+	W, C, DA, S
Phoenicurus auroreus	Daurian Redstart	C	WV							+	+		WL, C, DA, TS
Phylloscopus borealis	Arctic Warbler	C	AM						+				WL, TS, CT
Phylloscopus fuscatus	Dusky Warbler	C	WV						+	+	+	+	CT, WL, C, SHG, DA, TS
Phylloscopus inornatus	Yellow-browed Warbler	C	WV						+	+	+	+	CT, WL, TS, C
Phylloscopus proregulus	Pallas's Leaf Warbler	U-C	WV							+	+		WL, TS, C
Phylloscopus tenellipes	Pale-legged Leaf Warbler	S	AM, WV						+				WL, TS
Pica pica ~	Common Magpie	C	R						+	+	+	+	CT, WL, DA, TS
Prinia flaviventris ~	Yellow-bellied Prinia	A	R								+		SHG
Prinia inornata ~	Plain Prinia	C	R									+	C
Pycnonotus aurigaster ~	Sooty-headed Bulbul	C	R									+	C
Pycnonotus jocosus ~	Red-whiskered Bulbul	A	R						+	+	+	+	CT, WL, W, C, SHG, TS, S
Pycnonotus sinensis ~	Chinese Bulbul	A	R						+	+	+	+	CT, WL, W, C, SHG, TS, S
Rallina eurizonoides ~	Slaty-legged Crake	Un	Un (Su, M, MV)									+	TS
Saxicola torquata	Common Stonechat	C	WV						+	+		+	C, SHG, WL
Scolopax rusticola	Eurasian Woodcock	S	WV, M					LC	+	+	+		WL
Serinus mozambiqus	Yellow-fronted Canary	N/A	N/A									+	DA
Spilornis cheela (CITES II)	Crested Serpent Eagle	N/A	M,R					LC				+	WL
Steptopelia chinensis ~	Spotted Dove	A	R						+	+	+	+	CT, WL, W, C, SHG, TS, S
Streptopelia orientalis	Oriental Turtle Dove	C	M WV							+	+		SHG, TS, C

Species name	Common name	Local Abundance	Status	Global Red List category (IUCN)	Global rating	Regional rating	Local rating	Level of concern	Sep - Oct 2003	Nov - Dec 2003	Jan - Feb 2004	Mar- May 2004	Habitat Present
Sturnus nigricollis ~	Black-collared Starling	A	R						+	+	+	+	CT, WL, W, C, SHG, TS, S
Sturnus sericeus	Red-billed Starling	A	WV			? @	@ #	GC		+	+		CT, WL
Sturnus sinensis	White-shouldered Starling	C	M,WV, Su			?	#	LC			+	+	WL
Tachybaptus ruficollis	Little Grebe	C	R					LC	+				CT
Tarsiger cyanurus	Red-flanked Bluetail	C	WV							+	+		WL, TS, C
Tringa glareola	Wood Sandpiper	A-C	WV			?		LC				+	CT
Turdus cardis	Japanese Thrush	U	M WV							+	+		WL, TS, C
Turdus hortulorum	Grey-backed Thrush	C	WV							+	+	+	WL, TS, C
Turdus merula	Common Blackbird	C	WV, M						+	+	+		TS, C
Turdus pallidus	Pale Thrush	S-U	WV								+		C, WL
Urocissa erythrorhyncha	Blue Magpie	C	R						+	+	+	+	WL, TS
Urosphena squameiceps	Asian Stubtail Warbler	C-S	WV							+	+		WL, TS
Zoothera dauma	Scaly Thrush	U	WV							+	+	+	WL, DA, TS, C
Zosterops japonicus ~	Japanese White-eye	A	R*						+	+	+	+	CT, WL, W, C, SHG, DA, TS, S

Note: Local abundance and status based on Carey *et al.* (2001), Viney et al., (1994) and conservation rating based on Fellowes *et al.* (2002).

Local Abundance:
A- Abundant
C- Common
U- Uncommon
S- Scarce
N/A – Not listed in Carey et al., 2001
Un- Uncertain
Species Name: CITES (Appendix I, II or III)

Status:
SpM- Spring Migrant
M- Passage Migrant
R- Resident
WV- Winter Visitor
Su- Summer Visitor
AM- Autumn Migrant
? Inadequate Information

Cat E – Species for which all published Hong Kong records are considered likely to relate to birds that have escaped or have been released from captivity (Carey *et al.*, 2001).

$: scarce visitor in Hong Kong
? : inadequate information on restrictedness
* : probably under-recorded
@: population highly concentrated
: in marked decline
\+ : Recorded during reporting period
~ Signs of Breeding (Carey *et al.*, 2001) - Breeding was recorded if one or more of the following were observed:
- Bird apparently holding territory;
- Courtship, display or anxiety call and agitated behavior of adult indicating presence of young or nest;
- Brood- patch on trapped bird;
- Adult visiting probably nest-site;
- Nest-building (including excavating nest hole);
- Distraction display or injury-feigning;
- Used nest found;
- Recently fledged young;
- Adult carrying faecal sac or food;
- Adult entering or leaving nest-site in circumstances indicating occupied nest (including colonies);
- Nest with eggs found, or bird sitting but not disturbed, or eggshells found near nest;
- nest with young or downy young of ducks, gamebirds, waders or other nidifugous species.

RC: Regional Concern
LC: Local Concern
PRC: Potential Regional Concern
( ) : Based on restricted nesting or roosting site

Habitat Type
C- Cultivated Field
CT- Coastal
DA – Developed Area
S –Stream
SHG- Shrubby Grassland
TS- Tall Shrubland
W – Wasteland
WL- Woodland

5.9 Terrestrial Mammals

5.9.1 Mammal surveys were carried out and a summary of the species recorded between September 2003 and May 2004 is presented below in *Table 5.14.* Full details of the survey results are presented in *Appendix I*. A map showing the area surveyed for mammals is presented in *Figure 6b.*

Table 5.14 A Summary of the Mammal Species Recorded

Species / Group	Protection Status	Locations Recorded	Local Abundance and Level of Conservation Interest
Muntiacus muntjac (Indian Muntjac)	WAPO	Tall shrubland at Sha Lo Wan and Sham Shek Tsuen.	Probably common (Reels, 1996) Considered as Potential Regional Concern (Fellowes *et al.,*2002).
Suncus murinus (Brown Musk Shrew)	WAPO	Village in Sham Wat.	Common (Reels, 1996)

5.9.2 Indian Muntjac *Muntiacus muntjac* were recorded in the tall shrubland of Sha Lo Wan in September 2003 and also in April 2004. Another sighting of the Indian Muntijac was made in the tall shrubland at Sham Shek Tsuen in April 2004. Calling of this species was also heard from almost the same location in March 2004. All Muntjac species are known to be in drastic decline in the region and considered to be of potential regional concern by Fellowes *et al.* (2002). In addition, one Brown Musk Shrew *Suncus murinus* was recorded in the village of Sham Wat in October 2003.

5.9.3 Both terrestrial mammal species recorded are locally common and Goodyer (1992) recorded them in many parts of the Territory and the Indian Muntijac has scattered records in Lantau (Reels, 1996). Only limited recent information is available for the Brown Musk Shrew (Goodyer, 1992). No other large mammal species was recorded during the course of the surveys and this supports the conclusion that large mammals are scarce across Lantau Island.

5.9.4 It should be noted that some unidentified insectivorous bats were observed during the February, April and May 2004 night surveys flying across Tai Ho Wan, Sham Wat and San Shek Wan. All bat species are protected in Hong Kong under the Wild Animals Protection Ordinance. Bat species have been reported previously from Lantau such as Least's Horseshoe bat *Rhinolophus pusillus* in Tai Ho (Ades, 1999; Mouchel, 2000), the Long-fingered Bat in Mui Wo (Green Lantau Association, 1998) and Greater Short-nosed Fruit Bat *Cynopterus sphinx* in north Lantau (Ades, 1999). Although many bats are common and widespread in Hong Kong, some are rare including the Least's Horseshoe Bat in Tai Ho (Mouchel, 2000).

5.10 Insects (Butterflies and Dragonflies)

5.10.1 The insect surveys were conducted over the 9-month period between September 2003 and May 2004 covering both the wet and dry seasons. The dragonfly and butterfly species recorded during the surveys are summarised in *Tables 5.15* and *5.16*, respectively. Details including the locations and period recorded are presented in *Appendices J* and *K* for dragonflies and butterflies, respectively.

Dragonflies

5.10.2 Twenty-four species of dragonfly were recorded in different habitats including stream, shrubland, coastal, grassland, wasteland and secondary woodland. The dragonflies recorded during the surveys were all common and abundant in Hong Kong although a number of the species are considered uncommon (Wilson, 1997, 2003) and of conservation interest (Fellowes *et al*., 2002). The majority of the species were sighted near streams or ponds while a few were recorded in secondary woodland or shrubby grassland.

5.10.3 Dragonfly species of local concern included the Elegant Clubtail *Leptogomphus elegans* recorded near Tai Ho Wan and the Sapphire Flutterer *Rhyothemis triangularis* observed near a pond in Tung Chung Bay. Both species were recorded in May 2004. One globally threatened (Fellowes *et al*., 2002) dragonfly species Small Hooktail *Melligomphus moluamis* was recorded near a stream at San Tau. Note that Elegant Clubtail and Small Hooktail have been previously recorded in the vicinity of the study area (Mouchel, 2002a). Apart from the aforesaid three species, all other species recorded during the course of the surveys are considered common and abundant in Hong Kong (Wilson, 1997, 2003).

5.10.4 The abundance of dragonfly species showed significant seasonal variation. The abundance was apparently higher in March to May 2004 surveys when compared with those conducted between September and November 2003. During the January and February 2004 surveys, no species of dragonfly was recorded. The dragonfly species recorded during the surveys are summarised in *Table 5.15* below and further details are presented in *Appendix J*.

Table 5.15 Dragonflies Recorded in the Study Area, September 2003 to May 2004

Species name	Common name	Status	Locations Recorded	Remarks
Brachydiplax chalybea	Blue Dasher	Common	Tung Chung Bay	
Acisoma panorpoides	Asian Pintail	Common	Tai Ho Wan	
Anax immaculifrons	Fiery Emperor	Common	Hau Hok Wan, Tai Ho Wan	
Coeliccia cyanomelas	Blue Forest Damsel	Common	San Tau	
Copera marginipes	Yellow Featherlegs	Abundant	Pak Mong to Ngau Kwu Long, Pak Mong to Tai Ho Wan	
Crocothemis servilia	Crimson Darter	Abundant	Pak Mong to Tai Ho Wan	
Diplacodes trivialis	Blue Percher	Abundant	Tai Ho Wan	
Euphaea decorata	Black-banded Gossamerwing	Abundant	Sha Lo Wan, San Tau, Pak Mong to Tai Ho Wan	
Leptogomphus elegans	Elegant Clubtail	Common	Pak Mong to Tai Ho Wan	Local Concern (Fellowes *et al*., 2002)
Lyriothemis elegantissima	Forest Chaser	Common	Pak Mong to Tai Ho Wan	
Melligomphus moluamis	Small Hooktail	Uncommon	San Tau	Global Concern (Fellowes *et al*., 2002)
Neurothemis tullia	Pied Percher	Common	Tung Chung Bay	
Orthetrum chrysis	Red-faced Skimmer	Common	Pak Mong to Tai Ho Wan	
Orthetrum glaucum	Common Blue Skimmer	Abundant	Sham Wat Wan, San Shek Wan, Sha Lo Wan, Hau Hok Wan, San Tau, Pak Mong to Ngau Kwu Long, Pak Mong to Tai Ho Wan, Ngau Au	
Orthetrum luzonicum	Marsh Skimmer	Abundant	Sha Lo Wan	
Orthetrum pruinosum	Common Red Skimmer	Abundant	Sham Wat Bay, Kau Liu, Hau Wong Temple, Tai Ho Wan	

Species name	Common name	Status	Locations Recorded	Remarks
Orthetrum sabina	Green Skimmer	Abundant, common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Kau Liu, Tin Sam, San Tau, Tai Ho Wan	
Pantala flavescens	Wandering Glider	Abundant	Sham Wat Bay, Sham Shek Tsuen, San Shek Wan, Sha Lo Wan, Hau Hok Wan, Chek Lap Kok, Kau Liu, Hau Wong Temple, Ma Wan Chung, Tung Chung Battery, Pak Mong to Tai Ho Wan, Pak Mong to Ngau Kwu Long, Kau Liu to Hau Hok Wan, Ngau Au	
Prodasineura autumnails	Black Threadtail	Abundant	Sha Lo Wan, San Tau, Pak Mong to Tai Ho Wan	
Rhinocypha perforata	Common Blue Jewel	Abundant	Sha Lo Wan, San Tau, Pak Mong to Tai Ho Wan	
Rhyothemis triangularis	Sapphire Flutterer	Uncommon	Tung Chung Bay	Local Concern (Fellowes *et al.*, 2002)
Tramea virginia	Saddlebag Glider	Common	Chek Lap Kok	
Trithemis aurora	Crimson Dropwing	Abundant	Sha Lo Wan, Hau Hok Wan, Tung Chung Bay, Pak Mong to Tai Ho Wan	
Trithemis festiva	Indigo Dropwing	Abundant	Sham Wat Bay, Hau Hok Wan, San Tau, Pak Mong to Ngau Kwu Long, Pak Mong to Tai Ho Wan	

Note: After Wilson (1997, 2003).

Butterflies

5.10.5 Ninety species of butterfly were recorded in different habitats including edge of woodland, tall shrubland, riparian, cultivated field, coastal grassland and shrubby grassland. During the course of surveys, the butterfly species encountered were mostly common and abundant in Hong Kong except six species of conservation interest (Fellowes *et al.*, 2002; Young and Yiu, 2002). These included Common Albatross *Appias albina*, Burmese Bush Blue *Arhopala bimana*, Small Grass Yellow *Eurema brigitta*, Danaid Eggfly *Hypolimnas misippus*, Dragontail *Lamproptera curius* and Falcate Oak Blue *Mahathala ameria*. All of these are of local conservation concern (Fellowes *et al.*, 2002). The three rare species (Common Albatross, Burmese Bush Blue and Dragontail) were only recorded in San Tau. This supports the conclusion that San Tau is an important habitat for butterfly species.

5.10.6 The butterfly species recorded during the surveys are presented in *Table 5.16* below. Details including the locations and period recorded are presented in *Appendix K*.

Table 5.16 Butterflies Recorded in the Study Area, September 2003 to May 2004

Species name	Common name	Status*	Locations Recorded	Remarks
Abisara echerius	Plum Judy	Very common	Sham Wat Bay, San Shek Wan, Sha Lo Wan, Hau Hok Wan, Kau Liu, Tin Sam, San Tau, Tai Ho Bay, Pak Mong to Ngau Kwu Long, Sham Shek Tsuen headland, Ngau Au	
Acytolepis puspa	Common Hedge Blue	Common	Sham Wat Bay, San Shek Wan, Chek Lap Kok, San Tau, Tung Chung Bay, Pak Mong to Ngau Kwu Long, Ngau Au	
Ampittia dioscorides	Bush Hopper	Uncommon	Sha Lo Wan, Tai Ho Bay	
Appias albina	Common Albatross	Rare	San Tau	Local Concern (Fellowes *et al*., 2002)
Arhopala birmana	Burmese Bush Blue	Rare	San Tau	Local Concern (Fellowes *et al*., 2002)
Artipe eryx	Green Flash	Uncommon	Kau Liu to Hau Hok Wan	
Astictopterus jama	Forest Hopper	Common	San Tau, Pak Mong to Ngau Kwu Long, Sham Shek Tsuen headland	
Athyma nefte	Colour Sergeant	Common	San Tau, Tung Chung Bay	
Athyma perius	Common Sergeant	Common	Tai Ho Bay	
Athyma selenophora	Staff Sergeant	Common	San Tau, Pak Mong to Tai Ho Wan	
Bibasis gotama	Pale Awlet	Uncommon	San Tau	
Catopsilia pomona	Lemon Emigrant	Common	Sham Wat Bay, San Shek Wan, Chek Lap Kok, Tung Chung Bay, Hau Wong Temple, Ma Wan Chung, Pak Mong to Ngau Kwu Long, Kau Liu to Hau Hok Wan	
Catopsilia pyranthe	Mottled Emigrant	Common	San Tau, Hau Wong Temple, Pak Mong to Ngau Kwu Long	
Cepora nerissa	Common Gull	Common	Sha Lo Wan, San Tau, Pak Mong to Tai Ho Wan, Kau Liu to Sha Lo Wan	
Cethosia biblis	Hong Kong Lacewing	Rare	San Tau, Tung Chung Bay, Pak Mong to Ngau Kwu Long	
Charaxes bernardus	Tawny Rajah	Common	Tin Sam, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan	
Chilades lajus	Lime Blue	Very common	Sham Wat Bay, Pak Mong to Ngau Kwu Long	
Cupha erymanthis	Rustic	Very common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Chek Lap Kok, Kau Liu, San Tau, Tung Chung Bay, Tung Chung Battery, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland, Ngau Au, Kau Liu to Hau Hok Wan	
Cyrestis thyodamas	Mapwing	Common	Sha Lo Wan, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan, Hok Hok Wan to Sha Lo Wan	
Danaus chrysippus	Plain Tiger	Uncommon	Sham Wat Bay	
Danaus genutia	Common Tiger	Very common	Sham Wat Bay, Chek Lap Kok, Tin Sam, Pak Mong, Tai Ho Bay	

Species name	Common name	Status*	Locations Recorded	Remarks
Delias pasithoe	Red-base Jezebel	Very common	Sham Wat Bay, Chek Lap Kok, Kau Liu, Tin Sam, San Tau, Hau Wong Temple, Ma Wan Chung, Tung Chung Battery, Pak Mong to Ngau Kwu Long, Ngau Au, Kau Liu to Hau Hok Wan	
Erionota torus	Banana Skipper	Common	Sham Wat Bay	
Euchrysops cnejus	Gram Blue Cupid	Common	Tai Ho Bay	
Euploea core	Common Indian Crow	Very common	Sha Lo Wan, Chek Lap Kok, San Tau, Hau Wong Temple, Tung Chung Battery	
Euploea midamus	Blue-spotted Crow	Very common	Sham Wat Bay, Hau Hok Wan, Kau Liu, San Tau, Hau Wong Temple, Pak Mong to Tai Ho Wan	
Eurema blanda	Three-spot Grass Yellow	Uncommon	Pak Mong to Tai Ho Wan	
Eurema brigitta	Small Grass Yellow	Uncommon	Kau Liu	Population in marked decline and of local concern (Fellowes *et al.*, 2002).
Eurema hecabe	Common Grass Yellow	Very common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Chek Lap Kok, Kau Liu, San Tau, Tung Chung Bay, Hau Wong Temple, Ma Wan Chung, Tung Chung Battery, Pak Mong to Ngau Kwu Long, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland, Ngau Au, Kau Liu to Sha Lo Wan	
Eurema laeta	Spotless Grass Yellow	Uncommon	Sha Lo Wan, Tung Chung Bay, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland	
Euthalia phemius	White-edged Blue Baron	Common	San Tau	
Everes lacturnus	Tailed Cupid	Common	Tai Ho Bay, Pak Mong to Ngau Kwu Long	
Faunis eumeus	Common Faun	Common	San Tau, Tai Ho Bay, Pak Mong to Ngau Kwu Long, Sham Shek Tsuen headland	
Graphium agamemnon	Tailed Jay	Very common	Kau Liu, San Tau, Tung Chung Bay, Hau Wong Temple, Tai Ho Bay, Pak Mong to Ngau Kwu Long, Kau Liu to Hau Hok Wan	
Graphium doson	Common Jay	Uncommon	Sha Lo Wan, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan, Kau Liu to Hau Hok Wan	
Graphium sarpedon	Common Bluebottle	Very common	Sham Wat Bay, Sha Lo Wan, Chek Lap Kok, Kau Liu, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland, Kau Liu to Hau Hok Wan	
Hebomoia glaucippe	Great Orangetip	Common	Sha Lo Wan, San Tau, Tung Chung Bay, Ngau Au, Hau Hok Wan to Sha Lo Wan	
Heliophorus epicles	Purple Sapphire	Common	Tin Sam, Pak Mong to Tai Ho Wan	
Hestina asslimilis	Red Ring-skirt	Common	Pak Mong to Tai Ho Wan	
Hypolimnas bolina	Great Eggfly	Very common	Chek Lap Kok, San Tau, Tai Ho Bay, Pak Mong to Ngau Kwu Long	
Hypolimnas misippus	Danaid Eggfly	Uncommon	Chek Lap Kok	Local concern (Fellowes *et al.*, 2002)

Species name	Common name	Status*	Locations Recorded	Remarks
Iambrix salsala	Chestnut Bob	Uncommon	Kau Liu to Hau Hok Wan	
Ideopsis similis	Ceylon Blue Glassy Tiger	Very common	Sham Wat Bay, Sha Lo Wan, Kau Liu, San Tau, Hau Wong Temple, Tung Chung Battery, Tai Ho Bay, Pak Mong to Ngau Kwu Long	
Iraota timoleon	Silver Streak Blue	Uncommon	Kau Liu	
Ixias pyrene	Yellow Orange Tip	Uncommon	Sha Lo Wan, Hau Hok Wan, Hau Hok Wan to Sha Lo Wan	
Jamides bochus	Dark Cerulean	Common	Sham Wat Bay, Kau Liu	
Junonia almana	Peacock Pansy	Common	Tung Chung Battery, Tai Ho Bay, Pak Mong to Tai Ho Wan, Pak Mong to Ngau Kwu Long	
Junonia atlites	Grey Pansy	Common	Pak Mong to Tai Ho Wan, Pak Mong to Ngau Kwu Long	
Junonia hierta	Yellow Pansy	Uncommon	San Tau	
Junonia iphita	Chocolate Pansy	Uncommon	San Tau	
Junonia lemonias	Lemon Pansy	Uncommon	Pak Mong to Ngau Kwu Long	
Kaniska canace	Blue Admiral	Common	Hau Hok Wan, Kau Liu, Tin Sam, San Tau	
Lampides boeticus	Long-tailed Blue	Common	Sham Wat Bay, Pak Mong to Ngau Kwu Long	
Lamproptera curius	Dragontail	Rare	San Tau,	Local Concern (Fellowes *et al.*, 2002)
Lethe confusa	Common White-banded Brown	Very common	Kau Liu, San Tau, Sham Shek Tsuen headland, Kau Liu to Hau Hok Wan	
Mahathala ameria	Falcate Oak Blue	Uncommon	Kau Liu to Hau Hok Wan	Local Concern (Fellowes *et al.*, 2002)
Melanitis leda	Common Evening Brown	Very common	Sham Wat Bay, Kau Liu, San Tau, Tai Ho Bay, Sham Shek Tsuen headland	
Mycalesis mineus	Dark Brand Bush Brown	Very common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Kau Liu, San Tau, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland	
Mycalesis zonata	South China Bush Brown	Common	Sham Wat Bay, Kau Liu, San Tau, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland	
Nacaduba kurava	Rounded Six-line Blue	Very common	Pak Mong to Tai Ho Wan	
Neopithecops zalmora	Quaker	Uncommon	Sha Lo Wan, Tung Chung Bay	
Neptis hylas	Common Sailer	Very common	Sha Lo Wan, Hau Hok Wan, Kau Liu, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland, Ngau Au, Kau Liu to Hau Hok Wan	
Odontoptilum angulatum	Chestnut Angle	Common	Sham Wat Bay, San Tau, Pak Mong to Ngau Kwu Long	
Papilio bianor	Chinese Peacock	Common	San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan	
Papilio clytia	Common Mime	Common	Sham Wat Bay, Sha Lo Wan, Chek Lap Kok, Kau Liu, Tin Sam, San Tau, Tung Chung Battery, Pak Mong to Tai Ho Wan, Kau Liu to Hau Hok Wan	
Papilio demoleus	Lime Butterfly	Common	Sha Lo Wan, Hau Hok Wan, Chek Lap Kok, Kau Liu, San Tau, Tung Chung Bay, Pak Mong to Ngau Kwu Long	
Papilio helenus	Red Helen	Very common	Sham Wat Bay, Kau Liu, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan, Kau Liu to Sha Lo Wan	

Species name	Common name	Status*	Locations Recorded	Remarks
Papilio memnon	Great Mormon	Very common	Sha Lo Wan, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan	
Papilio paris	Paris Peacock	Very common	Sha Lo Wan, Hau Hok Wan, Kau Liu, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan, Kau Liu to Hau Hok Wan	
Papilio polytes	Common Mormon	Very common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Kau Liu, San Tau, Tung Chung Bay, Hau Wong Temple, Pak Mong to Tai Ho Wan, Sham Shek Tsuen headland, Kau Liu to Sha Lo Wan	
Papilio protenor	Spangle	Very common	Hau Hok Wan, San Tau, Hau Wong Temple, Tung Chung Battery, Pak Mong to Tai Ho Wan, Hau Hok Wan to Sha Lo Wan	
Papilio xuthus	Swallowtail	Rare	San Shek Wan, San Tau, Sham Shek Tsuen headland	
Parasarpa dudu	Commodore	Uncommon	Tung Chung Bay	
Parathyma sulpitia	Five-dot Sergeant	Common	San Tau, Kau Liu to Hau Hok Wan	
Parnara guttata	Common Straight Swift	Common	Sha Lo Wan, Tin Sam, Tai Ho Bay	
Pathysa antiphates	Five-bar Swordtail	Common	Sha Lo Wan, Kau Liu, San Tau, Tung Chung Bay, Pak Mong to Tai Ho Wan	
Phaedyma columella	Short-banded Sailer	Uncommon	Sha Lo Wan, Pak Mong to Tai Ho Wan	
Pieris canidia	Indian Cabbage White	Very common	Sham Wat Bay, Sha Lo Wan, San Tau, Chek Lap Kok, Kau Liu, Tin Sam, Tung Chung Bay, Hau Wong Temple, Pak Mong to Tai Ho Wan	
Polyura nepenthes	Shan Nawab	Uncommon	San Tau, Tung Chung Battery, Tai Ho Bay, Pak Mong to Ngau Kwu Long, Hau Hok Wan to Sha Lo Wan	
Rapala manea	Slate Flash	Uncommon	Pak Mong to Tai Ho Wan	
Rohana parisatis	Black Prince	Uncommon	Sha Lo Wan, San Tau, Pak Mong to Ngau Kwu Long, Kau Liu to Sha Lo Wan	
Spindasis lohita	Long-banded Silverline	Uncommon	Tai Ho Bay	
Suastus gremius	Indian Palm Bob	Common	Pak Mong to Ngau Kwu Long,	
Symbrenthia lilaea	Jester	Common	Sha Lo Wan, Pak Mong to Tai Ho Wan	
Vanessa indica	Indian Red Admiral	Common	Pak Mong to Ngau Kwu Long,	
Ypthima baldus	Common Five-ring	Very common	Sha Lo Wan, Hau Hok Wan, Tai Ho Bay, Pak Mong to Ngau Kwu Long, Hau Hok Wan to Sha Lo Wan	
Ypthima lisandra	Straight Five-ring	Common	Tai Ho Bay,	
Zemeros flegyas	Punchinello	Common	Sham Wat Bay, San Tau, Tung Chung Bay,	
Zizeeria maha	Pale Grass Blue	Very common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Chek Lap Kok, Kau Liu, San Tau, Tung Chung Bay, Hau Wong Temple, Ma Wan Chung, Pak Mong to Tai Ho Wan, Ngau Au	
Zizina otis	Lesser Grass Blue	Common	Tai Ho Wan	

Note: After Young and Yiu (2002).

5.11 Herpetofauna (Reptiles and Amphibians)

5.11.1 The herpetofauna were surveyed during both the day and night by active searching in appropriate microhabitats, combined with auditory detection and chance encounters, in areas traversed or potentially impacted by the proposed road alignment. The herpetofauna surveys were conducted over a 9-month period between September 2003 and May 2004 covering both the wet and dry seasons. Twenty-one species of herpetofauna were recorded in the study area during the course of the surveys, including five species of conservation interest. A summary of the species recorded is provided in *Table 5.17* below and details including locations and period recorded are presented in *Appendix L*.

Amphibians

5.11.2 Of the seven amphibian species recorded in the study area, the Lesser Spiny Frog (*Rana exilispinosa*) is of conservation concern. The Lesser Spiny Frog was recorded in Tai Ho Wan, San Tau, Kau Liu, Hau Hok Wan, Sha Lo Wan and Sham Wat Bay. Although this species is widespread in hill and mountain streams in Hong Kong (Karsen *et al*., 1998), this frog is considered threatened in China due to a decline in populations throughout its range (Hunan, Fujian and Guangdong). This species is, therefore, considered to be of conservation concern (Fellowes *et al*., 2002). The other amphibian species are common and widespread in Hong Kong (Karsen *et al*., 1998).

5.11.3 Although several populations of Romer's Tree Frog (*Philautus romeri*) have been recorded on Lantau Island (Lau and Dudgeon, 1999; Mouchel, 2002a; AFCD, pers. comm.), no signs of Romer's Tree Frog (including tadpoles and audible frog calls) were found during the present surveys. Romer's Tree Frog are widespread on north Lantau (Mouchel, 2002a) and of very high conservation interest. Recent records have indicated that a remnant population of Romer's Tree Frog is extant on Scenic Hill where 2.86 ha of secondary woodland is present. Careful assessment of the Scenic Hill secondary woodland and aquatic habitats potentially utilised by the frog (well-wooded areas near to streams; Karsen *et al.*, 1998) that may be impacted by the project is, therefore, required.

Reptiles

5.11.4 Of the fourteen reptile species recorded in the study area, all are common in Hong Kong except the Blue-tailed skink (*Eumeces quadrilineatus*), Four-clawed Gecko (*Gehyra mutilata*), Tokay Gecko (*Gekko gecko*), Chinese Cobra (*Naja atra*) and Taiwan Kukri snake (*Oligodon formosanus*). The Chinese Cobra and Tokay Gecko are of conservation interest. The Common Rat Snake is common in Hong Kong but of conservation interest in the wider region (Fellowes *et al*., 2002)

5.11.5 Chinese Cobra in southern China is believed to be in population decline (Mouchel, 2002a) and this species is of conservation interest in the wider region (Fellowes *et al*., 2002). This species is considered globally restricted to southern China (Karsen *et al*., 1998), and is a CITES Appendix II species. It is also listed as vulnerable in the China Red Data Book of Endangered Animals (Zhao, 1998). This species was recorded at Sham Shek Tsuen headland in October 2003.

5.11.6 Tokay Gecko is considered locally rare (Karsen *et al*., 1998) and was recorded at San Tau, San Shek Wan and Sham Wat Bay during the night survey in April 2004. This species is threatened regionally and the global population is in marked decline (Fellowes *et al*., 2002).

5.11.7 Common Rat Snake is common throughout Hong Kong (Karsen *et al*., 1998) and was recorded in Tung Chung Bay during two day-time surveys in May 2004. This species is of conservation interest at the regional scale (Fellowes et al., 2002).

Table 5.17 Herpetofauna Recorded in the study area, September 2003 to May 2004

Species name	Common name	Status*	Location Recorded	Remarks
Kaloula pulchra	Asiatic Painted Frog	Common	San Shek Wan, Sha Lo Wan, Kau Liu, San Tau, Hau Wong Temple and Pak Mong.	
Microhyla pulchra	Marbled Pigmy Frog	Common	San Shek Wan	
Polypedates megacephalus	Brown Tree Frog	Common/ Abundant	Sham Wat Bay, San Shek Wan, Sha Lo Wan, Pak Mong and Tai Ho Wan.	
Rana exilispinosa	Lesser Spiny Frog	Common	Sham Wat Bay, Sha Lo Wan, Hau Hok Wan, Kau Liu, San Tau and Tai Ho Wan.	Wide spread and common in local streams and hills (Karsen *et al*., 1998) Global population in marked decline and considered of Potential Global Concern (Fellowes *et al.,* 2002)
Rana guentheri	Günther's Frog	Very common	Sham Wat Bay, San Shek Wan, Sha Lo Wan, San Tau, Pak Mong and Hok Tau Wan.	
Rana limnocharis	Paddy Frog	Very common	San Shek Wan, Sha Lo Wan, San Tau, Pak Mong and Tai Ho Wan.	
Naja atra	Chinese Cobra	Common	Sham Shek Tsuen headland	Common in Hong Kong (Karsen *et al*., 1998) CITES Appendix II Global population in marked decline and population in drastic decline regionally (Fellowes *et al*., 2002) Considered of Potential Regional Concern (Fellowes *e al*., 2002)
Oligodon formosanus	Taiwan Kukri Snake	Not generally common	Pak Mong to Ngau Kwu Long	
Ptyas mucosus	Common Rat Snake	Common	Tung Chung Bay	Common in Hong Kong (Karsen *et al*., 1998) Potential Regional Concern (Fellowes *et al*., 2002)
Trimeresurus albolabris	Bamboo Snake	Common	Pak Mong	
Ateuchosaurus chinensis	Chinese Forest Skink	Common on Lantau	San Tau	
Calotes versicolor	Changeable Lizard	Common	Sha Lo Wan, Hau Hok Wan, San Tau, Tung Chung Bay, Hau Wong Temple, Pak Mong, Tai Ho Wan	
Eumeces chinensis	Chinese Skink	Very common	Tung Chung Bay and Tai Ho Wan	
Eumeces quadrilineatus	Blue-tailed Skink	Uncommon to abundant	San Shek Wan,Sha Lo Wan, Hau Hok Wan and Kau Liu	
Gehyra mutilata	Four-clawed Gecko	Uncommon	San Tau	

Species name	Common name	Status*	Location Recorded	Remarks
Gekko chinensis	Chinese Gecko	Very common	San Shek Wan, Sha Lo Wan, Hau Hok Wan, Kau Liu, San Tau, Pak Mong and Tai Ho Wan.	
Gekko gecko	Tokay Gecko	Rare	Sham Wat Bay, San Shek Wan and San Tau	Locally rare (Karsen *et al*., 1998) Global and regional population in marked decline (Fellowes *et al*., 2002) Regional Concern (Fellowes *et al*., 2002)
Hemidactylus bowringii	Bowring's Gecko	Very common	Sham Wat Bay, San Shek Wan,Sha Lo Wan,Hau Hok Wan, Chek Lap Kok, Kau Liu, San Tau, Pak Mong and Tai Ho Wan.	
Mabuya longicaudata	Long-tailed Skink	Fairly common and widespread	San Tau and Tai Ho Wan.	
Scincella reevesii	Reeves' Smooth Skink	Very common	San Shek Wan and San Tau.	
Bufo melanostictus	Asian Common Toad	Very abundant, common	Sham Wat Bay, Sha, Lo Wan, Hau Hok Wan, Chek Lap Kok, San Tau, Hau Wong Temple, Pak Mong and Tai Ho Wan.	

Note: After Karsen *et al*. (1998).

5.12 Habitats and Vegetation

5.12.1 Macro-habitats have been mapped on 1:50,000 and 1:15,000 map based on Government base maps. Over the 9-month survey period, seventeen field surveys were conducted. A list of recorded plant species together with estimates of relative abundance is presented in *Appendix M*. The conservation status of each plant species recorded was derived primarily from the comprehensive studies by Siu (2000), Wu and Lee (2000), Xing *et al*. (2000) and the AFCD (2001; 2003).

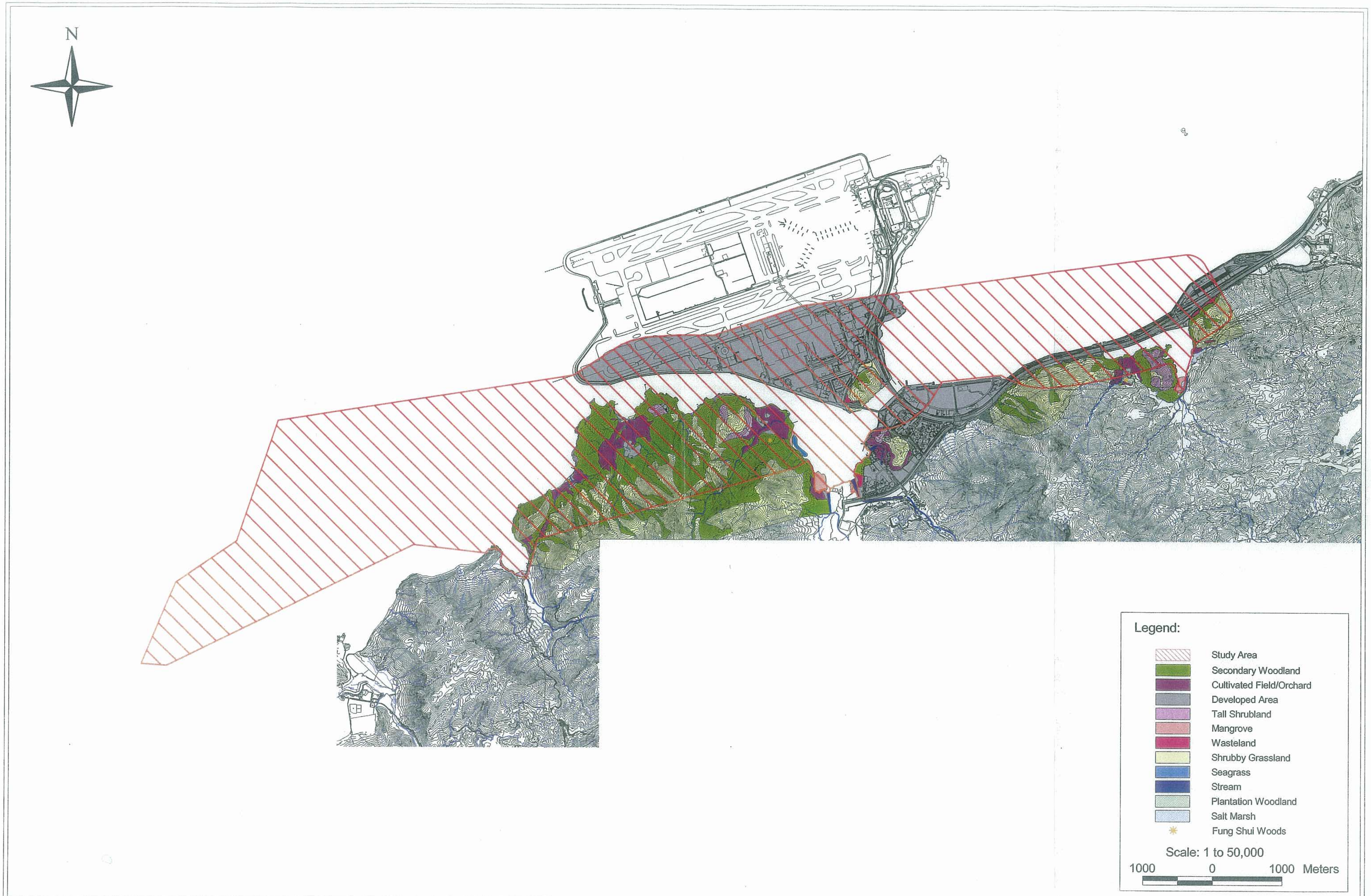
5.12.2 The habitat map covering the entire terrestrial and coastal study area is shown in *Figures 10a-c*. The habitats recorded within the study area were dominated by developed area, secondary woodland and shrubby grassland, with isolated patches of tall shrubland. Numerous streams, many of them pristine, traverse these habitats. A summary of the overall coverage of habitat types in the study area is shown in *Table 5.18* below and representative photographs of major habitat types present are provided in *Figures 11a-c*. Based upon the information obtained during the survey period, a summary of each habitat type is detailed in the following sections.

Table 5.18 Coverage of the Different Habitat Types Within the study area

Habitat Type	Area (ha)	No. of plant species recorded
Secondary Woodland	302.54	217
Plantation Woodland	6.57	125
Tall Shrubland	22.17	185
Shrubby Grassland	191.8	153
Mangrove and Seagrass	10.57	85
Salt Marsh	1.63	74
Cultivated Land/Orchard	59.9	126
Developed Area	483.9	129
Wasteland	2.64	159
Stream/Riparian/Pond	5.36	N/A

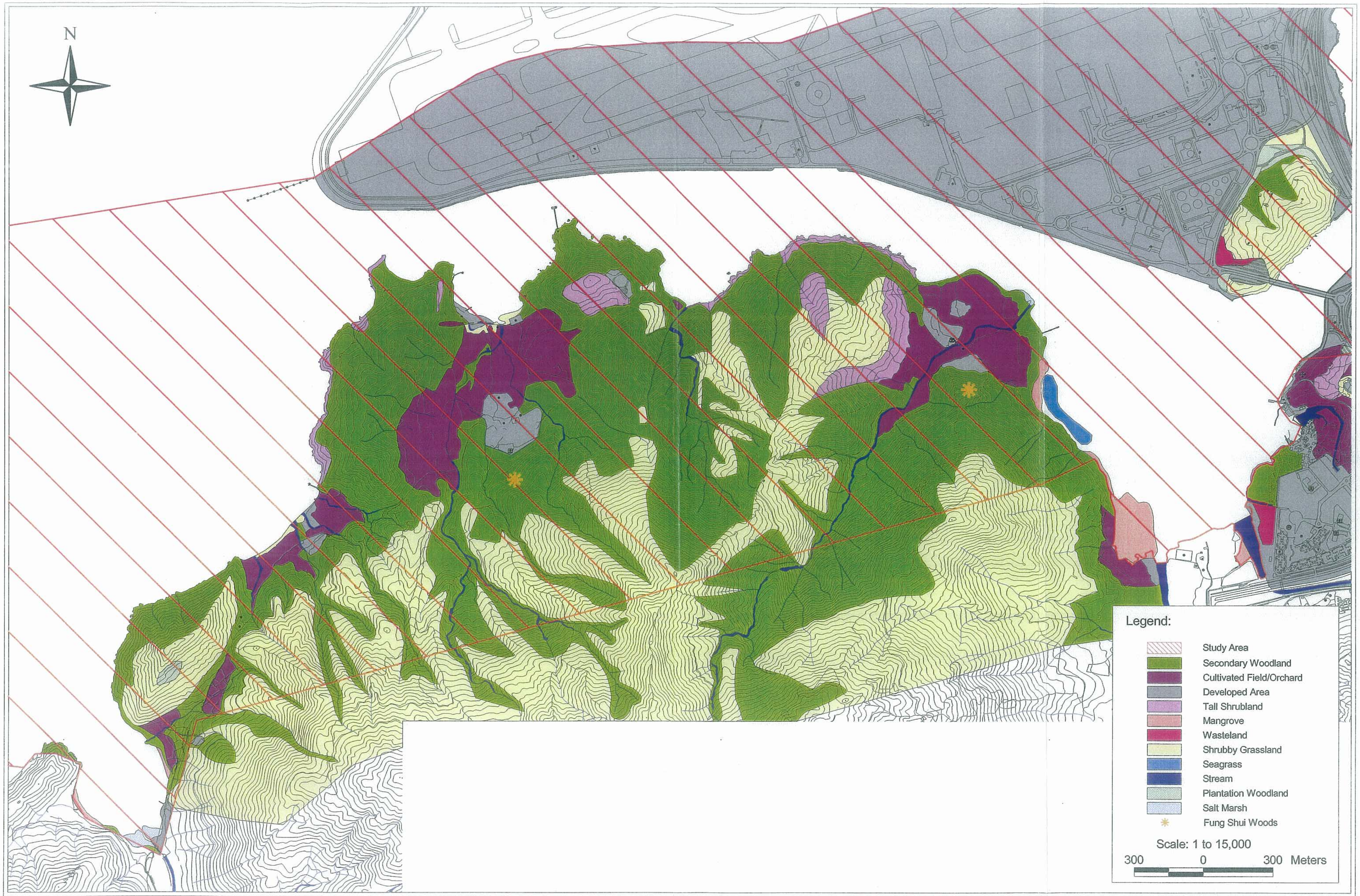
Note: N/A not applicable

5.12.3 A total of 475 plant species were recorded within the study area including restricted tree species *Actinidia latifolia*, *Canarium album*, *Celtis biondii*, *Celtis timorensis*, *Dimocarpus longan*, *Ehretia longiflora*, *Lasianthus wallichii*, *Litchi chinensis*, *Thespesia populnea* and *Vitex negunda var cannabifolia*. *D. longan* and *L. chinensis* are orchard trees widely cultivated but restricted to fung shui woods. In addition, some restricted shrub species were recorded including *Abelmoschus moschatus*, *Boehmeria nivea*, *Bruguiera gymnorrhiza* and *Ricinus communis*. Some locally restricted herb species were recorded including *Acrostichum arureum*, *Asplenium neolaserpitiifoloium, Crinum asiaticum, Cyanotis vaga, Diplacrum caricinum, Indigofera spicata, Limnophila aromatica* together with eight restricted climbers, *Abrus mollis*, *Caesaplinia bondou*, *Cansjera rheedii*, *Impomea imperati*, *Merremia hederacea*, *Toddalia asiatica*, *Uvaria grandiflora* and *Vitis balansana* together one rare sedge *Carex tristachya.* Notable species of conservation interest included four orchid species *Cleisostoma simondii*, *Acampe rigida*, *Arundina chinensis*, *Eulophia graminea*, the insectivorous herb *Drosera indica* and the tree *Dodonaea viscosa,* the shrub, *Pavetta hongkongensis*, the sedge *Carex tristachya and* three rare seagrass *Halophila ovata*, *Halophila beccarii* and *Zostera japonica*. The *Aquilaria sinensis* is listed under State Protection (Category II) and classified as "Near Threatened" in China Red Data Book (AFCD, 2003). Despite its nationally protected status, this species is considered common (Xing *et al*., 2000) in Hong Kong. Floral survey



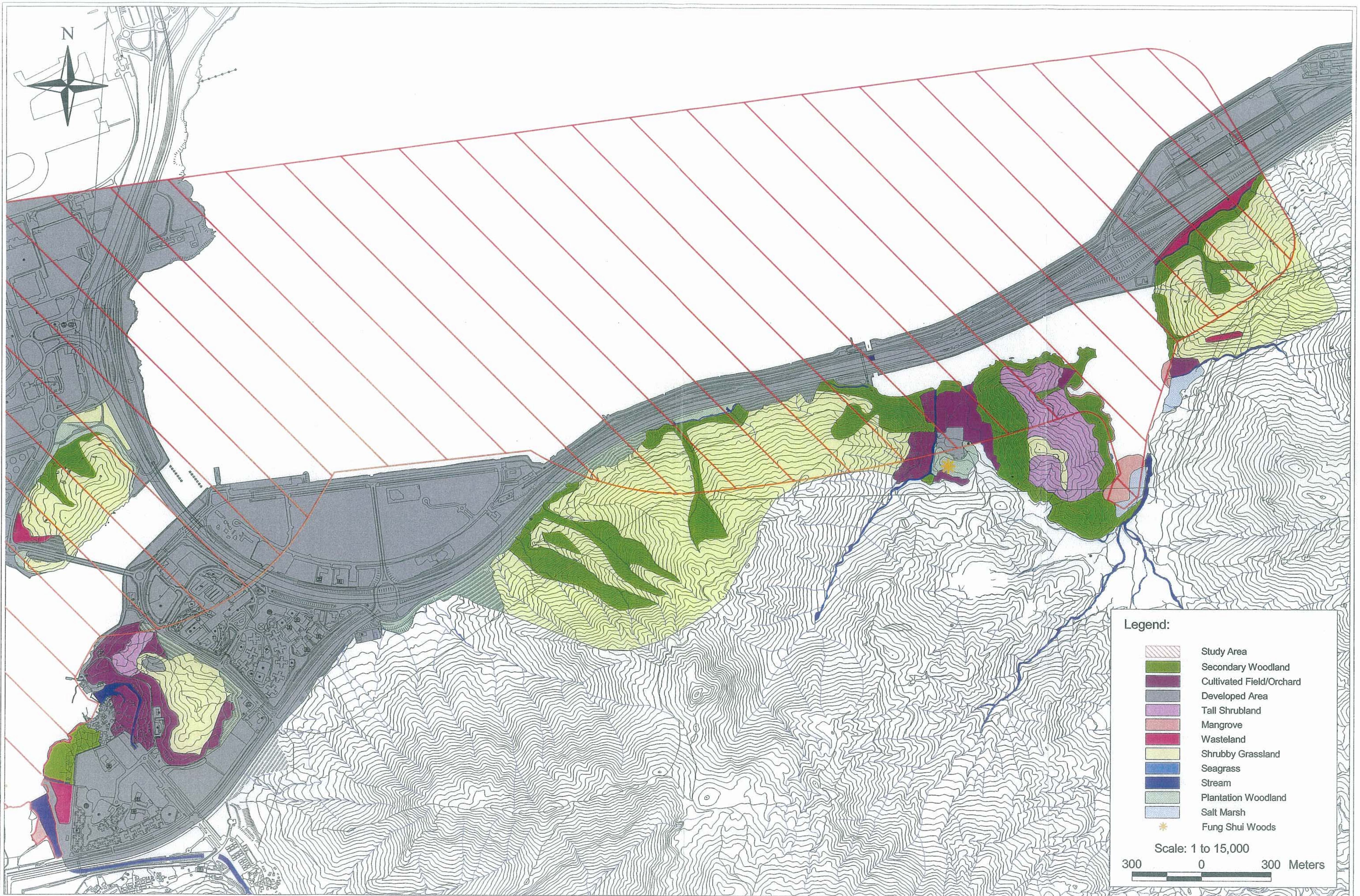
Habitat Map

Meinhardt Mouchel
Figure 10a



Habitat Map

Meinhardt Mouchel
Figure 10b



Habitat Map

Meinhardt Mouchel
Figure 10c


An example of tall shrubland habitat


Fruit trees cultivated in an orchard


Salt Marsh habitat


Village dwellings classified as "Developed Area"

Photographs of Habitats Present within the Study Area

Meinhardt Mouchel

Figure No.: 11a

Mangrove habitats are of conservation importance

Plantation woodland habitats are mostly found on hill slopes

The seagrass habitat present in San Tau

Photographs of Habitats Present within the Study Area

Meinhardt Mouchel

Figure No.: **11b**

An example of wasteland

Shrubby grassland habitats are common within the study area

Some woodland habitats in North Lantau are well established

Photographs of Habitats Present within the Study Area

Meinhardt Mouchel

Figure No.: 11c

revealed the presence of this species in a number of locations including plantation woodland, secondary woodland and developed area.

5.12.4 A total of five locally protected species were found within the study area. Two orchid species, *Cleisostoma simondii* and the Bamboo orchid *Arundina chinensis* were recorded near Hau Hok Wan (*Figure 12*). Another patch (more than 10 individuals) of orchid, *Arundina chinensis* was also found (*Figure 12*) in the west-facing slope (~ 12m above sea level) of the headland of Tai Ho Wan while the orchid, *Acampe rigida* was also noted along the shoreline from Hau Hok Wan to Kau Liu. Another orchid, the Pale Purple Eulophia *Eulophia graminea*, was found within the tall shrubland near Hau Hok Wan and a patch was found in tall shrubland at Sha Lo Wan during the supplementary surveys. Pale Purple Eulophia is listed as restricted in Hong Kong (Siu, 2000). Apart from the *Eulophia graminea*, all of the aforementioned orchid species are very common in Hong Kong (Siu, 2000). Note that all members of the orchid family (Orchidaceae) are protected under the Forestry Regulations and the Animals and Plants (Protection of Endangered Species) Ordinance Cap. 187(AP Ordinance). In addition to the four orchids, patches of the locally protected *Pavetta hongkongensis* were also observed in a group of 4-6 individuals in secondary woodland and tall shrubland habitats. Although protected under the Forestry Regulation, this species is considered common (Xing *et al*., 2000).

5.12.5 About 20 individuals of an insectivorous herb, the sundew, *Drosera indica*, were found on a rock face along the shoreline from Hau Hok Wan to Kau Liu. This species is very rare and only previously recorded in Tung Chung and Cape d'Aguilar (AFCD, 2003). In addition, a single stand of Clammy Hop Seed *Dodonaea viscosa* was recorded along the back of the beach near Sha Lo Wan. *D. viscosa*, is considered a rare shrub/tree but has been recorded in Ham Tin and Tung Chung. These two species are rare (Xing *et al*., 2000) but they are not protected under any Hong Kong Ordinance.

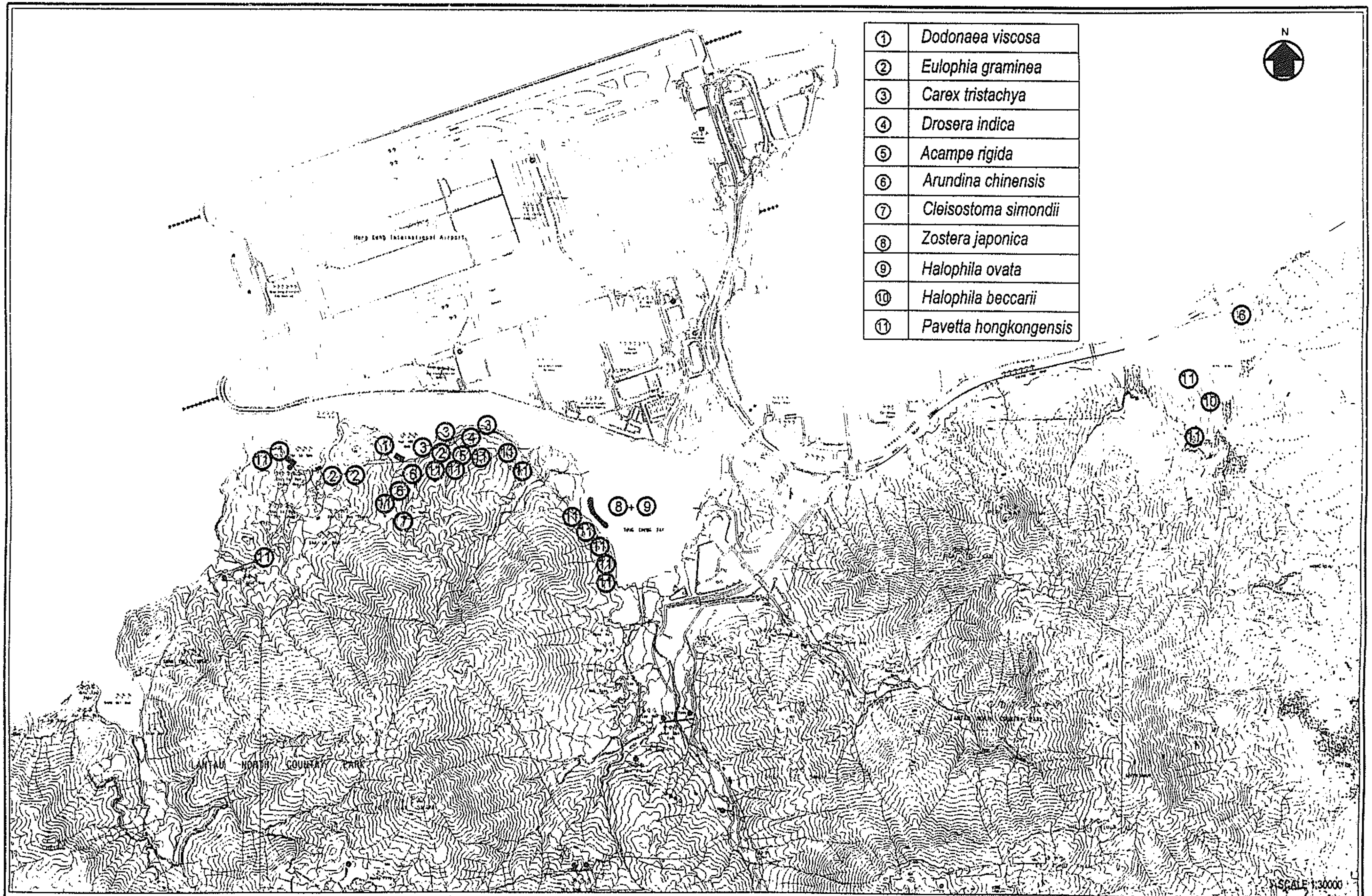
5.12.6 In addition to the orchid, the seagrass, *Halophila beccarii* was also found at Tai Ho Wan during low tide in the supplementary survey and this have been previously recorded by a number of studies (Mott, 1998; Mouchel, 2000). This area supports more than 20 colonies with size of about 30cm X 30cm. Together with the two seagrass species (*Halophila ovata* and *Zostera japonica*) found in preceding surveys, a total of three seagrass species were recorded in this study.

5.12.7 Apart from the orchid and seagrass, a rare sedge species *Carex tristachya* was recorded near Hau Hok Wan. The only known occurrence of this sedge in Hong Kong was at Hau Hok Wan (Xing *et al*., 2000) and approximately 6 patches of this species (approximately 70 individuals) were found spreading along both sides of the footpath near a tall shrubland near Hau Hok Wan.

5.12.8 The location of the locally rare and protected floral species recorded during the course of the surveys are presented in *Figure 12*.

Secondary Woodland

5.12.9 Notable woodland patches can be found at Tai Ho Wan headland and adjacent to Sha Lo Wan San Tsuen. The woods behind San Tau, Pak Mong and Sha Lo Wan Tsuen are known to have fung shui significance. However, recent surveys revealed that the woodland behind Pak Mong has been heavily modified and dominated by planted species *Acacia confusa.* This woodland, therefore, is now marked under the habitat type of plantation woodland. Secondary woodland habitat is extensive and relatively rich in flora with a total of 217 species recorded within this habitat type. Major/dominant plant species included trees *Aporosa dioica*, *Bridelia tomentosa*, *Litsea glutinosa*, *Mallotus paniculata*, *Schefflera octophylla* and *Sterculia lanceolata.* Dominant shrub species included *Litsea rotundiafolia*, *Ilex asprella* and *Psychotria rubra*. Species known to have local restricted distributions that were present



Location of Locally Rare / Protected Floral Species Recorded between September 2003 and May 2004

Meinhardt Mouchel

Figure No. 12

included *Canarium album, Celtis biodii, Dimocarpus longan, Ehretia longiflora, Lasianthus wallichii, Litchi chinensis, Vitex negundo var cannabifolia, Asplenium neolaserpitiifoloim, Pericampylus glaucus, Teuricum quadrifarium, Abrus mollis, Caesalpinia bonduc, Cansjera rheedii, Toddalia asiatica* and *Uvaria grandiflora.* Seven out of eight restricted trees were recorded within this habitat type. Of the species recorded, only the shrub *Pavetta hongkongensis* was protected under the law but this species is considered common (Xing *et al*., 2000).

Plantation Woodland

5.12.10 Plantation woodland habitats are mainly either located on the hill slopes or near developed areas. This habitat type is dominated by species with either high amenity value or pioneer species comprised of *Acacia confusa*, *Dimocarpus longan, Ficus hirta, Mallotus paniculata, Microcos paniculata* and *Pinus massoniana.* The understorey shrub consisted of *Ilex asprella*, *Litsea rotundifolia* and *Vitex negundo var negundo*, the climbers, *Lydgodium japonicum* and *Embelia laeta*. The understorey shrub communities present were not particularly diverse. A total of 125 plant species were present in the plantation woodland habitats. Of these, *Dimocarpus longan*, *Lasianthus wallichii*, *Vitex negundo var cannabifolia* and *Abrus mollis* are restricted locally. The *Aquilaria sinensis* is listed under State Protection (Category II) and is considered “Near Threatened” in the China Plant Red Data Book. However, this species is common in Hong Kong (Xing *et al*., 2000).

Tall Shrubland

5.12.11 Tall shrubland within the study area is patchily located along the coast of Tung Chung to Sham Wat and is dominant on the hill-slope of the Tai Ho Wan headland. This habitat type is densely populated with a mix of native tree and shrubby plant species. Species found commonly in this habitat type included tree species such as *Aconychia pedunculata*, *Cratoxylum cochinchinense*, *Schefflera octophylla*, *Rhus succedanea* and *Mallotus paniculatus*; the shrub *Litsea rotundifolia, Melastoma sanguineum* and *Rhaplolepis indica,* the climbers *Alyxia sinensis* and *Embelia ribes;* as well as the herbs *Dianella ensifolia* and *Dicranopteris pedata.*

5.12.12 A total of 185 species were recorded in this habitat and species commonly found in this habitat type included some pioneer tree species such as *Mallotus paniculata, Sapium discolor*, the shrubs*, Eurya japonica, Litsea rotundifolia, Melastoma sanguineum, Rhaphiolepis indica,* together with the climbers*, Alyxia sinensis, Lygodium japonicum, Cassytha filiformis* and *Tetracera asiatica. Carex tristachya* is a rare sedge (Xing *et al*., 2000) recorded within this habitat in Hau Hok Wan and patches of the orchid *Eulophia graminea* were found near tall shrubland habitats at Hau Hok Wan and Sha Lo Wan. Apart from woodland habitat, the locally protected *Pavetta hongkongensis* was also observed within this habitat.

Shrubby Grassland Mosaic

5.12.13 The shrubby grassland is composed of a range of plant species showing various growth forms (from herbaceous ferns to woody tree species) that are patchily distributed on the hill-slopes within the study area and mostly located at higher elevations along the hill slopes. Generally, this habitat type is open in structure and has a height of less than 2m. Moreover, it is believed that part of this mosaic may be disturbed frequently by hill-fire as evidenced by the presence of patches of the fire-resistant fern *Dicranopteris pedata*, especially in the areas behind the burial grounds. There were 153 floral species recorded within this habitat. Tree species recorded were not particularly diverse and major species included *Ficus variolosa*, *Aporosa dioica* and *Cratoxylum cochinchinense.* However, a range of shrubs species were recorded including *Baeckea frutescens*, *Aster baccharoides*, *Breynia fruticosa*, *Melastoa sanguineum* and *Helicteres angustifolia* as well as the herbs, *Arundinella setosa*, *Eremochloa ciliaris*, *Eulalia* spp., *Grewia biloba*, *Innula cappa*, *Ischaemum rugosum* together with climbers, *Alyxia sinensis*, *Cassytha filiformis*, *Lygodium japonicum*, *Millettia nitida* and *Morinda umbellata.* Species present were similar to those present in the tall shrubland although fewer tree species were recorded. Three protected orchids *Acampe rigida, Arundina chinensis* and *Cleisostoma simondii* were recorded within this habitat. Although all three species are common in Hong Kong (Siu, 2000), all members of the orchid family (Orchidaceae) are protected under the AP Ordinance in Hong Kong.

Coastal Habitat and Salt Marsh

5.12.14 Since mangroves, seagrass and salt marsh are closely associated, these habitats are collectively classified and described as coastal habitat in the species list. Major mangrove stands, seagrass beds and salt marsh, however, have been shown separately on the habitat map. Mouchel (2000 and 2002a) and Tam and Wong (2002) have previously undertaken detailed studies of the distribution and composition of mangroves on North Lantau including those at Tai Ho Wan and San Tau.

5.12.15 Despite the comparatively small habitat size, the coastal habitats are rich in species. Four noteworthy species included the rare tree, *Dodonaea viscosa* at the back of the Sha Lo Wan Beach, the insectivorous herb, *Drosera indica* found near Hau Hok Wan, as well as three seagrass species, *Zostera japonica, Halophila beccarii* and *Halophila ovata*. Apart from these, some species recorded that have restricted distribution included the herbs, *Stenoloma biflorum* and *Cyanotis vaga* and the climber, *Ipomoea imperati* that were observed along the coastal area from Tung Chung to Sham Wat. The woody climber *Caesaplinia bonduc* was present within the coastal fringe at Tai Ho Wan. Apart from the rare species and six true mangroves, some wetland species including *Ischaemum* sp*., Eriocaulon* sp*., Xyris indica, Scleria levis, Limnophila aromatica* and *Leersia hexandra* were also recorded. The aforesaid rare and protected species are presented in *Figure 12*.

Seagrass

5.12.16 Field surveys for seagrass beds covered the whole coastal study area and surveys were undertaken on 2, 4, 29, 30 November and 2 December 2003 and 26, 28 January and 22, 25, 26 March and 6, 7 May 2004. Field survey results confirmed that two seagrass beds were present. The seagrass bed at Tung Chung Bay where the San Tau SSSI is located support two seagrass species, *Halophila ovata* and *Zostera japonica* which are of ecological importance. During the April 2004 survey, the seagrass *Halophila beccarii* habitat was found during the low tide at Tai Ho Wan supporting more than 20 colonies with size of about 30cm X 30 cm.

5.12.17 It should be noted that the seagrass bed at San Tau has been subject to impacts associated with the reclamation works for the airport at Chek Lap Kok. The seagrass has, however, successfully recovered since the works were completed.

5.12.18 The seagrass species, *Zostera japonica* and *Halophila ovata* are considered rare locally (Xing *et al.*, 2000). *Zostera japonica* has been recorded in three localities namely Sheung Sze Wan, Tung Chung (San Tau) and Lai Chi Wo (AFCD, 2003). Another locally restricted seagrass species, *Halophila ovata*, is considered to be of special scientific interest because it is one of the few marine flowering plants in Hong Kong (AFCD, 2003). Apart from San Tau, *Haplophila ovata* has been previously recorded in Tai Tam Bay, Ho Chung, Hoi Ha Wan, Wu Shek Kok and Lai

Chi Wo (AFCD, 2003). *Zostera japonica* and *Halophila ovata* are usually found co-habiting the seaward margins of mangrove stands (AFCD, 2003).

5.12.19 The seagrass, *Halophila beccarii* is also locally rare (Xing *et al*., 2000) and was previously found at Tai Ho Wan (Mott, 1998; Mouchel, 2000). This species have been recorded in two other localities including Starling Inlet and Black Point (Xing *et al*., 2000) with the largest *H. beccarii* bed in Ha Pak Nai (Fong, 1999c).

Mangrove

5.12.20 Mangrove communities are under threat from urbanisation and reclamation and as many stands have been destroyed in Hong Kong they are considered to be a conservation priority (Tam and Wong, 2000). The mangrove habitat at San Tau is regarded as an important stand in Hong Kong. Mangroves are also present in Tai Ho Wan. There is a large amount of existing data on the mangal and seagrass habitats present in the study area (e.g., Mouchel, 2000; Tam and Wong, 2000; Mouchel, 2002a) but up to date surveys were also conducted between September 2003 and May 2004. A habitat map has been prepared (see *Figures 10a-c*) based upon the survey results.

5.12.21 During the initial surveys, intertidal mangrove habitats were recorded at a few locations and major stands included Sham Wat, Tai Ho Wan and San Tau to Tung Chung Bay (*Figures 10a–c*). The mangrove species recorded in the larger stands are discussed further below.

Tai Ho Mangrove Habitats

5.12.22 The number of floral species recorded in Tai Ho was fairly high. There were six true mangrove species including *Lumnitzera racemosa*, *Kandelia candel*, *Bruguiera gymnorrhiza*, *Avicennia marina*, *Aegiceras corniculatum* and *Acanthus ilicifolius.* In addition to these true mangrove species, a number of mangal associated flora, such as *Limonium sinense*, *Clerodendrum inerme* and *Acrostichum aureum* were also recorded within the mangrove habitat. During the field surveys, other common species recorded within the coastal or mangrove communities included *Zoysia sinica*, *Suaeda maritime* and *Vitex rotundifolia*.

5.12.23 Among the true mangrove species recorded, *Bruguiera gymnorrhiza* is considered to have a restricted distribution in Hong Kong (Xing *et al*., 2000). This species has established a relatively large population in Tai Ho and it is known to adapt to hardened and stiff mud.

Tung Chung and San Tau Mangrove Habitats

5.12.24 The Tung Chung and San Tau mangrove habitats have also been well studied in recent years (Tam and Wong, 2000; Mott, 2003). The mangrove habitat at San Tau is considered to be of particular ecological importance. This habitat is dominated by the mangroves *Aeigceras corniculatum*, *Kandelia candel* and the restricted *Bruguiera gymnorrhiza*. Other mangroves *Avicennia marina* and *Acanthus ilicifolius* are also well represented. Apart from the restricted mangrove species *Bruguiera gymnorrhiza*, some locally restricted species were also recorded in the vicinity of the habitats and these include *Thespesia populnea, Stenoloma biflorum* and *Ipomoea imperati.*

Cultivated Field/Orchard

5.12.25 Cultivated field includes both active, inactive cultivation fields and orchards. Cultivated fields are mainly scattered among the village areas and mostly distributed along the coast of the study area. These are planted with fruit trees and ornamental plants such as *Litchi chinensis*, *Dimocarpus longan*, *Clausena lansium*, *Citrus* sp., and some widespread herbs including *Lantana camara*, *Solanum torvum* and *Lygodium japonicum*. A number of restricted species including *Celtis timorensis*, *Dimocarpus longan*, *Litchi chinensis*, *Abelmoschus moschatus*, *Ipomoea purpurea*, *Plumbago zeylanica*, *Merremia hederacea*, and *Toddalia asiatica* were recorded. A total of 126 species were present in this habitat although no rare or protected species was recorded.

Developed Area

5.12.26 The developed area refers to urbanised areas including roads, buildings and villages that can be found in Chek Lap Kok, Tung Chung and some scattered in the western part of the study area. This habitat is artificial and predominantly composed of herbs and climbers and occasionally with some planted or orchard trees such as *Casuarina equisetifolia*, *Bambusa* sp., *Clausena lansium* and *Averrhoa carambola*. Despite some observations of restricted species, including the trees *Celtis timorensis*, *Vitex negundo var cannabifolia* and the herb, *Plumbago zeylanica*, the 129 species recorded in the developed areas are common and widespread in Hong Kong. No locally rare or protected species was recorded. However, the tree *Aquilaria sinensis* is protected in China and individuals of this species were recorded in the developed area near Tai Ho and San Tau. It should be noted that this species is common in Hong Kong.

Wasteland

5.12.27 Wasteland is dominated by mainly weedy herbaceous ruderal vegetation, and is mostly to be found in heavily disturbed or previously developed areas. Within the study area this habitat type is poorly represented. In general, the species diversity of this habitat is poor and its structural complexity is simple. Dominant species are mainly herbaceous; such as the common herbs, *Cynodon dactylon*, *Panicum maximum*, *Lygodium japonicum* and the climbers *Mikania micrantha* and *Pueraria lobaba.* However, it should be noted that several restricted species were also recorded in wasteland including *Plumbago zeylanica, Teucrium quadrifarium* and *Merremia hederacea.*

6. Species of Conservation Interest Present and Faunal Diversity

Species of Conservation Interest

6.1 Annex 8 of the TMEIAO specifies three criteria by which a species' conservation significance may be measured: protection status (local, Chinese or international), with legally protected species afforded higher conservation value; geographical distribution, with higher conservation value afforded to species with more restricted geographical ranges; and rarity, with higher conservation value afforded to species which are internationally rare than to species which are only regionally or locally rare.

6.2 As mentioned above, the published literature on Hong Kong fauna does not always provide a clearly-defined objective basis for conservation assessment of species, and for this reason the assessments below is complemented by reference to Fellowes *et al.* (2002). This paper examines the local (Hong Kong), regional (southern China) and global restrictedness of native fauna species occurring in a wild state in Hong Kong, combined with an assessment of the vulnerability of populations, using the most reliable and up to date information available, and assigns a rating to each species accordingly. Thus, a species of 'Local Concern' may not be particularly threatened globally or regionally, but is rare or restricted in Hong Kong. A species of 'Regional Concern' may not be particularly threatened globally, but is rare or restricted in the region. For a species of 'Global Concern', a given Hong Kong locality is considered to be of global importance. Some species are regarded as being of 'Potential Regional Concern' or 'Potential Global Concern' and these species are considered to be relatively secure in Hong Kong but all Hong Kong localities are of potential regional and global importance, respectively. Based on the criteria mentioned above, species of conservation interest recorded within the study area during our field surveys (September 2003 ~ May 2004) are listed in *Table 6.1* below.

Table 6.1 Faunal and Floral Species of Conservation Interest Recorded within the Study Area during the Course of Our Surveys (September 2003 ~ May 2004)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Avifauna				
Acrocephalus bistrigiceps (Black-browed Reed Warbler)	WAPO	Breeds in southeast Siberia, Mongolia, northeast China, Indochina, Thailand, northern India and Bangladesh (Carey *et al*., 2001) Recorded in Deep Bay, Lantau, and Hong Kong Island (Carey *et al*., 2001)	Shrubland in Sham Wat Bay and Tung Chung Bay	Common migrant (Carey *et al*., 2001) Local Concern (Fellowes *et al*., 2002)
Apus pacificus (Pacific Swift)	WAPO	Breeds from Siberia east to Japan, Vietnam, Thailand and Burma, and winters through southeast Asia to Australia. Records in China include Tibet, Shandong, Henan, Jiangsu (Carey *et al*., 2001)	Woodland, shrubby grassland and tall shrubland at Sham Shek Tsuen, San Shek Wan, Sha Lo Wan, ferry pier between Sha Lo Wan and Hau Hok Wan, Hau Hok Wan, Chek Lap Kok, Tin Sam and Tung Chung Battery	Common spring migrant and localised summer visitor (Carey *et al*., 2001) Local Concern based on restricted breeding and/or roosting sites (Fellowes *et al*., 2002)
Ardea cinerea (Grey Heron)	WAPO	In most of the Palearctic, sub-Saharan Africa, much of the oriental region and Indonesia (Carey *et al*., 2001) Starling Inlet, Shuen Wan, Lantau and Deep Bay (Carey *et al*., 2001)	Coastal habitat Tung Chung Bay, San Tau and Tai Ho Wan	Abundant winter visitor (Carey *et al*., 2001) Potential Regional Concern (Fellowes *et al*., 2002)
Ardeola bacchus (Chinese Pond Heron)	WAPO	Breeds in Burma, China, Japan; winters in Malay peninsula, Indochina, Borneo and Sumatra (Carey *et al*., 2001) Mainly New Territories including Mai Po, Lok Ma Chau and also Hong Kong Island and Lantau (Carey *et al*., 2001)	Coastal habitat Sham Wat Bay, Sham Shek Tsuen, Sha Lo Wan, Hau Hok Wan, Tin Sam, San Tau, Tung Chung Bay, Tai Ho Wan	Common resident (Carey *et al*., 2001) Potential Regional Concern/ Regional Concern based on restricted breeding and/or roosting sites (Fellowes *et al*., 2002)
Bubo bubo (Eurasian Eagle Owl)	WAPO	Norway to Sahara and east to Sakhalin and southern China (Carey *et al*., 2001) Fairly widespread in Hong Kong (Carey *et al*., 2001)	Shrubby grassland at Pak Mong	Scarce but widespread resident (Carey *et al*., 2001) Regional population in marked decline but possibly under-recorded (Fellowes *et al*., 2002) Regional Concern (Fellowes *et al*., 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Bulbulcus ibis (Cattle Egret)	WAPO	Southern Europe, Africa, Indian Subcontinent, Southeast and Eastern Asia, Australia, America (Carey *et al*., 2001) Deep Bay, Kai Tak, Yuen Long, Lantau and mainly breeds in New Territories (Carey *et al*., 2001)	Coastal habitat at Tung Chung Bay	Uncommon to common summer visitor (Carey *et al*., 2001) Regional population in marked decline Local Concern, restricted breeding and/or roosting sites (Fellowes *et al*., 2002)
Butorides striatus (Striated Heron)	WAPO	America, Africa and Asia (Carey *et al*., 2001) Deep Bay, Lai Chi Wo, Shuen Wan, Hebe Haven and some other localities in Hong Kong (Carey *et al*., 2001)	Sea off Tai Ho Wan	Uncommon to scarce summer visitor (Carey *et al*., 2001) Local Concern (Fellowes *et al*., 2002)
Cisticola juncidis (Zitting Cisticola)	WAPO	Europe, Middle East Africa, India, Asia, Indonesia, New Guinea, Australia and China (Carey *et al*., 2001) Breeding confined to Northern New Territories and Deep Bay and also records from Shing Mun River, Lok Ma Chau and Long Valley (Carey *et al*., 2001)	Shrubby grassland at Sham Wat Bay	Common winter visitor (Carey *et al*., 2001) Local population in marked decline (Fellowes *et al*., 2002) Local Concern (Fellowes *et al*., 2002)
Dendrocitta formosae (Grey Treepie)	WAPO	Himalayas, Burma, Thailand, Indochina to China. (Carey *et al*., 2001) Primarily on western Hong Kong Island and central New Territories (Carey *et al*., 2001)	Secondary woodland at Cheung Tung Road Hill	Scarce to uncommon migrant and winter visitor (Carey *et al*., 2001) Local Concern (Fellowes *et al*., 2002)
Egretta alba (Great Egret)	WAPO	Eurasia, Indian sub-continent to southern China, Indonesia, Australia (Carey *et al*., 2001) Records are mainly from wetlands such as Mai Po, Inner Deep Bay, Starling Inlet, Shuen Wan and also Hebe Haven, Cape D'Aguilar, Lantau and Lamma (Carey *et al*., 2001)	Coastal habitat, secondary woodland at Sham Wat Wan, Sha Lo Wan, ferry pier between Sha Lo Wan and Hau Hok Wan, Chek Lap Kok and Tung Chung Bay	Common to abundant resident (Carey *et al*., 2001) Regional population in marked decline (Fellowes *et*. *al*., 2002) Potential Regional Concern based on restricted breeding or roosting sites (Fellowes *et al*., 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Egretta eulophotes (Swinhoe's Egret)	WAPO	West coast of Korea, coast of Easten China and the Sea of Japan, Philippines, Vietnam, Thailand, Malaysia, Singapore, Indonesia and Brunei (Carey *et al.*, 2001) Breeding record in Yim Tso Ha egretry, records from A Chau, Mai Po, Lok Ma Chau, Deep Bay and Tsing Yi (Carey *et al.*, 2001)	Coastal habitat at Tung Chung Bay	Records from Yuen Long, Deep Bay, Starling Inlet, A Chau, Mai Po, Lok Ma Chau and Tsing Yi (Carey *et al.*, 2001). Listed as globally Vulnerable by IUCN (Fellowes *et al.*, 2002)
Egretta garzetta (Little Egret)	WAPO	Eastern Europe, Central and Southern Asia, Austalia and South Africa (Carey *et al.*, 2001) Breeding records in Yuen Long, Nam Sang Wai, Lok Ma Chau, Tsim Bei Tsui, Mai Po, Shuen Wan (Carey *et al.*, 2001)	Coastal habitat, secondary woodland at Sham Wat Wan, Sha Lo Wan, ferry pier between Sha Lo Wan and Hau Hok Wan, Hau Hok Wan, Chek Lap Kok, Tin Sam and Tung Chung Bay	Abundant resident (Carey *et al.*, 2001) Regional population in marked decline (Fellowes *et. al.*, 2002) Potential Regional Concern based on restricted breeding and/or roosting sites (Fellowes *et. al.*, 2002)
Egretta intermedia (Intermediate Egret)	WAPO	Africa, Japan, Malaysia, Indonesia and Australia (Carey *et al.*, 2001) Most records from Deep Bay, Shuen Wan and Starling Inlet (Carey *et al.*, 2001)	Coastal habitat at Tung Chung Bay	Common autumn migrant and winter visitor (Carey *et al.*, 2001) Regional population in marked decline (Fellowes *et al.*, 2002) Regional Concern (Fellowes *et al.*, 2002)
Egretta sacra (Pacific Reef Egret)	WAPO	Eastern and southeast Asia, Japan, Australia, New Zealand (Carey *et al.*, 2001) Mostly found along rocky coastline in southern areas of Hong Kong Island, and coast of outlying islands such as Sokos, Lamma, Po Toi, Waglan Island (Carey *et al.*, 2001)	Coastal habitat at Sha Lo Wan, ferry pier between Sha Lo Wan and Hau Hok Wan, Chek Lap Kok and Tung Chung Bay.	Uncommon Resident (Carey *et al.*, 2001) Scarce visitor in Hong Kong and inadequate information on restrictedness (Fellowes *et al.*, 2002) Local Concern (Fellowes *et al.*, 2002)
Emberiza aureola (Yellow-breasted Bunting)	WAPO	Breeds across Eurasia, winters in southeast Asia, Thailand and Indochina (Carey *et al.*, 2001) Mai Po, Long Valley, Mong Tseng and Kai Tak Airport (Carey *et al.*, 2001)	Shrubby grassland at Tin Sam and Tung Chung Bay	Uncommon to common migrant (Carey *et al.*, 2001) Local population in marked decline and Regional Concern (Fellowes *et al.*, 2002) Inadequate information on regional restrictedness and regional population in marked decline (Fellowes *et al.*, 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Emberiza fucata (Chestnut-eared Bunting)	WAPO	From western Himalayas to Japan (Carey *et al*., 2001) Most records in Deep Bay, Sha Lo Tung, Ho Chung, Long Valley, Tai Mong Tsai, Lantau and Luk Keng (Carey *et al*., 2001)	Woodland at Tai Ho Wan	Scarce migrant and rare in winter (Carey *et al*., 2001) Local population in marked decline and Local Concern (Fellowes *et al*., 2002)
Falco peregrinus (Peregrine Falcon)	WAPO	Worldwide distribution including China (Carey *et al*., 2001) Widespread localities and reported throughout New Territories, Kowloon, Hong Kong Island, Lantau and outlying island (Carey *et al*., 2001)	Shrubby grassland at Sha Lo Wan	Scarce resident and winter visitor (Carey *et al.,* 2001) Local Concern (Fellowes *et al*., 2002)
Halcyon pileata (Black-capped Kingfisher)	WAPO	Breeding records in India, Indochina, China, Korea and winters south to Sri Lanka Malaysia and Indonesia (Carey *et al*., 2001) In suitable habitats throughout New Territories and Lantau, occasionally seen in Kowloon, Hong Kong Island and offshore islands (Carey *et al*., 2001)	Coastal habitat at Sham Wat Bay, San Shek Wan tunnel option , Sha Lo Wan, Tung Chung Bay and Tai Ho Wan	Common autumn migrant and winter visitor (Carey *et al.,* 2001) Local population in marked decline (Fellowes *et al*., 2002) Local Concern (Fellowes *et al*., 2002)
Halcyon smyrnensis (White-throated Kingfisher)	WAPO	Turkey, India, Indochina, China, Sri Lanka, Malaysia, Sumatra and the Philippines (Carey *et al*., 2001) Widespread in winter and autumn and nesting sites were found in Lung Tsai Ng Yuen, Shuen Wan, Chi Ma Wan, Luk Keng and Tung Chung (Carey *et al.*, 2001)	Coastal habitat at Sham Wat Bay, Hau Hok Wan, Chek Lap Kok, Tin Sam, Tung Chung Bay, Tai Ho Wan and Tung Chung Battery	Common autumn migrant, winter visitor and resident (Carey *et al.,* 2001) Local Concern based on restricted breeding and/or roosting sites (Fellowes *et al*., 2002)
Haliaeetus leucogaster (White-bellied Sea Eagle)	WAPO	India, Sri Lanka, southern China, southeast Asia, the Philippines and Australia (Carey *et al.,* 2001) Found in coastal areas and offshore islands in Hong Kong (Carey *et al.,* 2001)	Secondary woodland at Sham Shek Tsuen and Sha Lo Wan	Uncommon resident in coastal areas and offshore islands (Carey *et al*., 2001, Tsim *et al*., 2003) Regional population under-recorded and regional concern (Fellowes *et al.*, 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Heteroscelus brevipes (Grey-tailed Tattler)	WAPO	Breeds in Siberia, Kamchatka and the Kuril and winters in Taiwan, the Malay Peninsula, the Philippines, through Indonesia and New Guinea (Carey *et al*., 2001) Highest number found in Deep Bay and also widespread in coastal areas throughout Hong Kong (Carey *et al*., 2001)	Coastal habitat at Tung Chung Bay and Tai Ho Wan	Local and Regional population in marked decline (Fellowes *et al*., 2002) Local Concern (Fellowes *et al*., 2002)
Hieraaetus fasciatus (Bonelli's Eagle)	WAPO	Southern Europe through Central Asia to India and southern China (Carey *et al*., 2001) Records are mainly from New Territories and also urban Kowloon, Hong Kong Island and outlying islands (Carey *et al*., 2001)	Shrubby grassland at San Shek Wan (Tunnel Option)	Scarce resident (Carey *et al.,* 2001) Regional Concern (Fellowes *et al*., 2002)
Himantopus himantopus (Black-winged Stilt)	WAPO	Resident in southern hemisphere, central America and Africa, summer visitor to US, Europe, Asia and China and winter visitor to southeast Asia (Carey *et al*., 2001) Most records are from Deep Bay, Long Valley and Kam Tin (Carey *et al*., 2001)	Intertidal mudflat at Tin Sam	Common to uncommon winter visitor (Carey *et al.,* 2001) Population under-recorded and highly concentrated (Fellowes *et al*., 2002) Regional Concern (Fellowes *et al*., 2002)
Ketupa zeylonensis (Brown Fish Owl)	WAPO	Middle East to southern China (Carey *et al*., 2001) Restricted in Hong Kong (Carey *et al*., 2001)	Tai Ho Wan	Scarce resident in Hong Kong (Carey *et al*., 2001) Regional Concern (Fellowes *et al*., 2002)
Milvus migrans (Black Kite)	WAPO	Africa, Europe, Asia and Australasia. considered the commonest bird of prey in China (Carey *et al*., 2001) Widespread in Hong Kong and found in a wide variety of coastal and inland habitats such as small islands, sea-coast, intertidal mudflat, landfills, grassy hillsides (Carey *et al*., 2001)	Secondary woodland, tall shrubland, shrubby grassland, coastal habitat at Sham Wat Bay, San Shek Wan, San Shek Wan (Tunnel Option), Sha Lo Wan, ferry pier between Sha Lo Wan and Hau Hok Wan, Hau Hok Wan, Tin Sam, Tung Chung Bay, Pak Mong and Tai Ho Wan	Abundant winter visitor and Resident (Carey *et al.,* 2001) Regional population in marked decline and highly concentrated (Fellowes *et al*., 2002) Potential Regional Concern based on restricted breeding and/or roosting sites (Fellowes *et al*., 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Nycticorax nycticorax (Black-crowned Night Heron)	WAPO	Worldwide distribution (Carey *et al*., 2001) Breeds in Yim Tso Ha, Mai Po, Hebe Haven, Ho Chung and Shuen Wan (Carey *et al*., 2001)	Coastal habitat at Tai Ho Wan	Common to abundant Resident (Carey *et al.,* 2001) Local Concern based on restricted breeding and/or roosting sites (Fellowes *et al*., 2002)
Scolopax rusticola (Eurasian Woodcock)	WAPO	Breeds from Europe through Central Asia to Sakhalin and Japan, winters in Europe, North Africa, southeast Asia and southern China (Carey *et al*., 2001) Throughout Hong Kong but mostly recorded in Tai Po Kau, Shek Kong and Hong Kong Island (Carey *et al*., 2001)	Secondary woodland at Hau Hok Wan and Tai Ho Wan	Scarce winter visitor (Carey *et al.,* 2001) Local Concern (Fellowes *et al*., 2002)
Spilornis cheela (Crested Serpent Eagle)	WAPO	Occurs throughout Oriental region from India to China (Carey *et al*., 2001) Tsim Bei Tsui and mostly recorded in New Territories such as Lam Tsuen, Tai Po Kau and occasionally recorded from Kowloon Hills, Hong Kong Island, Lantau and Kat O (Carey *et al*., 2001)	Woodland at Sham Shek Tsuen	Uncommon resident (Carey *et al*., 2001) Local Concern (Fellowes *et al*., 2002)
Sturnus sericeus (Red-billed Starling)	WAPO	Breeds only in China and winter visitor in northern Indochina (Carey *et al*., 2001) Mainly recorded in Deep Bay area with other favored localities being Long Valley, Kam Tin, Starling Inlets and Shuen Wan (Carey *et al*., 2001)	Coastal habitat and secondary woodland at Tin Sam and Tai Ho Wan	Abundant but localised winter visitor (Carey *et al*., 2001) Global Concern (Fellowes *et al*., 2002) Local population in marked decline and population highly concentrated (Fellowes *et al*., 2002) Inadequate information on regional restrictedness (Fellowes *et al*., 2002)
Sturnus sinensis (White-shouldered Starling)	WAPO	Breeding restricted to southern China and northern Indochina (Carey *et al*., 2001) Occurs in urban area, Hog Kong Island, Deep Bay and Long Valley (Carey *et al*., 2001)	Secondary woodland at ferry pier between Sha Lo Wan and Hau Hok Wan	Common passage migrant and localised breeding summer visitor and winter visitor (Fellowes *et al*., 2002) Local Concern (Fellowes *et al*., 2002) Local population in marked decline (Fellowes et al., 2002) Inadequate information on regional restrictedness (Fellowes *et al*., 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Tachybaptus ruficolis (Little Grebe)	WAPO	Widespread in Europe, sub-Saharan Africa, Middle East, Central Asia and the Indian subcontinent, southeast Asia and Japan (Carey *et al*., 2001) Locally common in Deep Bay and other sites included Nam Sang Wai, Tsim Bei Tsui, northeast and eastern New Territories (Carey *et al*., 2001)	Coastal habitat at Sha Lo Wan	Common resident (Carey *et al.,* 2001) Local Concern (Fellowes *et al*., 2002)
Tringa glareola (Wood Sandpiper)	WAPO	Breeds from northern Europe through central Siberia to Kamchatka and winters from tropical and subtropical Africa across southern Asia to China, the Philippines, Indonesia and Australia (Carey *et al*., 2001) Throughout New Territories, Long Valley, Shuen Wan, Kam Tin, Ha Tsuen, San Tin, Lok Ma Chau and Lantau (Carey *et al*., 2001)	Coastal habitat at Sham Wat Bay	Common to abundant passage migrant and winter visitor (Carey *et al*., 2001) Local Concern (Fellowes *et al*., 2002)
Herpetofauna				
Gecko gecko (Tokay Gecko)	None	Bangladesh east to southern China and south to the Philippines and Indonesia (Karsen *et al*., 1998)	Developed Area and rocky outcrop at Sham Wat Wan, San Shek Wan and San Tau	Rare in Hong Kong (Karsen *et al*., 1998) Regional Concern and marked decline in regional population (Fellowes *et al.*, 2002)
Naja atra (Chinese Cobra)	None	Restricted to southern China, Taiwan, northern Vietnam Widespread in Hong Kong (Karsen *et al.*, 1998)	A freshly sloughed skin was found at a stream (SS6) near Sham Shek Tsuen headland	Listed as Vulnerable in China Red Data Book Global population in marked decline and regional population in drastic decline (Fellowes *et al.*, 2002) Potential Regional Concern (Fellowes *et al.*, 2002)
Ptyas mucosus (Common Rat Snake)	None	Central and southern China including Taiwan, south and southeast Asia (Karsen *et al*., 1998)	Coastal, shrubby grassland and secondary woodland at Tung Chung Bay	Common in Hong Kong (Karsen *et al*., 1998) Potential Regional Concern, marked decline in regional and global population (Fellowes *et al*., 2002)
Rana exillispinosa (Lesser Spiny Frog)	None	Common in Hong Kong hill streams. Also known from Hunan, Fujian and Guangdong provinces (Karsen *et al*., 1998)	Streams at Sha Lo Wan, San Shek Wan, Hau Hok Wan, San Tau, Tai Ho Wan and a stream near Pak Mong (SL9, SS6, HH2, HH3, HH5, ST8, TH4, TH1, NLH4)	Potential Global Concern (Fellowes *et al.,* 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Butterfly				
Appias albinia (Common Albatross)	None	Recorded in S. India, Sri Lanka, Nepal, northeast India, Yunnan, Guangxi, Guangdong, Hainan, Taiwan, Ryu Kyus, Philippines, New Guinea and Australia (Bascombe, 1995)	Cultivated field at San Tau	Rare in Hong Kong (Walthew, 1997; Reels and Walthew, 1998; Young and Yiu, 2002) Local Concern (Fellowes *et al*., 2002)
Arhopala birmana (Burmese Bush Blue)	None	Nepal, northeast India, Burma, Thailand, Guangdong, Taiwan (Bascombe, 1995)	Developed area and woodland at San Tau	Rare in Hong Kong (Walthew, 1997; Reels and Walthew, 1998; Young and Yiu, 2002) Local Concern (Fellowes *et al*., 2002)
Eurema brigitta (Small Grass Yellow)	None	Ethiopian, Oriental regions (Bascombe, 1995)	Tall shrubland at Kau Liu to Hau Hok Wan.	Inadequate global and regional data Rare to uncommon in Hong Kong (Walthew, 1997; Reels and Walthew, 1998; Young and Yiu, 2002) Population in marked decline and of local concern (Fellowes *et al*., 2002).
Hypolimnas misippus (Danaid Egg-fly)	None	Florida, Antilles, South America, Africa, Arabian peninsula, Sri Lanka, India, China, Taiwan, Philippines, Malay Peninsula, Lesser Sundas, New Guinea, Bismarcks, Solomon Islands and Australia (Bascombe, 1995)	Shrubby grassland at Chek Lap Kok	Local Concern (Fellowes *et al*., 2002) Uncommon in Hong Kong (Walthew, 1997; Reels and Walthew, 1998; Young and Yiu, 2002)
Lamproptera curius (Dragontail)	None	India, Sichuan, Hubei Yunnan, Guangxi, Guangdong, Hainan, Indo-China, Malay Peninsula, Java, Borneo and Palawan (Bascombe, 1995)	A stream at San Tau	Locally rare (Walthew, 1997; Reels and Walthew, 1998; Young and Yiu, 2002) Local Concern (Fellowes *et al*., 2002)
Mahathala ameria (Falcate Oak Blue)	None	Nepal, India, Guangxi, Hainan, Guangdong, Jiangxi, Fujian, Zhejiang, Taiwan, Burma, Thailand and Indo-China (Bascombe, 1995)	Tall shrubland at Kau Liu to Hau Hok Wan	Uncommon in Hong Kong (Walthew, 1997; Reels and Walthew, 1998; Young and Yiu, 2002) Local Concern (Fellowes *et al*., 2002)
Dragonfly				
Leptogomphus elegans (Elegant Clubtail)	None	Fujian, Guangdong and Guangxi (Wilson, 2003)	Secondary woodland at Pak Mong to Tai Ho Wan	Common and widespread in Hong Kong (Wilson, 1997; 2003) Local Concern (Fellowes *et al*., 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Melligomphus moluamis (Small Hooktail)	None	No further range Endemic to Hong Kong (Wilson, 1997; 2003) Keung Shan, Mount Butler, Tai Po Kau and Yuen Tun Ha (Wilson, 2003)	Stream at San Tau	Uncommon in Hong Kong (Wilson, 2003) Global Concern (Fellowes *et al.*, 2002)
Rhyothemis triangularis (Sapphire Flutterer)	None	Borneo, Burma, China, Indonesia, India, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Thailand and Vietnam (Wilson,2003) Cheung Sheung, Double Island, Kang Mun Tsui, Kau Sai Chau, Luk Keng, Lamma Island, Tai Tam Country Park, Tai Po Kau and Sha Lo Tung (Wilson,2003)	Pond at Tung Chung Bay	Uncommon in Hong Kong (Wilson, 1997; 2003) Local Concern (Fellowes *et al.*, 2002)
Mammal				
Muntiacus muntjac (Indian Muntjac)	WAPO	Widespread from India to Southern China and Southeast Asia (Francis, 2001) Probably common in Hong Kong (Reels, 1996)	Tall shrubland at Sha Lo Wan and Sham Shek Tsuen	Probably common (Reels, 1996) Potential Regional Concern (Fellowes *et al.*, 2002)
Freshwater Fish				
Acrossocheilus beijiangensis (Beijiang Thick Lipped Barb)	None	Restricted to Guangdong Province. Highly restricted in Hong Kong (Chong and Dudgeon, 1999)	Tung Chung (TC1)	Global Concern (Fellowes *et al.*, 2002)
Anguilia marmorata (Giant Mottled Eel)	None in Hong Kong Class II protected species in Mainland China.	Distributed from South Africa, Mauritius, China, Taiwan, Japan	Sham Wat (SW7) and Tai Ho (TH1)	Global Concern (Fellowes *et al.*, 2002). Listed in the China Red Data Book of Endangered Animals
Channa asiatica (Chinese Moon Snakehead)	None	Widespread in south-east China, Taiwan, Japan and Sri Lanka	Sham Wat (SW7), Tung Chung (TC1), Sha Lo Wan (SL3), Pak Mong (PM1) and Tai Ho (TH1)	Local Concern (Fellowes *et al.*, 2002)
Oryzias curvinotus (Rice Fish)	None	Restricted to Hainan, Guangdong and north Vietnam (Chong and Dudgeon, 1999)	Tung Chung (TC1)	Global Concern (Fellowes *et al.*, 2002)

Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Plecoglossus altivelis (Ayu)	None	Widely distributed in rivers along the coasts of Korea, China, Taiwan, Japan and Vietnam (Chong and Dudgeon, 1999)	Tai Ho (TH1)	Regional Concern (Fellowes *et al*., 2002) Listed in the China Red Data Book of Endangered Animals
Takifugu ocellatus (Archpatch Puffer)	None		Sham Wat (SW7), San Tau (ST9), Tung Chung (TC1), Pak Mong (PM3), Tai Ho (TH1)	Local Concern (Fellowes *et al*., 2002)
Flora				
Acampe rigida (Banana Orchid)	AP, FR	Hainan, Guangdong, Guangxi, Yunnan, Guizhou, Tropical Asia and Africa (AFCD, 2001) Shek O, Tung Chung, Lantau Island (AFCD, 2001)	Shrubby grassland near Hau Hok Wan	Classified as common (Siu *et al*., 2000)
Arundina chinensis (Bamboo Orchid)	AP, FR	Central, east, south, southwest China and Tropical Asia (AFCD, 2001)	Shrubby grassland near Hau Hok Wan and Tai Ho Wan	Classified as very common (Siu *et al*., 2000) Common in Hong Kong (AFCD, 2001)
Carex tristachya	None	Hau Hok Wan (Xing *et al*., 2000)	Tall shrubland near Hau Hok Wan	Classified as very rare (Xing *et al*., 2000)
Cleisostoma simondii (Bee Orchid)	AP, FR	Guangdong, Hainan and Fujian (AFCD, 2001)	Shrubby grassland near Hau Hok Wan	Classified as very common (Siu, 2000) and common (AFCD, 2001)
Drosera indica (Indian Sundew)	None	Taiwan, Fujian, Hainan, Guangdong, Guangxi, Tropical and subtropical regions of Asia, Africa and Australia (AFCD, 2003) Tung Chung and Cape D'Augilar (Xing *et al*, 2000; AFCD, 2003)	Coastal habitat along Hau Hok Wan to Kau Liu	Classified as very rare (Xing *et al*., 2000) Classified as Least Concern in IUCN Red List (AFCD, 2003)
Dodonaea viscosa	*None*	Ham Tin and Tung Chung (Xing *et al*, 2000)	Coastal habitat at Sha Lo Wan	Classified as rare (Xing *et al*, 2000)
Eulophia graminea (Pale Purple Eulophia)	AP, FR	Hainan, Guangdong, Guangxi, Guizhou, Yunnan, Anhui, Taiwan and Tropical Asia (AFCD, 2001) Lam Tsuen and Ho Chung (AFCD, 2001)	Tall shrubland near Hau Hok Wan and Sha Lo Wan	Classified as restricted (Siu, 2000)
Halophila beccarii (Becar's Halophila)	None	Hainan, Guangdong, Taiwan and Tropical Asia (AFCD, 2001) Tai Tam Bay, Sheung Pak Nai, Ha Pak Nai, Starling Inlet, Black Point and Tai Ho (Xing *et al*., 2000; AFCD, 2001)	Coastal habitat at Tai Ho Bay	Classified as rare (Xing *et al*., 2000)

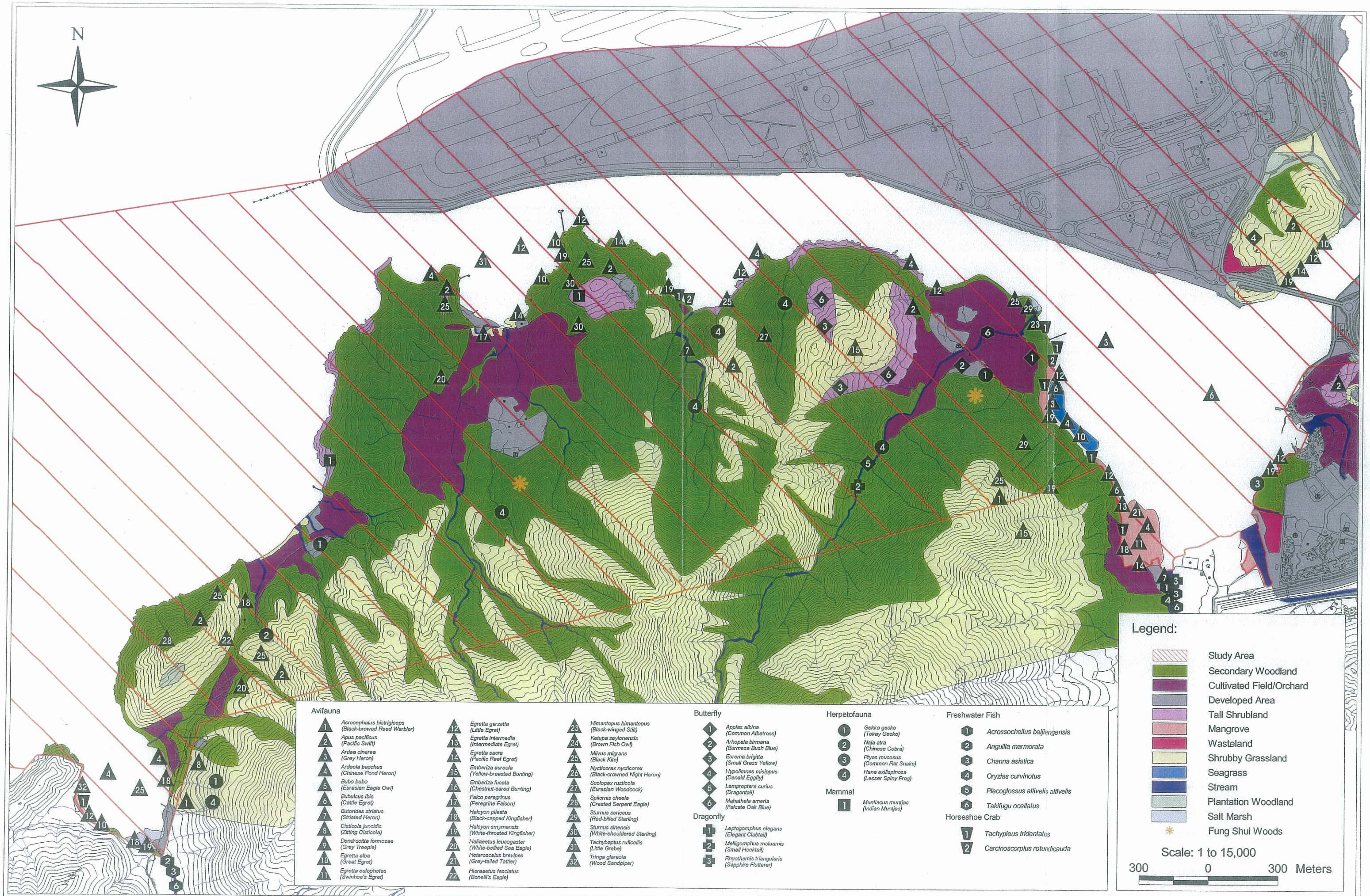
Species / Group	Protection Status	Distribution	Locations Recorded in this study	Rarity
Halophila ovata (Oval Halophila)	None	Hainan, Guangdong, Taiwan, Red Sea, India Ocean, West Pacific Ocean (AFCD, 2001; 2003) Tung Chung and Lai Chi Wo, Tai Tam Bay, Ho Chung, Hoi Ha Wan, Wu Shek Kok and San Tau (Xing *et al*., 2000; AFCD, 2003)	Coastal habitat at Tung Chung (San Tau)	Classified as rare (Xing *et al*, 2000) Classified as Least Concern in IUCN Red List (AFCD, 2003)
Pavetta hongkongensis (Hong Kong Pavetta)	FR	Guangdong, Guangxi, Yunnan, Philippines (AFCD, 2001)	Secondary woodland and tall shrubland at a number of location such as Hau Hok Wan	Classified as common (Xing *et al*., 2000 and AFCD, 2001)
Zostera japonica (Dwarf Eel Grass)	None	Shandong Hebei, Liaoning, Japan, Russia (AFCD, 2001) Sheung Sze Wan, Tung Chung Pier, Lai Chi Wo and San Tau (Xing, 2000; AFCD, 2001)	Coastal habitat at Tung Chung (San Tau)	Classified as rare (Xing *et al.*, 2000) Classified as Least Concern in IUCN Red List (AFCD, 2003)
Corals				
Balanophyllia sp.	AP	Typically found in temperate seas (Scott, 1984) In Hong Kong, mostly restricted to the western waters (AFCD, 2004)	Sham Wat to San Shek Wan (S01-S05; S07-S09), East of Chek Lap Kok (S22)	Common in Hong Kong waters (Scott, 1984; AFCD, 2004)
Marine Mammals				
Sousa chinensis (Indo-Pacific humpback dolphin)	WAPO AP UN Biodiver-sity Treaty	Typically distributed in estuaries and shallow coastal waters. Indian and Western Pacific. South Africa in the west to Northern Australia and Southern China including Xiamen and Taiwan One population predominantly distributed in the Pearl River Estuary and western waters of Hong Kong	Mostly in waters north and west of Lantau Seasonally in waters south and east of Lantau	Approximately 1,028 individuals identified in breeding population in the Pearl River Estuary with about 100 inhabiting the Northwestern waters of Hong Kong (Jefferson, 2000)
Horseshoe crabs				
Tachypleus tridentatus	None	Indo-west Pacific (Morton and Lee, 2003)	Sham Wat, Hau Hok Wan, San Tau, Tung Chung Bay	Probably declining and extirpated throughout much of its range due to water pollution and loss of nursery grounds (Morton and Lee, 2003)
Carcinoscorpius rotundicauda	None	Indo-west Pacific (Morton and Lee, 2003)	Hau Hok Wan, San Tau, Tai Ho Wan	Probably declining and extirpated throughout much of its range due to water pollution and loss of nursery grounds (Morton and Lee, 2003)

Notes: WAPO = Wild Animals Protection Ordinance; AP = Animals and Plants (Protection of Endangered Species) Ordinance; FR = Forestry Regulations; UN= United Nations.

6.3 A total of fifty-two terrestrial and freshwater fauna species of conservation interest were recorded from various habitats within the study area. The localities where these faunal species of conservation interest were recorded are presented in *Figure 13*. Many of these species, in particular birds and mammals, have high mobility and are not always restricted to a single habitat. Conversely, fauna such as freshwater fish are restricted to the streams and impact avoidance is more difficult. Similarly, certain bird species form highly concentrated flocks and in this regard the ardeids are of greater conservation concern than more mobile generalists. The faunal species occurrence within the different habitats present in the study area are presented below in *Table 6.2* and mapped on *Figure 13a-b*.

6.4 Ten floral species of conservation interest have been identified in the study area through field surveys. These included four orchids *Acampe rigida*, *Arundina chinensis*, *Cleisostoma simondii*, *Eulophia graminea*, one sedge, *Carex tristachya,* one shrub/tree *Dodonaea viscosa,* one herb*, Drosera indica* and three seagrass species *Halophila beccarii*, *Halophila ovata* and Zostera japonica.

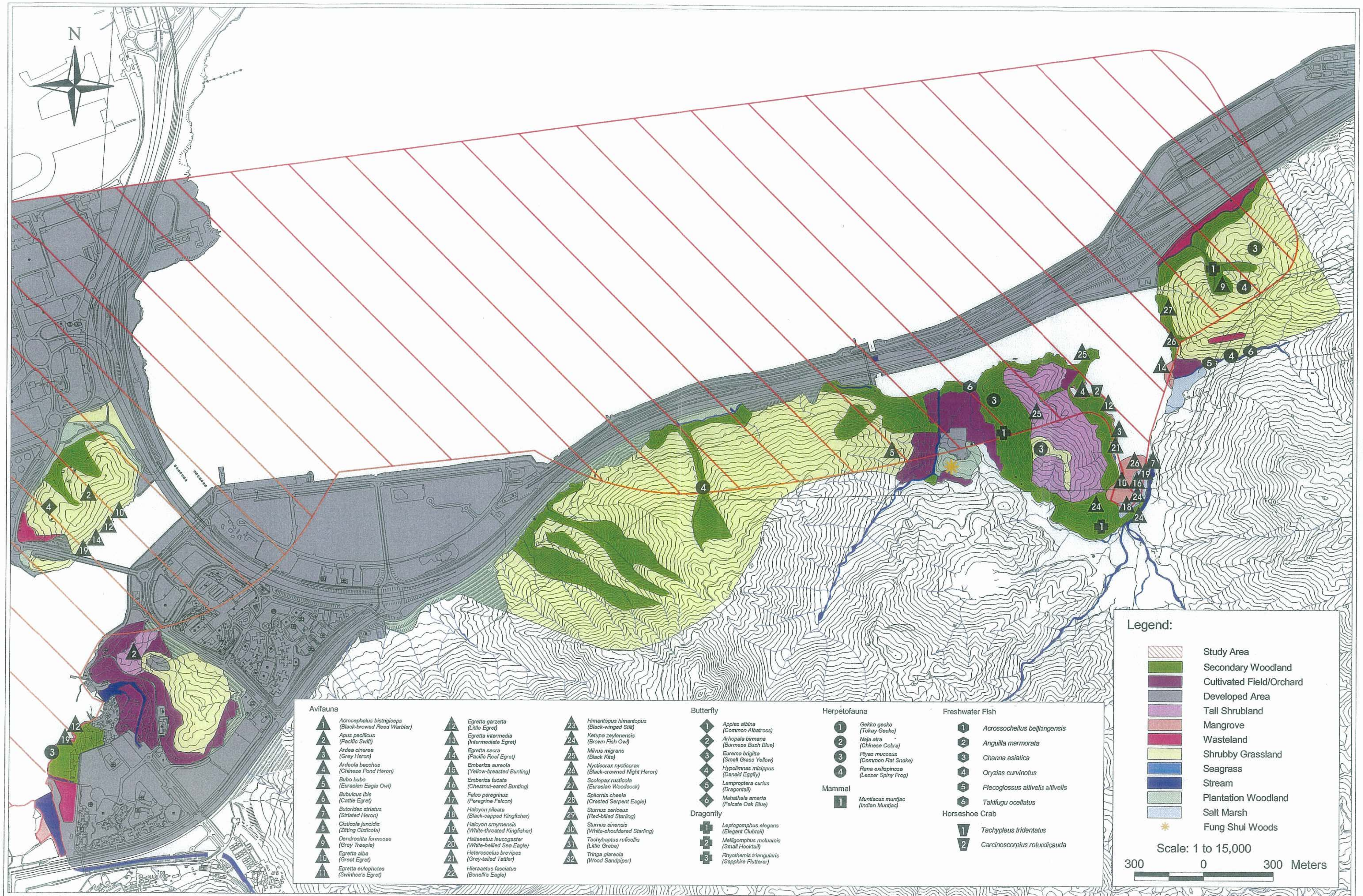
6.5 There were four marine species of conservation interest recorded in the study area. These included the hard coral *Balanophyllia* sp., the Indo-Pacific humpback dolphin and two species of horseshoe crab (*Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*).



Location of Faunal Species of Conservation Interest

Meinhardt Mouchel
Figure 13a

MAP DATA REPRODUCED WITH PERMISSION OF THE DIRECTOR OF LANDS, HONG KONG, CONTRACT/AGREEMENT NO. MW 01/2003



Location of Faunal Species of Conservation Interest

Meinhardt Mouchel
Figure 13b

Table 6.2 Number of Terrestrial Faunal Species Present in Different Habitat Types Within the Study Area

	Secondary Woodland	Plantation Woodland	Tall Shrubland	Shrubby Grassland	Stream/ Riparian/Pond	Coastal	Developed Area	Wasteland	Cultivated Field/Orchard
Butterfly	62	0	45(2)	67(1)	20 (1)	11	43(1)	13	41(2)
Dragonfly	9(1)	0	3	13	17(2)	2	2	2	1
Herpetofauna	12(1)	0	7	12(2)	6(2)	1(1)	10(1)	4	5
Avifauna	61(9)	1	44 (2)	37(8)	16 (4)	42(18)	18	11	34
Freshwater fish	0	0	0	0	67 (6)	0	0	0	0
Mammal	0	0	2 (1)	0	0	0	1	0	0
Flora	217(1)	125(0)	185(3)	153(2)	N/A	141(5)	129(0)	159(0)	126(0)
Total No. of Faunal Species	144	1	101	129	126	56	74	30	81
Faunal Species of Conservation Interest	11	0	5	11	15	19	2	0	2
Floral Species of Conservation Interest	1	0	3	2	0	5	0	0	0

Note: ( ) = Species of conservation interest , N/A = not applicable

Secondary Woodland

6.6 A total of 144 faunal species were recorded in the secondary and plantation woodland habitats across the study area. This habitat was rich in butterflies and avifauna, with 62 and 61 species recorded respectively, of which nine bird species (Pacific Swift, Grey Treepie, White-bellied Sea Eagle, Brown Fish Owl, Black Kite, Eurasian Woodcock, Crested Serpent Eagle, Red-Billed Starling and White-shouldered Starling) are of conservation interest. This was the only habitat in which Grey Treepie, Chest-eared Bunting, Crested Serpent Eagle, White-bellied Sea Eagle, White-shouldered Starling and Eurasian Woodcock were observed. Despite the high number recorded, no butterfly species is of conservation interest.

6.7 Nine species of odonates were also recorded within this habitat type and the Elegant Clubtail is of conservation interest. This was the only habitat in which Elegant Clubtail was recorded.

6.8 Twelve species of herpetofauna were recorded within this habitat type and only the Common Rat Snake is of conservation concern.

6.9 This habitat supports the highest number of floral species. Of these, one protected shrub species was recorded. Patches of the protected shrub *Pavetta hongkongensis* were recorded in a group of 4-6 individuals in a number of locations.

Plantation Woodland

6.10 Given the limited area within the study area, only one avifauna species was recorded in this habitat type and no floral and fauna species of conservation interest present.

Tall Shrubland

6.11 This habitat contained 101 species of fauna, including 44 species of avifauna, two of which, namely the Pacific Swift and Black Kite are considered to be of some conservation interest.

6.12 Other non-avian fauna include 45 species of butterfly, 3 species of dragonfly, 7 species of herpetofauna and 2 species of mammal. Among the butterfly species, Small Grass Yellow and Falcate Oak Blue are of conservation interest. This was the only habitat in which these two species were recorded.

6.13 Apart from the abovementioned species, the protected mammal, Indian Muntjac was recorded in the tall shrubland at Sha Lo Wan and San Shek Wan. This mammal species is considered to be of potential regional concern (Fellowes *et al*., 2002). No herpetofauna and dragonfly species of conservation concern was recorded.

6.14 A total of 185 floral species were recorded within this habitat. There were three species of conservation interest including one protected shrub Pavetta hongkongensis, one restricted orchid Eulophia graminea and one very rare sedge *Carex tristachya*.

Shrubby Grassland Mosaic

6.15 This extensive habitat contained 129 species, including 67 species of butterfly, 13 species of dragonfly and 12 species of herpetofauna.

6.16 Thirty-seven species of avifauna were recorded within this habitat of which eight are of conservation interest, namely Black-browed Reed Warbler, Pacific Swift, Eurasian Eagle Owl, Zitting Cisticola, Yellow-breasted Bunting, Peregrine Falcon, Bonelli's Eagle and Black Kite. This was the only habitat in which Bonelli's Eagle, Peregrine Falcon, Yellow-breasted Bunting, Zitting Cisticola and Black-browed Reed Warbler were recorded.

6.17 Apart from the avifauna, one butterfly (Danaid Eggfly) and two reptile species (Common Rat Snake and Tokay Gecko) are of conservation interest.

6.18 Three protected orchids *Acampe rigida*, *Arundina chinensis* and *Cleisostoma simondii* were recorded within this habitat. All these flora species are common in Hong Kong (Xing et al., 2000).

Stream/Riparian/Pond

6.19 This habitat was rich in faunal species with 126 species of fauna recorded, of which fourteen are of conservation interest. Streams are numbered as presented in *Figures 2.1-2.4* in the following discussions.

6.20 Freshwater fish made up the majority of species, with 67 species recorded at streams within the study area. Of these, six species are considered to be of conservation interest. These were comprised of Beijiang Thick Lipped Barb (TC1), Giant Mottled Eel (SW7, TH1), Rice Fish (TC1), Chinese Moon Snakehead (PM1, SL3, SW7, TH1 and TC1), Ayu (TH1) and Archpatch Puffer (PM3, ST9, SW7, TH1 and TC1). The survey provided further data on the importance of stream systems throughout the study area and ecologically important streams included Tung Chung Stream (TC1), Tai Ho Stream (TH1) and Sham Wat Stream (SW7).

6.21 Among seventeen Odonates species recorded within this habitat, two are of conservation interest. The Small Hooktail is of global concern (Fellowes *et al*., 2002) and Sapphire Flutterer is of local concern. Local population of the latter is in decline.

6.22 Twenty butterfly species were recorded of which one, the Dragontail, is of conservation. This was the only habitat in which Dragontail was recorded.

6.23 A total of sixteen avifauna species were recorded within this habitat, of which the Striated Heron, White-throated Kingfisher, Brown Fish Owl and Black-crowned Night Heron are of conservation interest. This was the only habitat in which the Straited Heron was recorded.

6.24 In addition to the above, herpetofauna were limited at stream habitats with only six species recorded. Of these, two were considered to be of conservation interest, one species of reptile, the CITES II listed Chinese Cobra, and one species of amphibian of conservation concern, the locally common but globally restricted Lesser Spiny Frog were recorded.

Coastal

6.25 Coastal habitat comprised seagrass habitat, salt marsh, rocky shoreline and mangrove habitats. A total of 56 species was recorded. This habitat is rich in avifauna with 42 bird species observed. Eighteen of them are of conservation interest namely, Grey Heron, Chinese Pond Heron, Cattle Egret, Great Egret, Swinhoe's Egret, Little Egret, Intermediate Egret, Pacific Reef Egret, Black-capped Kingfisher, White-throated Kingfisher, Grey-tailed Tattler, Black-winged Stilt, Brown Fish Owl, Black Kite, Black-crowned Night Heron, Red-billed Starling, Little Grebe and Wood Sandpiper. Apart from the Brown Fish Owl, Black Kite, Black-crowned Night Heron and Red-billed Starling, the other fourteen species were only recorded in coastal habitat.

6.26 In addition to the avifauna, eleven butterflies and two dragonflies were recorded in this habitat type but all of these are common and widespread in Hong Kong.

6.27 One reptile species, the Common Rat Snake, was recorded within this habitat in Tung Chung Bay. This species is threatened regionally (Fellowes *et al*., 2002).

6.28 141 floral species have been identified within this habitat of which five are of conservation interest. These included the tree *Dodonaea viscosa*, herb *Drosera indica* and three seagrass species *Halophila beccarii*, *Halophila ovata* and *Zostera japonica*. All these are rare in Hong Kong (Xing et al., 2000).

6.29 In addition to the above, two species of horseshoe crabs *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda* were recorded within the intertidal mudflat and seagrass habitats. The coastal habitats present in the study area are, therefore, considered to be ecologically important to horseshoe crabs.

Developed Area

6.30 A total of 74 faunal species were recorded within this habitat and two of these are of conservation interest.

6.31 This habitat was rich in butterfly species with forty-three species recorded. However, only Burmese Bush Blue is rated of local concern (Fellowes *et al*., 2002). Two species of dragonfly, eighteen bird species, one mammal and ten herpetofauna species were recorded, of which Tokay Gecko is globally restricted (Fellowes *et al*., 2002).

6.32 A total of 129 floral species were present in the developed area habitat. Of these, none were rare or protected.

Wasteland

6.33 Wasteland was depauperate in fauna and supported the lowest number of faunal species. Only thirteen butterfly, eleven avifauna, four herpetofauna, and two dragonfly species were recorded in this habitat. All these were common and widespread and no species of conservation concern was recorded.

6.34 There were 159 flora species present in this habitat although no rare or protected species was recorded.

Cultivated Field/Orchard

6.35 Cultivated Land supported eighty-four faunal species, including forty-one species of butterfly, one species of dragonfly, five species of herpetofauna and thirty-four species of bird. The locally restricted butterfly Common Albatross and Burmese Bush Blue were recorded in the cultivated fields at San Tau. Butterfly species was the only species of conservation interest recorded in this habitat.

6.36 126 floral species were recorded within this habitat and no species of conservation interest present.

Subtidal Habitat

6.37 There were four marine species recorded of conservation interest. The hard coral *Balanophyllia* sp. is protected in Hong Kong although it should be noted that the species is common and the few individuals present within the study area were in poor condition and of low ecological importance. The Indo-Pacific humpback dolphin was also present and this species is considered threatened throughout much of its range due to various pressures including loss of habitat, fishing activity and pollution (Liu and Hills, 1997; Jefferson, 2000). Two horseshoe crabs were recorded in the study area (*Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*). Horseshoe crabs have undergone population declines throughout much of their range and extirpated from certain locations in Hong Kong such as Tolo Harbour (Morton and Lee, 2003).

7. Habitat Quality

7.1 Background

7.1.1 In this section, the ecological importance of the habitats identified within the study area have been evaluated in accordance with criteria stipulated in Annex 8 of the EIAO TM.

7.2 Secondary Woodland

7.2.1 As discussed earlier in *Section 5.12.6*, secondary woodland patches are distributed throughout the study area. Although there are differences in many ecological aspects of these patches, the ecological value of secondary woodland as a whole is considered high. An assessment of the secondary woodland in accordance with the criteria stated in Annex 8 of the TMEIA is provided below in *Table 7.1*.

Table 7.1 Ecological Evaluation of Secondary Woodland Within the Study Area

Criteria	Secondary Woodland
Naturalness	Secondary woodland dominated by native plant species and suffering only limited human disturbance
Size	Comparatively large in size (>300 ha)
Diversity	Rich in terms of floral diversity (217 species recorded)
Rarity	None of the plant species recorded are rare in Hong Kong. One regionally protected tree *Aquilaria sinensis* and one locally protected shrub *Pavetta hongkongensis* were recorded, which are both common in Hong Kong. Eleven faunal species of conservation interest were recorded
Re-creatability	Possible if adequate resources are available (man-power, land, finance, re-planting material) and in the absence of disturbance, but original habitat characteristics including the community composition and structural complexity may require > 20 years to establish (Mouchel, 2002a)
Fragmentation	Fragmentation of patches is minimal
Ecological linkage	Native secondary woodland may provide a movement corridor for wildlife and it could serve as a seed source to facilitate the succession process in the surrounding area. Functionally linked to streams passing through this habitat
Potential value	High in terms of size and species diversity
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Relatively old (>50 years) with respect to the size of the trees and the structural complexity and community composition
Abundance/ Richness of wildlife	Very high butterfly, high dragonfly, high herpetofauna and very high avifauna abundance. High species richness with 144 species of fauna present; 12 species of conservation interest including nine avifauna, one dragonfly and one reptile.
Ecological value	High

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.3 Plantation Woodland

7.3.1 As discussed earlier in *Section 5.12.7*, patches of plantation woodland are distributed throughout the study area. Although there are differences in many ecological aspects of these patches, the ecological value of plantation woodland as a whole is considered moderate to low. An assessment of the secondary woodland in accordance with the criteria stated in Annex 8 of the TMEIA is provided below in *Table 7.2*.

Table 7.2 Ecological Evaluation of Plantation Woodland Within the Study Area

Criteria	Plantation Woodland
Naturalness	Man-made planted habitat
Size	Relatively small (6.57 ha)
Diversity	Rich floral diversity (125 species)
Rarity	None of the plant species recorded are rare in Hong Kong. One regionally protected but locally common tree was recorded. No faunal species of conservation interest
Re-creatability	Readily re-creatable provided adequate resources are available (man-power, land, finance, re-planting material)
Fragmentation	Moderately fragmented
Ecological linkage	Not functionally linked to any high value habitat
Potential value	Relatively low given small size of the plantation
Nursery/ breeding ground	No significant breeding ground or nursery detected
Age	Young plantation forest
Abundance/ Richness of wildlife	Low avifauna abundance and no other species were noted. Low species richness with only one avifauna species present and no species of conservation interest
Ecological value	Moderate to Low

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.4 Tall Shrubland

7.4.1 The habitat structure and species diversity of tall shrubland within the study area is complex and rich. The species composition is comparable to secondary woodland and the ecological value of this habitat type is considered moderate to high. An assessment of the tall shrubland in accordance with the criteria stated in Annex 8 of the TMEIA is provided below in *Table 7.3*.

Table 7.3 Ecological Evaluation of Tall Shrubland Within the Study Area

Criteria	Tall Shrubland
Naturalness	Natural habitat
Size	Comparatively small area (22.17 ha)
Diversity	Botanically diverse (185 species)
Rarity	Two rare floral species recorded included *Carex tristachya* and *Eulophia graminea*. One locally protected but common shrub was recorded. Six faunal species of conservation interest were present
Re-creatability	Readily re-creatable provided that adequate resources are available (man-power, land, finance, re-planting material) and in the absence of disturbance
Fragmentation	Fragmentation is moderate with respect to the distribution pattern of the habitat within the study area
Ecological linkage	Generally not functionally linked to any high value habitat
Potential value	High given the rich tree flora within the habitat
Nursery/ breeding ground	No significant breeding or nursery ground recorded
Age	Moderate in terms of the succession pathway
Abundance/ Richness of wildlife	Very high butterfly, medium dragonfly, high herpetofauna, very high avifauna and medium mammal abundance. High species richness with 101 species of fauna recorded in this habitat, five species of conservation interest including two butterfly, two avifauna and one mammal species
Ecological value	Moderate to high

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.5 Shrubland-Grassland Mosaic

7.5.1 Shrubland-grassland mosaic is species rich and structurally complex as a whole for the mosaic, and is considered to have a moderate ecological value. An assessment of the shrubland-grassland mosaic in accordance with the criteria stated in Annex 8 of the TMEIA is provided below in *Table 7.4*.

Table 7.4 Ecological Evaluation of Shrubland-Grassland Mosaic Within the Study Area

Criteria	Shrubland-Grassland Mosaic
Naturalness	Natural habitat but may suffer frequent disturbance (hill fire)
Size	Large in size (191.8 ha)
Diversity	Botanically diverse (153 species)
Rarity	Three common and protected orchids although no rare floral species recorded. Species of conservation interest included eight avifauna, one butterfly and two reptile species
Re-creatability	Readily re-creatable provided that adequate resources are available (man-power, land, finance, re-planting material) and in the absence of disturbances such as fire
Fragmentation	Fragmentation is relatively limited with respect to the distribution pattern of the habitat within the study area
Ecological linkage	Functionally linked to streams
Potential value	Moderate as a result of the location and the potential for fire disturbance
Nursery/ breeding ground	No significant breeding ground or nursery detected
Age	Young in terms of the succession pathway
Abundance/ Richness of wildlife	High dragonfly and herpetofauna and very high butterfly and avifauna abundance. High species richness with 129 species of fauna present; 11 species of conservation interest including one butterfly, two herpetofauna and eight avifauna.
Ecological value	Moderate

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.6 Streams and Riparian Habitat

7.6.1 Riparian vegetation in the study area is broadly similar to that of the surrounding habitat, comprising secondary woodland and shrubby grassland. The stream habitats are of particular value notably due to the fish fauna present although several other important species were also present in the riparian zone. Several streams in the study area are seasonal, or of very low base flow, and these are of lower ecological value than the permanent streams with reliable discharge, upon which fully aquatic fauna are dependent. The following evaluation divides streams into two broad categories, those with generally higher base flow supporting species of conservation interest, and those with generally lower base flow supporting less species of conservation interest (*Table 7.5*).

Table 7.5 Ecological Evaluation of Streams and Riparian Habitat Within the Study Area

Criteria	**Streams (relatively higher base flow): SW1, SW7, SS1-SS4, SS6, SL1-SL7, SL9, SL10, HH5, HH7, ST4-ST9, TC1-TC3, NLH4-NLH8, PM1, PM3, TH1, TH5**	**Streams (relatively lower base flow): SW2-SW6, SS5, SS9-SS10, SL8, HH1-HH3, HH6, ST1, ST12-ST14, TC4-TC9, NLH1-NLH3, PM4-PM7, TH3-TH4, TH6-TH9**
Naturalness	Natural habitat, pristine at higher elevations, generally more disturbed at lower elevations	Natural habitat, pristine at higher elevations, generally more disturbed at lower elevations
Size	Small in size as a whole for the study area. Relatively moderate to high base flow	Small in size as a whole for the study area. Relatively low base flow
Diversity	Botanically diverse riparian strip as a whole for the habitat mosaic	Botanically diverse riparian strip as a whole for the habitat mosaic
Rarity	No rare floral species recorded. Numerous rare/endangered species of fauna were present, including fifteen species of conservation interest. *Acrossocheilus beijiangensis* was recorded in TC1, *Anguilla japonica* was recorded in SW7 and TH1, *Channa asiatica* was recorded in SW7, TC1, SL3, PM1 and TH1, *Oryzias curvinotus* was recorded in TC1, *Plecoglossus altivelis* was recorded in TH1 and *Takifugu ocellatus* was recorded in SW7, ST9, TC1, PM3 and TH1. The Lesser Spiny Frog was recorded in SL9, HH5, ST8, NLH4, TH1 and TH5 and Chinese Cobra was recorded in SS6 (although only the freshly sloughed skin of Chinese Cobra was found)	No rare floral species recorded and Lesser Spiny Frog was recorded in HH2, HH3 and SW4
Re-creatability	Re-creatable provided that works conducted in ecologically-sensitive manner and original flow not diverted or polluted, and in the absence of disturbance	Readily re-creatable provided that works conducted in ecologically-sensitive manner and original flow not diverted or polluted, and in the absence of disturbance
Fragmentation	Generally non-fragmented continuous linear habitat	Generally non-fragmented continuous linear habitat
Ecological linkage	Functionally linked to surrounding terrestrial and coastal habitat	Functionally linked to surrounding terrestrial and coastal habitat
Potential value	High as a result of the pristine condition and generally low level of disturbance	Moderate-low as a result of low/seasonal base flow
Nursery/ breeding ground	Significant breeding grounds of numerous species of conservation interest, including *Acrossocheilus beijiangensis*, *Anguilla japonica*, *Channa asiatica*, *Oryzias curvinotus Plecoglossus altivelis* and *Takifugu ocellatus* and potential breeding location for Lesser Spiny frog	No significant breeding ground or nursery detected
Age	Ancient geomorphological drainage features	Ancient geomorphological drainage features
Abundance/ Richness of wildlife	High butterfly, dragonfly, herpetofauna, avifauna and very high freshwater fish abundance. High species richness with 126 faunal species recorded; 15 species of conservation interest including one butterfly, two dragonfly, two herpetofauna, four avifauna and six freshwater fish	Low species richness with only one amphibian, a species of conservation interest, present
Ecological value	High	Moderate-low, given the value of the surrounding habitat (secondary woodland or shrubby grassland)

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.7 Wasteland

7.7.1 Wasteland is found close to the developed areas and comprised mainly of ruderal plants of low ecological value. An assessment of the wasteland habitat in accordance with the criteria stated in Annex 8 of the TMEIA is provided below in *Table 7.6*.

Table 7.6 Ecological Evaluation of Wasteland within the Study Area

Criteria	Wasteland
Naturalness	Semi-natural as the habitat is established on heavily disturbed land predominantly inhabited by ruderal plant species
Size	Relatively small (2.64 ha)
Diversity	Relatively botanically diverse (159 species)
Rarity	None of the floral and faunal species recorded are rare in Hong Kong
Re-creatability	Readily re-creatable
Fragmentation	High
Ecological linkage	Not functionally linked to any high value habitat
Potential value	Low potential value with respect to the planned land-use
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Young in terms of the succession pathway
Abundance/ Richness of wildlife	High butterfly and avifauna, medium dragonfly and herpetofauna abundance. Medium species richness with 30 faunal species present and no species of conservation interest
Ecological value	Low

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.8 Cultivated Field/Orchard

7.8.1 Cultivated field/Orchard within the study area are comparatively small in size and intensively modified and managed by human activities. The ecological value is hence considered low (*Table 7.7*).

Table 7.7 Ecological Evaluation of Cultivated/Agricultural Land within the Study Area

Criteria	Cultivated/Agricultural Land
Naturalness	Man-made habitat
Size	Comparatively small (59.9 ha)
Diversity	Relatively diverse plant community (126 species)
Rarity	Two butterfly species of conservation interest and no rare floral species present
Re-creatability	Readily creatable
Fragmentation	Relatively fragmented given the size of the patches
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity
Potential value	Potentially high depending on the agricultural management practices
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Unknown
Abundance/ Richness of wildlife	Low dragonfly, medium herpetofauna, very high butterfly and avifauna abundance. Medium species richness with 81 fauna species recorded of which two butterfly species are of conservation interest
Ecological value	Low

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.9 Developed Area

7.9.1 The developed areas were often associated with intensive human activities (notably at the airport) and had limited ecological resources, and hence low ecological value. An assessment of the developed area in accordance with the criteria stated in Annex 8 of the TMEIA is provided below in *Table 7.8*.

Table 7.8 Ecological Evaluation of Developed Area Within the Study Area

Criteria	Developed Area
Naturalness	Man-made habitat with intensive human activities
Size	Relatively large (483.9 ha)
Diversity	Relatively diverse plant community (129 species)
Rarity	Two faunal species of conservation interest recorded and no rare floral species present
Re-creatability	Readily re-creatable
Fragmentation	Moderate
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity
Potential value	Low potential value with respect to the planned land-use
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	No information (airport construction commenced 1990s)
Abundance/ Richness of wildlife	Medium dragonfly, high herpetofauna, high avifauna and very high butterfly abundance. Medium species richness with 81 faunal species recorded; 2 species of conservation interest including 1 butterfly and 1 herpetofauna
Ecological value	Low

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.10 Mangrove and Seagrass

7.10.1 There are important mangrove stands and seagrass beds within the coastal fringe of the study area. The habitat serves as a nursery, foraging and roosting ground for many faunal species and the ecological value of this habitat type is considered high. Seagrass bed and mangrove habitats are defined as important habitat in Technical Memorandum (TM) of Environmental Impact Assessment Ordinance (EIAO). An assessment of these habitats in accordance with the criteria stated in Annex 8 of the TM is provided below in *Table 7.9*.

Table 7.9 Ecological Evaluation of Mangrove/Seagrass Within the Study Area

Criteria	Mangrove/Seagrass
Naturalness	Natural habitat
Size	Comparatively small area (10.57 ha)
Diversity	Botanically diverse (85 species) with the presence of 6 mangal species
Rarity	Mangrove and seagrass habitats are rare in Hong Kong. Rare plant species recorded included *Dodonaea viscosa* and *Drosera indica* and three seagrass species, *Zostera japonica*, *Halophila beccarii* and *Halophila ovata*. Fifty-six faunal species were recorded, of which 19 species of conservation interest present. One species of horseshoe crab were recorded
Re-creatability	Readily re-creatable provided that adequate resources and suitable substrate are available (man-power, soft intertidal mudflat, finance, re-planting material) and in the absence of disturbance. Soft-substrate intertidal habitat likely difficult to re-create
Fragmentation	Fragmentation is high due to reclamation's along the coastal fringe
Ecological linkage	Functionally linked to streams, mudflat, salt marshland, coastal waters
Potential value	High given the rich seagrass, established mangrove and tree flora and fauna within the habitat
Nursery/ breeding ground	Significant nursery ground for horseshoe crabs and roosting and/breeding location for many avifauna (notably ardeids)
Age	Moderate in terms of the succession pathway
Abundance/ Richness of wildlife	Very high avifauna, high butterfly, medium dragonfly and low herpetofauna abundance. High species richness with 56 faunal species present of which 19 of these are of conservation interest including 18 avifauna and 1 reptile
Ecological value	High

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.11 Marine Intertidal Shores (Hard and Soft Shores)

7.11.1 The ecological importance of the hard and soft shore intertidal habitats present were evaluated in accordance with the suggested criteria stated in Annex 8 of the EIAO TM. The habitats present were composed of artificial seawall, boulder shores with intermittent sand deposits, sandflats and mudflats. These natural habitats are generally rated higher in the TM. It should, however, be noted that these habitats are reasonably common and present in similar locations elsewhere in Hong Kong.

Hard Intertidal Shores

7.11.2 The faunal diversity of the rocky intertidal shores was generally low and only 34 common marine-dependent species were recorded along the whole coastline and molluscs (predominantly littorinid gastropods, predatory gastropods, bivalves including oysters) were the most abundant group recorded (*Appendix E*). All species present are found on hard (often including artificial substrates such as seawalls) substrates throughout Hong Kong coastal waters.

7.11.3 The shoreline in the western study area is functionally linked to the adjacent marine habitat (particularly the lower shore) although the coastline along the eastern part of the study area (around Tai Ho) has been subject to reclamation and is fragmented and of lower ecological value. The shoreline around the airport platform is artificial and also of low ecological value. The hard shores present are not anticipated to represent significant nursery or breeding areas for species of conservation interest. The natural hard shore intertidal habitats are, therefore, generally of moderate ecological importance.

Soft Intertidal Mudflats

7.11.4 The faunal diversity was generally low and only 22 common coastal species were recorded along the whole coastline and common molluscs such as mud snails (*Cerithidea* sp.) were the most abundant group recorded (*Appendix E*). All species present are found on other soft intertidal substrates throughout Hong Kong. The large venerid bivalve *Meretrix meretrix* are reasonably common on sheltered lower intertidal sand shores on Lantau (Morton and Morton, 1983) and were collected by villagers at Sham Wat during the course of the present surveys.

7.11.5 The soft interidal shores in the west of the study are relatively undisturbed, often functionally linked to the adjacent marine habitat and streams and owing to certain flora and faunal species present, are of high ecological value. The shoreline in the eastern study area is mostly fragmented, predominantly hard or composed of artificial seawall although some soft shores remain in Tung Chung Bay and near to Tai Ho. The aforementioned shores are relatively undisturbed, functionally linked to the adjacent marine and stream habitats and of high ecological value.

7.11.6 Important seagrass beds and mangrove stands have been recorded in the study area. The spoon grass, *Halophila beccarii* has been recorded at Tai Ho whilst *H. ovata* and the eelgrass, *Zostera japonica* have been recorded at San Tau. The latter two species were significantly reduced at San Tau due to the airport construction although they have more recently recovered following completion of the reclamation (Mouchel, 2002a). Mangrove communities are under threat from urbanisation and reclamation and many stands have been destroyed in Hong Kong and they are considered to be a conservation priority (Tam and Wong, 2000). The mangrove habitat at San Tau is regarded as an important stand in Hong Kong (Tam and Wong, 2000). Mangrove stands of conservation interest are also present at Sham Wat, Tung Chung Bay and Tai Ho Wan. Both mangrove and seagrass beds are important habitats for many birds (notably ardeids) and also serve as important nursery areas. The locations containing either seagrass or mangrove are, therefore, considered to be of high ecological value.

7.11.7 Notable mangal-associated fauna included ardeids (notable numbers recorded in Tung Chung Bay) and horseshoe crabs. The horseshoe crabs (*Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*) have been recorded from intertidal mudflats and sandflats at Sham Wat, Sha Lo Wan, Hau Hok Wan, San Tau, Tung Chung Bay and Tai Ho Wan (see *Table 5.12*). These bays are considered to be nursery grounds for juvenile horseshoe crabs and are of high ecological value.

7.12 Marine Habitat Quality

7.12.1 The ecological value of each habitat present in the study area is largely based on the species present. Habitats that contain species of conservation interest or serve as a nursery or breeding grounds are considered to have a higher ecological value. The marine waters present in the study area are used by the species of highest marine ecological importance, the Indo-Pacific humpback dolphin. A species-based impact evaluation for both the construction and operational phases of the project will be required for the dolphin. For the purposes of habitat evaluation, the horseshoe crabs are distributed in the coastal waters of the study area, but they are mostly associated with mangroves and seagrass beds and these habitats are likely the most important as they serve as nursery grounds.

Soft-Bottom Benthos

7.12.2 The marine benthic habitat present in the North-western waters of Hong Kong are generally characterised by soft-bottom material composed of silts and clay as a homogenous layer or in loosely packed mud clasts bound in a puzzle fabric (Mouchel, 200b). In areas subject to the influence of stronger tidal currents, coarser sands are also present (Mouchel, 2002b). The macroinvertebrate species present are characteristic of estuaries and dominant ecological groups present include polychaetes, bivalves, gastropods, crustaceans and echinoderms (e.g., Mouchel, 2002b). An assessment of the soft-bottom habitats in accordance with the criteria stated in Annex 8 of the TM is provided below in *Table 7.10*.

Table 7.10 Ecological Evaluation of Marine Soft-bottom Benthic Habitat Within the Study Area

Criteria	Marine Soft-Bottom Benthic Habitat
Naturalness	Natural habitat (although suffers disturbance both naturally through storm events and due to activities such as demersal trawling)
Size	Relatively large as majority of marine study area composed of soft-bottom silt-clay material
Diversity	Infauna diversity is relatively low (*H'* < 2) compared to other areas in Hong Kong due to the proximity of the prevailing estuarine conditions and possibly due to the predominantly silt-clay composition of the seabed that tends not to support high diversity (Mouchel, 2002b)
Rarity	Horseshoe crabs are rare in Hong Kong and adults have been recorded on this habitat. Horseshoe crabs were recorded within this habitat to the north of the Hong Kong International Airport
Re-creatability	Easily recreated as disturbed soft-bottom sediments are readily recolonized
Fragmentation	Highly connected to adjacent homogeneous habitat although fragmentation due to disturbance possible
Ecological linkage	Functionally linked to overlying water column
Potential value	Low
Nursery/ breeding ground	No species of conservation interest known to use soft-bottom sediments in the study area as a nursery or breeding ground
Age	The majority of deposits are considered to be derived locally although some likely transported by the Pearl River. Local seabed material is considered to be comprised of Holocene post-glacial sediments deposited over the past 12 000 years (Whiteside, 2000)
Abundance/ Richness of wildlife	Forty three species were recorded in the wet season (October 2003) and eighty six in the dry season (January 2004) together with some horseshoe crabs. Highest abundance recorded is similar to the eastern waters where 79 species of macroinvertebrate fauna were recorded in Tolo Harbour and Mirs Bay in 1986 (Shin, 1990)
Overall Ecological value	Low-moderate

Marine Hard-Substrate Intertidal and Subtidal

7.12.3 Natural shorelines over 500m are considered as important habitats in Hong Kong. The littoral communities present on the rocky shores in study area were comprised of common intertidal species that are found on similar habitat types elsewhere in Hong Kong (Morton and Morton, 1983; Williams, 2003). Biological diversity is not, therefore, considered to be high on the hard substrates present within the study area. The subtidal (dive) surveys revealed the presence of some hard corals although these were in poor condition and considered to be of low ecological value. An assessment of the hard-substrate intertidal and subtidal habitats in accordance with the criteria stated in Annex 8 of the TM is provided below in *Table 7.11*.

Table 7.11 Ecological Evaluation of Marine Hard Substrate Intertidal and Subtidal Habitat Within the Study Area

Criteria	Marine Hard Substrate Intertidal and Subtidal
Naturalness	Natural habitat
Size	Natural hard substrate intertidal habitats are mostly present in the eastern side of the study area as the shorelines in the west have been reclaimed. Natural hard substrate shoreline comparatively long (>500 m).
Diversity	Low
Rarity	No rare species recorded although some protected hard corals present subtidally at Sham Wat and East of Chek Lap Kok
Re-creatability	Readily re-creatable
Fragmentation	North Lantau shoreline highly fragmented due to reclamation although shores in the Western side of the study area relatively continuous
Ecological linkage	Connected to adjacent coastal habitats and subtidal to the overlying water column and soft-bottom seabed
Potential value	Moderate given the potential for colonisation of taxa such as corals
Nursery/ breeding ground	No species of conservation interest known to use hard-substrates in the study area as a nursery or breeding ground
Age	Natural hard shoreline largely composed of Jurassic granite and sandstone with siltstone
Abundance/ Richness of wildlife	Thirty-four littoral faunal species present. Number of individuals per unit area generally low (maximum density recorded 331 individuals m^{-2}) The only species of conservation interest present are subtidal isolated hard corals which are in poor condition
Overall Ecological value	Moderate-Low

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

Marine Soft-Substrate Intertidal Mudflat

7.12.4 Intertidal mudflats larger than one hectare and natural coastal shores longer than 500m are considered as important habitats in Hong Kong. The intertidal communities present on the soft shores in the study area were comprised of common species that are found on similar habitat types elsewhere in Hong Kong (Morton and Morton, 1983; Chan and Caley, 2003). Biological diversity is, therefore, considered to be moderate on the soft substrates present within the study area. However, adult horseshoe crabs also migrate to and utilise intertidal habitats to reproduce. The ecological value of intertidal mudflat habitats containing nursery grounds is, therefore, considered to be high. An assessment of the soft-substrate intertidal and subtidal habitats in accordance with the criteria stated in Annex 8 of the TM is provided below in *Table 7.12*.

Table 7.12 Ecological Evaluation of Marine Soft-Substrate Intertidal Mudflat Habitat Within the Study Area

Criteria	Marine Soft-Substrate Intertidal Mudflat
Naturalness	Natural habitat
Size	Natural soft substrate intertidal habitats are mostly present in the western side of the study area as the shorelines in the west have been reclaimed. Natural soft substrate shoreline comparatively long (>500 m).
Diversity	Low
Rarity	Horseshoe crabs are rare in Hong Kong. Two species of horseshoe crabs were recorded within this habitat
Re-creatability	Readily re-creatable provided that suitable hydrodynamic (depositional) regime present
Fragmentation	North Lantau shoreline highly fragmented due to reclamation although shores in the Western side of the study area relatively continuous
Ecological linkage	Connected to adjacent coastal and terrestrial habitats
Potential value	Moderate given the potential for colonisation of taxa such as horseshoe crabs
Nursery/ breeding ground	Potential nursery or breeding ground for horseshoe crabs
Age	Not known
Abundance/ Richness of wildlife	Twenty-two intertidal mudflat faunal species and two species of horseshoe crabs present. Number of individuals per unit area generally low (maximum density recorded 433 individuals m^{-2})
Overall Ecological value	Moderate

Notes: Abundance is defined as low =1 individual, medium =2-5, high = 6-20, very high = >20.

7.13 Overall Evaluation

7.13.1 The habitats present within the study area have been ranked according to their overall ecological value (*Table 7.13*). The intertidal mudflat (including the mangrove and seagrass habitat) is considered to be the most valuable habitat present. The streams and riparian habitats with high base flow were also ecologically valuable habitats, whereas developed areas, agricultural land and wasteland were of lowest ecological value.

Table 7.13 Summary of the Ecological Value of Habitats within the Study Area (ascending order of importance)

Habitat	Ecological Value
Mangrove and Seagrass	High
Streams and Riparian (high base flow)	High
Secondary woodland	High
Tall Shrubland	Moderate-High
Shrubland-Grassland Mosaic	Moderate
Marine Soft-Substrate Interidal Mudflat	Moderate
Plantation woodland	Moderate-Low
Stream and Riparian (low base flows)	Moderate-Low
Marine Hard Substrate Intertidal and Subtidal	Moderate-Low
Marine Soft-bottom Benthic	Moderate-Low
Developed Area	Low
Cultivated Field / Orchard	Low
Wasteland	Low

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Appendix A

Indicative Ecological Baseline Survey Programme

Agreement No MW 01/2003
Hong Kong- Zhuhai - Macao Bridge: Hong Kong Section and the North Lantau Highway Connection
Ecological Baseline Survey

ID	Task Name	2003 Aug – 2004 Aug
1	Instruction to Proceed	11 Sep
2		
3	Issue Preliminary Survey Methodology to AFCD	11 Sep
4	AFCD comments	
5	Respond to comments	
6		
7	**HKS and NLHC Study Area Including Tung Chung Bay & Sham Wat Bay - Habitat Mapping/Vegetation Survey**	
8	Habitat mapping, mangroves and seagrass - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep; 02 Nov
9	Habitat mapping, mangroves and seagrass - Tung Chung Bay & Sham Wat Bay only	16 Oct; 28 Oct
10	Mangroves and Seagrass (2nd survey)	02 Nov; 04 Nov
11	Mangroves and Seagrass (3rd Survey)	29 Nov; 2 Dec; 26 Jan
12	Mangroves and Seagrass (4th Survey) - extra 3 month survey period.	22 Mar
13	Mangroves and Seagrass (5th Survey) - extra 3 month survey period.	07 May
14		
15	**Long Term NLHC Study Area Including Tai Ho Wan - Habitat Mapping/Vegetation Survey**	
16	Habitat mapping, mangroves and seagrass - Long Term NLHC excluding Tai Ho Wan	26 Oct; 28 Oct
17	Habitat mapping, mangroves and seagrass - Tai Ho Wan only	04 Nov
18	Mangroves and Seagrass (2nd survey)	30 Nov
19	Mangroves and Seagrass (3rd Survey)	28 Jan
20	Mangroves and Seagrass (4th Survey) - extra 3 month survey period.	25 Mar; 26 Mar
21	Mangroves and Seagrass (5th Survey) - extra 3 month survey period.	06 May
22		
23	**NLHC Inland San Shek Wan Tunnel Option Study Area - Habitat Mapping/Vegetation Survey**	28 Oct; 15 Nov
24		
25	**HKS and NLHC Study Area Including Tung Chung Bay & Sham Wat Bay - Avifauna**	
26	1st Avifauna Survey (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	24 Sep
27	2nd Avifauna Survey (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	20 Oct
28	3rd Avifauna Survey (Day) - Tung Chung Bay & Sham Wat Bay only	21 Oct
29	4th Avifauna Survey (Day)	28 Nov
30	5th Avifauna Survey (Day)	19 Dec
31	6th Avifauna Survey (Day)	26 Jan

Figure 2: Indicative Ecological Survey Programme - 6 Month Surveys plus Further 3 Month Surveys

Agreement No MW 01/2003

Hong Kong- Zhuhai - Macao Bridge: Hong Kong Section and the North Lantau Highway Connection

Ecological Baseline Survey

ID	Task Name	2004 (Aug – Aug)
32	7th Avifauna Survey (Day)	18 Feb
33	1st Additional Nighttime Survey	23 Oct
34	2nd Additional Nighttime Survey	17 Feb
35	8th Avifauna Survey (Day) - extra 3 month survey period.	17 Mar
36	9th Avifauna Survey (Day) - extra 3 month survey period.	15 Apr
37	10th Avifauna Survey (Day) - extra 3 month survey period.	12 May
38	3rd Additional Nighttime Survey - extra 3 month survey period.	19 Apr
39		
40	**Long Term NLHC Study Area Including Tai Ho Wan - Avifauna**	
41	1st Avifauna Survey (Day) - Long Term NLHC excluding Tai Ho Wan	30 Sep
42	2nd Avifauna Survey (Day) - Long Term NLHC excluding Tai Ho Wan	29 Oct
43	3rd Avifauna Survey (Day) - Tai Ho Wan only	24 Oct
44	4th Avifauna Survey (Day)	19 Nov
45	5th Avifauna Survey (Day)	22 Dec
46	6th Avifauna Survey (Day)	27 Jan
47	7th Avifauna Survey (Day)	23 Feb
48	1st Additional Nighttime Survey	28 Oct
49	2nd Additional Nighttime Survey - Tai Ho Wan only	05 Nov
50	3rd Additional Nighttime Survey	27 Nov; 19 Feb
51	8th Avifauna Survey (Day) - extra 3 month survey period.	31 Mar
52	9th Avifauna Survey (Day) - extra 3 month survey period.	30 Apr
53	10th Avifauna Survey (Day) - extra 3 month survey period.	11 May
54	4th Additional Nighttime Survey - extra 3 month survey period.	27 Apr
55		
56	**NLHC Inland San Shek Wan Tunnel Option Study Area - Avifauna**	
57	Dry Season (Day/Night)	30 Oct; 05 Nov
58	Wet Season (Day/Night)	27 May
59		
60	**HKS and NLHC Study Area Including Tung Chung Bay & Sham Wat Bay - Mammals**	
61	1st Wet Season (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	20 Sep
62	2nd Wet Season (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep

Agreement No MW 01/2003

Hong Kong- Zhuhai - Macao Bridge: Hong Kong Section and the North Lantau Highway Connection

Ecological Baseline Survey

ID	Task Name	2004 (Aug – Aug)
63	3rd Wet Season (Night) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	22 Sep
64	4th Wet Season (Night) -HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep
65	5th Wet Season Survey (Day) - Tung Chung Bay & Sham Wat Bay only	24 Oct
66	6th Wet Season Survey (Day) - Tung Chung Bay & Sham Wat Bay only	27 Oct
67	7th Wet Season Survey (Night) - Tung Chung Bay & Sham Wat Bay only	23 Oct
68	8th Wet Season Survey (Night) - Tung Chung Bay & Sham Wat Bay only	27 Oct
69	1st Dry Season (Day)	25 Nov
70	2nd Dry Season (Night)	10 Dec
71	3rd Dry Season (Day)	22 Jan
72	4th Dry Season (Night)	17 Feb
73	5th Dry Season (Day) - extra 3 month survey period.	16 Mar
74	6th Dry Season (Night) - extra 3 month survey period.	20 Apr
75	9th Wet Season (Day) - extra 3 month survey period.	12 May
76	10th Wet Season (Night) - extra 3 month survey period.	18 May
77		
78	**Long Term NLHC Study Area Including Tai Ho Wan - Mammals**	
79	1st Wet Season (Day) - Long Term NLHC excluding Tai Ho Wan	02 Oct
80	2nd Wet Season (Day) - Long Term NLHC excluding Tai Ho Wan	08 Oct
81	3rd Wet Season (Night) - Long Term NLHC excluding Tai Ho Wan	05 Oct
82	4th Wet Season (Night) - Long Term NLHC excluding Tai Ho Wan	08 Oct
83	5th Wet Season Survey (Day) - Tai Ho Wan only	28 Oct
84	1st Dry Season (Day)	26 Nov
85	2nd Dry Season (Night)	15 Dec
86	3rd Dry Season (Day)	27 Jan
87	4th Dry Season (Night)	19 Feb
88	5th Dry Season (Day) - extra 3 month survey period.	17 Mar
89	6th Dry Season (Night) - extra 3 month survey period.	27 Apr
90	6th Wet Season (Day) - extra 3 month survey period.	9 May
91	7th Wet Season (Night) - extra 3 month survey period.	9 May
92		

Indicative Ecological Survey Programme - 6 Month Surveys plus Further 3 Month Surveys

ID	Task Name	2004 (Aug – Aug)
93	NLHC Inland San Shek Wan Tunnel Option Study Area - Mammals	
94	Dry Season (Day/Night)	05 Nov
95	Wet Season (Day/Night)	18 May
96		
97	HKS and NLHC Study Area Including Tung Chung Bay & Sham Wat Bay - Freshwater Fish	
98	1st Wet Season Survey - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep
99	2nd Wet Season Survey - Tung Chung Bay and Sham Wat Bay only	22 Oct
100	1st Dry Season Survey	15 Dec
101	2nd Dry Season Survey	17 Feb
102	3rd Dry Season Survey - extra 3 month survey period.	12 Apr
103	3rd Wet Season survey - extra 3 month survey period.	12 May
104		
105	Long Term NLHC Study Area Including Tai Ho Wan - Freshwater Fish	
106	1st Wet Season Survey - Long Term NLHC excluding Tai Ho Wan	25 Sep – 27 Sep
107	2nd Wet Season Survey - Tai Ho Wan only	22 Oct – 23 Oct
108	1st Dry Season Survey	15 Dec – 16 Dec
109	2nd Dry Season Survey	17 Feb – 18 Feb
110	3rd Dry Season Survey - extra 3 month survey period.	13 Apr
111	3rd Wet Season survey - extra 3 month survey period.	12 May
112		
113	NLHC Inland San Shek Wan Tunnel Option Study Area - Freshwater Fish	
114		
115	HKS and NLHC Study Area Including Tung Chung Bay & Sham Wat Bay - Herpetofauna	
116	1st Wet Season (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	20 Sep
117	2nd Wet Season (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep
118	3rd Wet Season (Night) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	22 Sep
119	4th Wet Season (Night) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep
120	5th Wet Season Survey (Day) - Tung Chung Bay & Sham Wat Bay only	24 Oct
121	6th Wet Season Survey (Day) - Tung Chung Bay & Sham Wat Bay only	27 Oct
122	7th Wet Season Survey (Night) - Tung Chung Bay & Sham Wat Bay only	23 Oct
123	8th Wet Season Survey (Night) - Tung Chung Bay & Sham Wat Bay only	27 Oct

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Timeline: 2003–2004 (Aug, Sep, Oct, Nov, Dec, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug)

ID	Task Name	Milestone
124	1st Dry Season (Day)	25 Nov
125	2nd Dry Season (Night)	10 Dec
126	3rd Dry Season (Day)	22 Jan
127	4th Dry Season (Night)	17 Feb
128	5th Dry Season (Day) - extra 3 month survey period.	16 Mar
129	6th Dry Season (Night) - extra 3 month survey period.	20 Apr
130	9th Wet Season (Day) - extra 3 month survey period.	12 May
131	10th Wet Season (Night) - extra 3 month survey period.	18 May
132		
133	**Long Term NLHC Study Area including Tai Ho Wan - Herpetofauna**	
134	1st Wet Season (Day) - Long Term NLHC excluding Tai Ho Wan	02 Oct
135	2nd Wet Season (Day) - Long Term NLHC excluding Tai Ho Wan	08 Oct
136	3rd Wet Season (Night) - Long Term NLHC excluding Tai Ho Wan	05 Oct
137	4th Wet Season (Night) - Long Term NLHC excluding Tai Ho Wan	08 Oct
138	5th Wet Season Survey (Day) - Tai Ho Wan only	28 Oct
139	1st Dry Season (Day)	26 Nov
140	2nd Dry Season (Night)	15 Dec
141	3rd Dry Season (Day)	27 Jan
142	4th Dry Season (Night)	19 Feb
143	5th Dry Season (Day) - extra 3 month survey period.	17 Mar
144	6th Dry Season (Night) - extra 3 month survey period.	27 Apr
145	6th Wet Season (Day) - extra 3 month survey period.	9 May
146	7th Wet Season (Night) - extra 3 month survey period.	9 May
147		
148	**NLHC Inland San Shek Wan Tunnel Option Study Area - Herpetofauna**	
149	Dry Season (Day/Night)	05 Nov
150	Wet Season (Day/Night)	18 May
151		
152	**HKS and NLHC Study Area including Tung Chung Bay & Sham Wat Bay - Insects**	
153	1st Wet Season (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	20 Sep
154	2nd Wet Season (Day) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep

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ID	Task Name	2004 (Aug – Aug)
155	3rd Wet Season (Night) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	20 Sep
156	4th Wet Season (Night) - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep
157	5th Wet Season Survey (Day) - Tung Chung Bay & Sham Wat Bay only	24 Oct
158	6th Wet Season Survey (Day) - Tung Chung Bay & Sham Wat Bay only	27 Oct
159	7th Wet Season Survey (Night) - Tung Chung Bay & Sham Wat Bay only	23 Oct
160	8th Wet Season Survey (Night) - Tung Chung Bay & Sham Wat Bay only	27 Oct
161	1st Dry Season (Day)	25 Nov
162	2nd Dry Season (Night)	10 Dec
163	3rd Dry Season (Day)	22 Jan
164	4th Dry Season (Night)	17 Feb
165	5th Dry Season (Day) - extra 3 month survey period.)	16 Mar
166	6th Dry Season (Night) - extra 3 month survey period.	20 Apr
167	9th Wet Season (Day) - extra 3 month survey period.	12 May
168	10th Wet Season (Night) - extra 3 month survey period.	18 May
169		
170	**Long Term NLHC Study Area Including Tai Ho Wan - Insects**	
171	1st Wet Season (Day) - Long Term NLHC excluding Tai Ho Wan	20 Sep
172	2nd Wet Season (Day) - Long Term NLHC excluding Tai Ho Wan	25 Sep
173	3rd Wet Season (Night) - Long Term NLHC excluding Tai Ho Wan	02 Oct
174	4th Wet Season (Night) - Long Term NLHC excluding Tai Ho Wan	08 Oct
175	5th Wet Season Survey (Day) - Tai Ho Wan only	28 Oct
176	1st Dry Season (Day)	26 Nov
177	2nd Dry Season (Night)	15 Dec
178	3rd Dry Season (Day)	27 Jan
179	4th Dry Season (Night)	19 Feb
180	5th Dry Season (Day) - extra 3 month survey period.	17 Mar
181	6th Dry Season (Night) - extra 3 month survey period.	27 Apr
182	6th Wet Season (Day) - extra 3 month survey period.	9 May
183	7th Wet Season (Night) - extra 3 month survey period.	9 May
184		

Figure 2: Indicative Ecological Survey Programme - 6 Month Surveys plus Further 3 Month Surveys

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ID	Task Name	2004 (Aug – Aug)
185	**NLHC Inland San Shek Wan Tunnel Option Study Area - Insects**	
186	Dry Season (Day/Night)	05 Nov
187	Wet Season (Day/Night)	13 May
188		
189	**HKS and NLHC Study Area including Tung Chung Bay & Sham Wat Bay - Stream and Intertidal Macroinvertebrates**	
190	1st Wet Season Survey	18 Sep
191	2nd Wet Season Survey	25 Sep
192	Dry Season Survey	15 Jan 16 Jan
193		
194	**Long Term NLHC Study Area including Tai Ho Wan - Stream and Intertidal Macroinvertebrates**	
195	Wet Season Survey	26 Sep
196	Dry Season Survey	07 Jan
197		
198	**NLHC Inland San Shek Wan Tunnel Option Study Area - Stream Macroinvertebrates**	16 Jan
199		
200	**HKS and NLHC Study Area including Tung Chung Bay & Sham Wat Bay - Intertidal Surveys**	
201	1st Wet Season Survey - HKS/NLHC excluding Tung Chung/Sham Wat Bay	18 Sep
202	2nd Wet Season Survey - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep
203	3rd Wet Season Survey - Tung Chung Bay and Sham Wat Bay only	21 Oct
204	4th Wet Season Survey - Tung Chung Bay and Sham Wat Bay only	22 Oct
205	1st Dry Season Survey - Original Study Area, Tung Chung Bay, Sham Wat Bay	18 Nov
206	2nd Dry Season Survey - Original Study Area, Tung Chung Bay, Sham Wat Bay	15 Jan 16 Jan
207		
208	**Long Term NLHC Study Area including Tai Ho Wan - Intertidal Surveys**	
209	1st Wet Season Survey - Long Term NLHC excluding Tai Ho Wan	26 Sep
210	2nd Wet Season Survey - Tai Ho Wan only	21 Oct
211	1st Dry Season Survey	19 Nov
212	2nd Dry Season Survey	07 Jan
213		
214	**HKS and NLHC Study Area including Tung Chung Bay & Sham Wat Bay - Horseshoe Crabs**	
215	1st Wet Season Survey - HKS/NLHC excluding Tung Chung/Sham Wat Bay	18 Sep

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ID	Task Name	2004: Aug – Sep – Oct – Nov – Dec – Jan – Feb – Mar – Apr – May – Jun – Jul – Aug
216	2nd Wet Season Survey - HKS/NLHC excluding Tung Chung/Sham Wat Bay	25 Sep – 26 Sep
217	3rd Wet Season Survey - HKS/NLHC including Tung Chung Bay	21 Oct
218	4th Wet Season Survey - Tung Chung Bay and Sham Wat Bay only	21 Oct – 22 Oct
219	1st Dry Season Survey	19 Nov
220	2nd Dry Season Survey	15 Jan – 16 Jan
221	3rd Dry Season Survey - extra 3 month survey period.	11 Mar
222	5th Wet Season Survey - extra 3 month survey period. (Sham Wat Bay Only)	23 Apr
223	6th Wet Season Survey - extra 3 month survey period. (Tung Chung Bay Only)	05 May
224		
225	**Long Term NLHC Study Area including Tai Ho Wan - Horseshoe Crabs**	
226	1st Wet Season Survey - Long Term NLHC excluding Tai Ho Wan	25 Sep
227	2nd Wet Season Survey - Tai Ho Wan only	21 Oct
228	1st Dry Season Survey	18 Nov
229	2nd Dry Season Survey	07 Jan
230	3rd Dry Season Survey - extra 3 month survey period.	23 Mar
231	2nd Wet Season Survey - extra 3 month survey period.	06 May
232		
233	**HKS, NLHC & Long Term NLHC Study Areas - Benthic Survey**	
234	Wet Season Survey	02 Oct
235	Sample Analysis	
236	Dry Season Survey	07 Jan
237	Sample Analysis	
238		
239	**HKS, NLHC & Long Term NLHC Study Areas - Coral Survey**	15 Oct

Indicative Ecological Survey Programme - 6 Month Surveys plus Further 3 Month Surveys

Appendix B

List of Recorded Freshwater and Estuarine Fish Species

Freshwater Fish

Date of survey: 25 and 27 September 2003

Fish Species \ Location			Sham Wat							San Shek Wan								Sha Lo Wan										Hau Hok Wan						San Tau										Tung Chung									North Lantau Highway								Pak Mong					Tai Ho							
No.	Species Name	Frequency	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SS1	SS2	SS3	SS4	SS5	SS6	SS9	SS10	SL1	SL2	SL3	SL4	SL5	SL6	SL7	SL8	SL9	SL10	HH1	HH2	HH3	HH5	HH6	HH7	ST1	ST4	ST5	ST6	ST7	ST8	ST9	ST12	ST13	ST14	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	NLH1	NLH2	NLH3	NLH4	NLH5	NLH6	NLH7	NLH8	PM1	PM3	PM4	PM6	PM7	TH1	TH3	TH4	TH5	TH6	TH7	TH8	TH9
1	*Anguilla japonica* (Temminck & Schlegel, 1846)	2	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
2	*Anguilla marmorata* (Quoy & Gaimard, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
3	*Pisodonophis boro* (Hamilton, 1822)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
4	*Pisodonophis cancrivorus* (Richardson, 1848)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
5	*Liniparhomaloptera disparis disparis* (Lin, 1934)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
6	*Pseudogastromyzon myersi* (Herre, 1932)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
7	*Oreonectes platycephalus* (Günther, 1868)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
8	*Misgurnus anguillicaudatus* (Cantor, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
9	*Schistura fasciolata* (Nichols & Pope, 1927)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
10	*Parazacco spilurus* (Günther, 1868)	5		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
11	*Nicholsicypris normalis* (Nichols & Pope, 1927)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
12	*Capoeta semifasciolata* (Günther, 1868)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
13	*Acrossocheilus beijiangensis* (Wu & Lin, 1977)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
14	*Cirrhinus molitorella* (Valenciennes, 1844)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
15	*Silurus cochinchinensis* (Valenciennes, 1840)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
16	*Clarias fuscus* (Lacepède, 1803)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
17	*Plotosus anguillaris* (Bloch, 1794)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
18	*Gambusia affinis affinis* (Baird & Girard, 1853)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
19	*Xiphophorus hellerii* (Heckel, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
20	*Xiphophorus variatus* (Meek, 1904)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
21	*Orizias curvinotus* (Nichols & Pope, 1927)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
22	*Tylosurus strongylurus* (van Hasselt, 1823)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
23	*Rhynchorhamphus georgii* (Valenciennes, 1847)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
24	*Monopterus albus* (Zuiew, 1793)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
25	*Mugil cephalus* (Linneaus, 1758)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
26	*Chelon subviridis* (Valenciennes, 1836)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
27	*Ambassys gymnocephalus* (Lacepède, 1802)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
28	*Lates calcarifer* (Bloch, 1790)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
29	*Lateolabrax japonicus* (Temminck & Schlegel, 1843)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
30	*Sillago japonica* (Temminck & Schlegel, 1843)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
31	*Sillago sihama* (Forsskål, 1775)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
32	*Gerres poeti* (Cuvier, 1829)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
33	*Gerres filamentosus* (Cuvier, 1829)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
34	*Lutjanus argentimaculatus* (Forsskål, 1775)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
35	*Lutjanus russellii* (Bleeker, 1849)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
36	*Acanthopagrus berda* (Forsskål, 1775)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
37	*Acanthopagrus latus* (Houttuyn, 1782)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
38	*Terapon jarbua* (Forsskål, 1775)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
39	*Scatophagus argus* (Linnaeus, 1766)	3	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
40	*Oreochromis mossambicus* (Peters, 1852)	3		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
41	*Butis butis* (Hamilton, 1822)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
42	*Butis koilomatodon* (Bleeker, 1849)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
43	*Eleotris oxycephala* (Temminck & Schlegel, 1845)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
44	*Eleotris acanthopoma acanthopoma* (Bleeker, 1853)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
45	*Eleotris melanosoma* (Bleeker, 1852)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
46	*Luciogobius guttatus* (Gill, 1859)	2	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
47	*Tridentiger bifasciatus* (Steindachner, 1881)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
48	*Tridentiger trigonocephalus* (Gill, 1859)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
49	*Mugilogobius abei* (Jordan & Snyder, 1901)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
50	*Mugilogobius chulae* (Smith, 1932)	3	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
51	*Mugilogobius obliquifasciatus* (Wu & Ni, 1985)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
52	*Pseudogobius javanicus* (Bleeker, 1856)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
53	*Bathygobius meggetti* (Hora & Mukerji, 1936)	4	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
54	*Rhinogobius duospilus* (Herre, 1935)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
55	*Rhinogobius giurinus* (Rutter, 1897)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
56	*Acentrogobius caninus* (Valenciennes, 1837)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
57	*Acentrogobius viridipunctatus* (Valenciennes, 1837)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
58	*Glossogobius giuris* (Hamilton, 1822)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
59	*Glossogobius olivaceus* (Temminck & Schlegel, 1845)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
60	*Siganus fuscescens* (Houttuyn, 1782)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
61	*Macropodus opercularis* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
62	*Channa asiatica* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
63	*Paralichthys olivaceus* (Temminck & Schlegel, 1846)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
64	*Takifugu obscurus* (Abe, 1949)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
65	*Takifugu ocellatus* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
66	*Takifugu niphobles* (Jordan & Snyder, 1901)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w

n/w no permanent water

Freshwater Fish

Date of survey: 22 and 23 October 2003

Fish Species / Location			Sham Wat							San Shek Wan								Sha Lo Wan									
No.	Species Name	Frequency	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SS1	SS2	SS3	SS4	SS5	SS6	SS9	SS10	SL1	SL2	SL3	SL4	SL5	SL6	SL7	SL8	SL9	SL10
1	*Anguilla japonica* (Temminck & Schlegel, 1846)	6	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
2	*Anguilla marmorata* (Quoy & Gaimard, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
3	*Pisodonophis boro* (Hamilton, 1822)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
4	*Pisodonophis cancrivorus* (Richardson, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
5	*Liniparhomaloptera disparis disparis* (Lin, 1934)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
6	*Pseudogastromyzon myersi* (Herre, 1932)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
7	*Oreonectes platycephalus* (Günther, 1868)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
8	*Misgurnus anguillicaudatus* (Cantor, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
9	*Schistura fasciolata* (Nichols & Pope, 1927)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
10	*Parazacco spilurus* (Günther, 1868)	6		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
11	*Nicholsicypris normalis* (Nichols & Pope, 1927)	1	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
12	*Capoeta semifasciolata* (Günther, 1868)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
13	*Acrossocheilus beijiangensis* (Wu & Lin, 1977)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
14	*Cirrhinus molitorella* (Valenciennes, 1844)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
15	*Silurus cochinchinensis* (Valenciennes, 1840)	4	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
16	*Clarias fuscus* (Lacepède, 1803)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
17	*Plotosus anguillaris* (Bloch, 1794)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
18	*Gambusia affinis affinis* (Baird & Girard, 1853)	5		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
19	*Xiphophorus helleri* (Heckel, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
20	*Xiphophorus variatus* (Meek, 1904)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
21	*Orizias curvinotus* (Nichols & Pope, 1927)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
22	*Tylosurus strongylurus* (van Hasselt, 1823)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
23	*Rhynchorhamphus georgii* (Valenciennes, 1847)	3		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
24	*Momopterus albus* (Zuiew, 1793)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
25	*Mugil cephalus* (Linneaus, 1758)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
26	*Chelon subviridis* (Valenciennes, 1836)	5		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
27	*Ambassys gymnocephalus* (Lacepède, 1802)	5	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
28	*Lates calcarifer* (Bloch, 1790)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
29	*Lateolabrax japonicus* (Temminck & Schlegel, 1843)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
30	*Sillago japonica* (Temminck & Schlegel, 1843)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
31	*Sillago shihama* (Forsskål, 1775)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
32	*Gerres poeti* (Cuvier, 1829)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
33	*Gerres filamentosus* (Cuvier, 1829)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
34	*Lutjanus argentimaculatus* (Forsskål, 1775)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
35	*Lutjanus russellii* (Bleeker, 1849)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
36	*Acanthopagrus berda* (Forsskål, 1775)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
37	*Acanthopagrus latus* (Houttuyn, 1782)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
38	*Terapon jarbua* (Forsskål, 1775)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
39	*Scatophagus argus* (Linnaeus, 1766)	2	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
40	*Oreochromis mossambicus* (Peters, 1852)	5		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
41	*Butis butis* (Hamilton, 1822)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
42	*Butis koilomatodon* (Bleeker, 1849)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
43	*Eleotris oxycephala* (Temminck & Schlegel, 1845)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
44	*Eleotris acantopoma acanthopoma* (Bleeker, 1853)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
45	*Eleotris melanosoma* (Bleeker, 1852)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
46	*Luciogobius guttatus* (Gill, 1859)	7	+	n/w	n/w	n/w	n/w	n/w		+				n/w	+	n/w	n/w			+					n/w		
47	*Tridentiger bifasciatus* (Steindachner, 1881)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
48	*Tridentiger trigonocephalus* (Gill, 1859)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
49	*Mugilogobius abei* (Jordan & Snyder, 1901)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w	+	n/w	n/w			+					n/w		
50	*Mugilogobius chulae* (Smith, 1932)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
51	*Mugilogobius obliquifasciatus* (Wu & Ni, 1985)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
52	*Pseudogobius javanicus* (Bleeker, 1856)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
53	*Bathygobius meggetti* (Hora & Mukerji, 1936)	12	+	n/w	n/w	n/w	n/w	n/w	+	+		+	+	n/w	+	n/w	n/w			+					n/w		
54	*Rhinogobius duospilus* (Herre, 1935)	9		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
55	*Rhinogobius giurinus* (Rutter, 1897)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
56	*Acentrogobius caninus* (Valenciennes, 1837)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
57	*Acentrogobius viridipunctatus* (Valenciennes, 1837)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
58	*Glossogobius giuris* (Hamilton, 1822)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
59	*Glossogobius olivaceus* (Temminck & Schlegel, 1845)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
60	*Siganus fuscescens* (Houttuyn, 1782)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
61	*Macropodus opercularis* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
62	*Channa asiatica* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
63	*Paralichthys olivaceus* (Temminck & Schlegel, 1846)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
64	*Takifugu obscurus* (Abe, 1949)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
65	*Takifugu ocellatus* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
66	*Takifugu niphobles* (Jordan & Snyder, 1901)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		

	Hau Hok Wan						San Tau														Tung Chung								
No.	HH1	HH2	HH3	HH5	HH6	HH7	ST1	ST4	ST5	ST6	ST7	ST8	ST9	ST12	ST13	ST14	ST16	ST18	ST19	ST20	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9
1	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
2	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
3	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
4	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
5	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
6	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
7	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
8	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
9	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
10	n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
11	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
12	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
13	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
14	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
15	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
16	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
17	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
18	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+	+	+	n/w	n/w	n/w	n/w	n/w	n/w
19	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
20	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
21	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
22	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
23	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
24	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
25	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
26	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
27	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
28	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
29	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
30	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
31	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
32	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
33	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
34	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
35	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
36	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
37	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
38	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
39	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
40	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w					+	+	+	n/w	n/w	n/w	n/w	n/w	n/w
41	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
42	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
43	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
44	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
45	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
46	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
47	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
48	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
49	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
50	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
51	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
52	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
53	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
54	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
55	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
56	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
57	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
58	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w					+			n/w	n/w	n/w	n/w	n/w	n/w
59	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
60	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
61	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
62	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
63	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
64	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
65	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w
66	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w								n/w	n/w	n/w	n/w	n/w	n/w

	North Lantau Highway								Pak Mong					Tai Ho							
No.	NLH1	NLH2	NLH3	NLH4	NLH5	NLH6	NLH7	NLH8	PM1	PM3	PM4	PM6	PM7	TH1	TH3	TH4	TH5	TH6	TH7	TH8	TH9
1	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
2	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
3	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
4	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
5	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
6	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
7	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
8	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
9	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
10	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
11	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
12	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
13	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
14	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
15	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
16	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
17	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
18	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
19	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
20	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
21	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
22	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
23	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
24	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
25	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
26	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
27	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
28	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
29	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
30	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
31	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
32	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
33	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
34	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
35	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
36	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
37	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
38	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
39	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
40	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
41	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
42	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
43	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
44	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
45	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
46	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
47	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
48	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
49	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
50	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
51	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
52	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
53	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
54	n/w	n/w	n/w	+	+	+	+	+	+		n/w	n/w	n/w	+	n/w	n/w	+	n/w	n/w	n/w	n/w
55	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
56	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
57	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
58	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
59	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
60	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
61	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
62	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
63	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
64	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
65	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
66	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w

n/w no permanent water

Freshwater Fish

Date of survey: 15 and 16 December 2003

Fish Species / Location — Sham Wat, San Shek Wan, Sha Lo Wan

No.	Species Name	Frequency	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SS1	SS2	SS3	SS4	SS5	SS6	SS9	SS10	SL1	SL2	SL3	SL4	SL5	SL6	SL7	SL8	SL9	SL10
1	*Anguilla japonica* (Temminck & Schlegel, 1846)	7	+	n/w	n/w	n/w	n/w	n/w					+	n/w		n/w	n/w			+					n/w		
2	*Anguilla marmorata* (Quoy & Gaimard, 1842)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
3	*Pisodonophis boro* (Hamilton, 1822)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
4	*Pisodonophis cancrivorus* (Richardson, 1848)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
5	*Liniparhomaloptera disparis disparis* (Lin, 1934)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
6	*Pseudogastromyzon myersi* (Herre, 1932)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
7	*Oreonectes platycephalus* (Günther, 1868)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
8	*Misgurnus anguillicaudatus* (Cantor, 1842)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
9	*Schistura fasciolata* (Nichols & Pope, 1927)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
10	*Parazacco spilurus* (Günther, 1868)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
11	*Nicholsicypris normalis* (Nichols & Pope, 1927)	2	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
12	*Capoeta semifasciolata* (Günther, 1868)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
13	*Acrossocheilus beijiangensis* (Wu & Lin, 1977)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
14	*Cirrhinus molitorella* (Valenciennes, 1844)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
15	*Silurus cochinchinensis* (Valenciennes, 1840)	4	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
16	*Clarias fuscus* (Lacepède, 1803)	4	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
17	*Plotosus anguillaris* (Bloch, 1794)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
18	*Gambusia affinis affinis* (Baird & Girard, 1853)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
19	*Xiphophorus helleri* (Heckel, 1848)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
20	*Xiphophorus variatus* (Meek, 1904)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
21	*Orizias curvinotus* (Nichols & Pope, 1927)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
22	*Tylosurus strongylurus* (van Hasselt, 1823)	2		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
23	*Rhynchorhamphus georgii* (Valenciennes, 1847)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
24	*Monopterus albus* (Zuiew, 1793)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
25	*Mugil cephalus* (Linneaus, 1758)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
26	*Chelon subviridis* (Valenciennes, 1836)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
27	*Ambassys gymnocephalus* (Lacepède, 1802)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
28	*Lates calcarifer* (Bloch, 1790)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
29	*Lateolabrax japonicus* (Temminck & Schlegel, 1843)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
30	*Sillago japonica* (Temminck & Schlegel, 1843)	3	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
31	*Sillago shihama* (Forsskål, 1775)	3	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
32	*Gerres poeti* (Cuvier, 1829)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
33	*Gerres filamentosus* (Cuvier, 1829)	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
34	*Lutjanus argentimaculatus* (Forsskål, 1775)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
35	*Lutjanus russelli* (Bleeker, 1849)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
36	*Acanthopagrus berda* (Forsskål, 1775)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
37	*Acanthopagrus latus* (Houttuyn, 1782)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
38	*Terapon jarbua* (Forsskål, 1775)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
39	*Scatophagus argus* (Linnaeus, 1766)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
40	*Oreochromis mossambicus* (Peters, 1852)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
41	*Butis butis* (Hamilton, 1822)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
42	*Butis koilomatodon* (Bleeker, 1849)	3	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
43	*Eleotris oxycephala* (Temminck & Schlegel, 1845)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
44	*Eleotris acantopoma acanthopoma* (Bleeker, 1853)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
45	*Eleotris melanosoma* (Bleeker, 1852)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		
46	*Luciogobius guttatus* (Gill, 1859)	13	+	n/w	n/w	n/w	n/w	n/w	+	+		+	+	n/w	+	n/w	n/w			+					n/w		
47	*Tridentiger bifasciatus* (Steindachner, 1881)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
48	*Tridentiger trigonocephalus* (Gill, 1859)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
49	*Mugilogobius abei* (Jordan & Snyder, 1901)	12	+	n/w	n/w	n/w	n/w	n/w	+			+	+	n/w	+	n/w	n/w			+					n/w		
50	*Mugilogobius chulae* (Smith, 1932)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
51	*Mugilogobius obliquifasciatus* (Wu & Ni, 1985)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
52	*Pseudogobius javanicus* (Bleeker, 1856)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
53	*Bathygobius meggetti* (Hora & Mukerji, 1936)	10	+	n/w	n/w	n/w	n/w	n/w	+	+		+	+	n/w	+	n/w	n/w			+					n/w		
54	*Rhinogobius duospilus* (Herre, 1935)	16		n/w	n/w	n/w	n/w	n/w	+		+	+	+	n/w	+	n/w	n/w			+					n/w		
55	*Rhinogobius giurinus* (Rutter, 1897)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
56	*Acentrogobius caninus* (Valenciennes, 1837)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
57	*Acentrogobius viridipunctatus* (Valenciennes, 1837)	1	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
58	*Glossogobius giuris* (Hamilton, 1822)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
59	*Glossogobius olivaceus* (Temminck & Schlegel, 1845)	8	+	n/w	n/w	n/w	n/w	n/w	+	+				n/w		n/w	n/w			+					n/w		
60	*Siganus fuscescens* (Houttuyn, 1782)	3	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w		
61	*Macropodus opercularis* (Linnaeus, 1758)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w		
62	*Channa asiatica* (Linnaeus, 1758)	1		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
63	*Paralichthys olivaceus* (Temminck & Schlegel, 1846)	2		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
64	*Takifugu obscurus* (Abe, 1949)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
65	*Takifugu ocellatus* (Linnaeus, 1758)	5		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		
66	*Takifugu niphobles* (Jordan & Snyder, 1901)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w		

Hau Hok Wan, San Tau, Tung Chung

No.	HH1	HH2	HH3	HH5	HH6	HH7	ST1	ST4	ST5	ST6	ST7	ST8	ST9	ST12	ST13	ST14	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9
1	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
2	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
3	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
4	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
5	n/w	n/w	n/w		n/w		n/w			+	+	+	+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
6	n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
7	n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
8	n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
9	n/w	n/w	n/w		n/w		n/w			+	+	+	+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
10	n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
11	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
12	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
13	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
14	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
15	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
16	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+		+	n/w	n/w	n/w	n/w	n/w	n/w
17	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w		+		n/w	n/w	n/w	n/w	n/w	n/w
18	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w
19	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
20	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
21	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
22	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
23	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
24	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
25	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
26	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
27	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
28	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
29	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
30	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
31	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
32	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
33	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
34	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
35	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
36	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
37	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
38	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
39	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
40	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w
41	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
42	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
43	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
44	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
45	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
46	n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
47	n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
48	n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
49	n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
50	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
51	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+		n/w	n/w	n/w	n/w	n/w	n/w
52	n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
53	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
54	n/w	n/w	n/w	+	n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
55	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
56	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
57	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
58	n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
59	n/w	n/w	n/w	+	n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
60	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
61	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
62	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w
63	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
64	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
65	n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w
66	n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w

North Lantau Highway, Pak Mong, Tai Ho

No.	NLH1	NLH2	NLH3	NLH4	NLH5	NLH6	NLH7	NLH8	PM1	PM3	PM4	PM6	PM7	TH1	TH3	TH4	TH5	TH6	TH7	TH8	TH9
1	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
2	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
3	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
4	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
5	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
6	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
7	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
8	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
9	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
10	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
11	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
12	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
13	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
14	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
15	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
16	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
17	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
18	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
19	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
20	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
21	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
22	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
23	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
24	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
25	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
26	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
27	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
28	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
29	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
30	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
31	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
32	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
33	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
34	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
35	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
36	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
37	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
38	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
39	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
40	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
41	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
42	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
43	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
44	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
45	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
46	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
47	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
48	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
49	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
50	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
51	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
52	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
53	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
54	n/w	n/w	n/w	+	+	+	+	+	+	+	n/w	n/w	n/w	+	n/w	n/w	+	n/w	n/w	n/w	n/w
55	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
56	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
57	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
58	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
59	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
60	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
61	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
62	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
63	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
64	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
65	n/w	n/w	n/w							+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
66	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w

n/w no permanent water

Freshwater Fish

Date of survey: 17 and 18 February 2004

Fish Species / Location			Sham Wat							San Shek Wan								Sha Lo Wan										Hau Hok Wan						San Tau										Tung Chung									North Lantau Highway								Pak Mong					Tai Ho							
No.	Species Name	Frequency	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SS1	SS2	SS3	SS4	SS5	SS6	SS9	SS10	SL1	SL2	SL3	SL4	SL5	SL6	SL7	SL8	SL9	SL10	HH1	HH2	HH3	HH5	HH6	HH7	ST1	ST4	ST5	ST6	ST7	ST8	ST9	ST12	ST13	ST14	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	NLH1	NLH2	NLH3	NLH4	NLH5	NLH6	NLH7	NLH8	PM1	PM3	PM4	PM6	PM7	TH1	TH3	TH4	TH5	TH6	TH7	TH8	TH9
1	*Anguilla japonica* (Temminck & Schlegel, 1846)	5	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
2	*Anguilla marmorata* (Quoy & Gaimard, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
3	*Pisodonophis boro* (Hamilton, 1822)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
4	*Pisodonophis cancrivorus* (Richardson, 1848)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
5	*Liniparhomaloptera disparis disparis* (Lin, 1934)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		+	n/w	n/w	n/w		n/w		n/w			n/w	n/w	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
6	*Pseudogastromyzon myersi* (Herre, 1932)	3		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
7	*Oreonectes platycephalus* (Günther, 1868)	2	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
8	*Misgurnus anguillicaudatus* (Cantor, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
9	*Schistura fasciolata* (Nichols & Pope, 1927)	7	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w		+	n/w	n/w	n/w		n/w		n/w			n/w	n/w	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
10	*Parazacco spilurus* (Günther, 1868)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w	+		n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
11	*Nicholsicypris normalis* (Nichols & Pope, 1927)	1	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
12	*Capoeta semifasciolata* (Günther, 1868)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
13	*Acrossocheilus beijiangensis* (Wu & Lin, 1977)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
14	*Cirrhinus molitorella* (Valenciennes, 1844)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
15	*Silurus cochinchinensis* (Valenciennes, 1840)	4	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
16	*Clarias fuscus* (Lacepède, 1803)	2	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
17	*Plotosus anguillaris* (Bloch, 1794)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
18	*Gambusia affinis affinis* (Baird & Girard, 1853)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
19	*Xiphophorus hellerii* (Heckel, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
20	*Xiphophorus variatus* (Meek, 1904)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
21	*Orizias curvinotus* (Nichols & Pope, 1927)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
22	*Tylosurus strongylurus* (van Hasselt, 1823)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
23	*Rhynchorhamphus georgii* (Valenciennes, 1847)	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
24	*Momopterus albus* (Zuiew, 1793)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
25	*Mugil cephalus* (Linneaus, 1758)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
26	*Chelon subviridis* (Valenciennes, 1836)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
27	*Ambassys gymnocephalus* (Lacepède, 1802)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
28	*Lates calcarifer* (Bloch, 1790)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
29	*Lateolabrax japonicus* (Temminck & Schlegel, 1843)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
30	*Sillago japonica* (Temminck & Schlegel, 1843)	2	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
31	*Sillago shihama* (Forsskål, 1775)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
32	*Gerres poeti* (Cuvier, 1829)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
33	*Gerres filamentosus* (Cuvier, 1829)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
34	*Lutjanus argentimaculatus* (Forsskål, 1775)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
35	*Lutjanus russellii* (Bleeker, 1849)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
36	*Acanthopagrus berda* (Forsskål, 1775)	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w		+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
37	*Acanthopagrus latus* (Houttuyn, 1782)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
38	*Terapon jarbua* (Forsskål, 1775)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
39	*Scatophagus argus* (Linnaeus, 1766)	2	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
40	*Oreochromis mossambicus* (Peters, 1852)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
41	*Butis butis* (Hamilton, 1822)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
42	*Butis koilomatodon* (Bleeker, 1849)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
43	*Eleotris oxycephala* (Temminck & Schlegel, 1845)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
44	*Eleotris acantopoma acanthopoma* (Bleeker, 1853)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w		+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
45	*Eleotris melanosoma* (Bleeker, 1852)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
46	*Luciogobius guttatus* (Gill, 1859)	8	+	n/w	n/w	n/w	n/w	n/w		+				n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
47	*Tridentiger bifasciatus* (Steindachner, 1881)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
48	*Tridentiger trigonocephalus* (Gill, 1859)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
49	*Mugilogobius abei* (Jordan & Snyder, 1901)	10	+	n/w	n/w	n/w	n/w	n/w	+					n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
50	*Mugilogobius chulae* (Smith, 1932)	8		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
51	*Mugilogobius obliquifasciatus* (Wu & Ni, 1985)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+	+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
52	*Pseudogobius javanicus* (Bleeker, 1856)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
53	*Bathygobius meggetti* (Hora & Mukerji, 1936)	12	+	n/w	n/w	n/w	n/w	n/w	+	+		+	+	n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
54	*Rhinogobius duospilus* (Herre, 1935)	16		n/w	n/w	n/w	n/w	n/w	+		+	+	+	n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	+	+	+	+	+	+	+	n/w	n/w	n/w	+	n/w	n/w	+	n/w	n/w	n/w	n/w
55	*Rhinogobius giurinus* (Rutter, 1897)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
56	*Acentrogobius caninus* (Valenciennes, 1837)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w		+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
57	*Acentrogobius viridipunctatus* (Valenciennes, 1837)	1	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
58	*Glossogobius giuris* (Hamilton, 1822)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w		+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
59	*Glossogobius olivaceus* (Temminck & Schlegel, 1845)	5	+	n/w	n/w	n/w	n/w	n/w	+	+				n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
60	*Siganus fuscescens* (Houttuyn, 1782)	4	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
61	*Macropodus opercularis* (Linnaeus, 1758)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
62	*Channa asiatica* (Linnaeus, 1758)	2		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
63	*Paralichthys olivaceus* (Temminck & Schlegel, 1846)	2		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
64	*Takifugu obscurus* (Abe, 1949)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
65	*Takifugu ocellatus* (Linnaeus, 1758)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w		+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
66	*Takifugu niphobles* (Jordan & Snyder, 1901)	5		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			n/w	n/w			n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w

n/w No permanent water

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Freshwater Fish

Date of survey: 12 and 13 April 2004

Fish Species / Location			Sham Wat							San Shek Wan								Sha Lo Wan										Hau Hok Wan						San Tau										Tung Chung									North Lantau Highway								Pak Mong					Tai Ho							
No.	Species Name	Frequency	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SS1	SS2	SS3	SS4	SS5	SS6	SS9	SS10	SL1	SL2	SL3	SL4	SL5	SL6	SL7	SL8	SL9	SL10	HH1	HH2	HH3	HH5	HH6	HH7	ST1	ST4	ST5	ST6	ST7	ST8	ST9	ST12	ST13	ST14	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	NLH1	NLH2	NLH3	NLH4	NLH5	NLH6	NLH7	NLH8	PM1	PM3	PM4	PM6	PM7	TH1	TH3	TH4	TH5	TH6	TH7	TH8	TH9
1	*Anguilla japonica* Temminck & Schlegel, 1846	3		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
2	*Anguilla marmorata* Quoy & Gaimard, 1842	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
3	*Pisodonophis boro* (Hamilton, 1822)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
4	*Pisodonophis cancrivorus* (Richardson, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
5	*Liniparhomaloptera disparis disparis* Lin, 1934	6		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+	+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
6	*Pseudogastromyzon myersi* Herre, 1932	5		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
7	*Oreonectes platycephalus* Günther, 1868	5	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
8	*Misgurnus anguillicaudatus* (Cantor, 1842)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
9	*Schistura fasciolata* (Nichols & Pope, 1927)	6	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
10	*Parazacco spilurus* (Günther, 1868)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
11	*Nicholsicypris normalis* (Nichols & Pope, 1927)	1	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
12	*Capoeta semifasciolata* (Günther, 1868)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
13	*Acrossocheilus beijiangensis* Wu & Lin, 1977	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
14	*Cirrhinus molitorella* (Valenciennes, 1844)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
15	*Silurus cochinchinensis* Valenciennes, 1840	3	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
16	*Clarias fuscus* (Lacepède, 1803)	2	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
17	*Plotosus anguillaris* (Bloch, 1794)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
18	*Gambusia affinis affinis* (Baird & Girard, 1853)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
19	*Xiphophorus hellerii* Heckel, 1848	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
20	*Xiphophorus variatus* (Meek, 1904)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
21	*Orizias curvinotus* (Nichols & Pope, 1927)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
22	*Tylosurus strongylurus* (van Hasselt, 1823)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
23	*Rhynchorhamphus georgii* (Valenciennes, 1847)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
24	*Momopterus albus* (Zuiew, 1793)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
25	*Mugil cephalus* Linneaus, 1758	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
26	*Chelon subviridis* (Valenciennes, 1836)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
27	*Ambassys gymnocephalus* (Lacepède, 1802)	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
28	*Lates calcarifer* (Bloch, 1790)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
29	*Lateolabrax japonicus* (Temminck & Schlegel, 1843)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
30	*Sillago japonica* Temminck & Schlegel, 1843	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
31	*Sillago sihama* (Forsskål, 1775)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
32	*Gerres poeti* Cuvier, 1829	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
33	*Gerres filamentosus* Cuvier, 1829	5		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
34	*Lutjanus argentimaculatus* (Forsskål, 1775)	5		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
35	*Lutjanus russellii* (Bleeker, 1849)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
36	*Acanthopagrus berda* (Forsskål, 1775)	3		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w		+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
37	*Acanthopagrus latus* (Houttuyn, 1782)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
38	*Terapon jarbua* (Forsskål, 1775)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
39	*Scatophagus argus* (Linnaeus, 1766)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
40	*Oreochromis mossambicus* (Peters, 1852)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
41	*Butis butis* (Hamilton, 1822)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
42	*Butis koilomatodon* (Bleeker, 1849)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
43	*Eleotris oxycephala* Temminck & Schlegel, 1845	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
44	*Eleotris acantopoma acanthopoma* Bleeker, 1853	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
45	*Eleotris melanosoma* Bleeker, 1852	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
46	*Luciogobius guttatus* Gill, 1859	5		n/w	n/w	n/w	n/w	n/w		+				n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
47	*Tridentiger bifasciatus* Steindachner, 1881	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
48	*Tridentiger trigonocephalus* Gill, 1859	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
49	*Mugilogobius abei* (Jordan & Snyder, 1901)	10	+	n/w	n/w	n/w	n/w	n/w	+					n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
50	*Mugilogobius chulae* (Smith, 1932)	8		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
51	*Mugilogobius obliquifasciatus* Wu & Ni, 1985	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
52	*Pseudogobius javanicus* (Bleeker, 1856)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
53	*Bathygobius meggatti* (Hora & Mukerji, 1936)	11	+	n/w	n/w	n/w	n/w	n/w	+	+			+	n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
54	*Rhinogobius duospilus* (Herre, 1935)	16		n/w	n/w	n/w	n/w	n/w	+		+	+	+	n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	+	+	+	+	+	+	+	n/w	n/w	n/w	+	n/w	n/w	+	n/w	n/w	n/w	n/w
55	*Rhinogobius giurinus* (Rutter, 1897)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
56	*Acentrogobius caninus* (Valenciennes, 1837)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
57	*Acentrogobius viridipunctatus* (Valenciennes, 1837)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
58	*Glossogobius giuris* (Hamilton, 1822)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
59	*Glossogobius olivaceus* (Temminck & Schlegel, 1845)	3	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
60	*Siganus fuscescens* (Houttuyn, 1782)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
61	*Macropodus opercularis* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
62	*Channa asiatica* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
63	*Paralichthys olivaceus* (Temminck & Schlegel, 1846)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
64	*Takifugu obscurus* (Abe, 1949)	5		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
65	*Takifugu ocellatus* (Linnaeus, 1758)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
66	*Takifugu niphobles* (Jordan & Snyder, 1901)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w

n/w No permanent water

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Freshwater Fish

Date of survey: 12 May 2004

Fish Species / Location			Sham Wat							San Shek Wan								Sha Lo Wan										Hau Hok Wan						San Tau										Tung Chung									North Lantau Highway								Pak Mong					Tai Ho							
No.	Species Name	Frequency	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SS1	SS2	SS3	SS4	SS5	SS6	SS9	SS10	SL1	SL2	SL3	SL4	SL5	SL6	SL7	SL8	SL9	SL10	HH1	HH2	HH3	HH5	HH6	HH7	ST1	ST4	ST5	ST6	ST7	ST8	ST9	ST12	ST13	ST14	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	NLH1	NLH2	NLH3	NLH4	NLH5	NLH6	NLH7	NLH8	PM1	PM3	PM4	PM6	PM7	TH1	TH3	TH4	TH5	TH6	TH7	TH8	TH9
1	*Anguilla japonica* (Temminck & Schlegel, 1846)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
2	*Anguilla marmorata* (Quoy & Gaimard, 1842)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
3	*Pisodonophis boro* (Hamilton, 1822)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
4	*Pisodonophis cancrivorus* (Richardson, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
5	*Plecoglossus altivelis altivelis* (Temminck et Schlegel, 1846)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
6	*Liniparhomaloptera disparis disparis* (Lin, 1934)	7		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+	+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
7	*Pseudogastromyzon myersi* (Herre, 1932)	6		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
8	*Oreonectes platycephalus* (Günther, 1868)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
9	*Misgurnus anguillicaudatus* (Cantor, 1842)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
10	*Schistura fasciolata* (Nichols & Pope, 1927)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
11	*Parazacco spilurus* (Günther, 1868)	8		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w			+	+	+		n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
12	*Nicholsicypris normalis* (Nichols & Pope, 1927)	1	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
13	*Capoeta semifasciolata* (Günther, 1868)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
14	*Acrossocheilus beijiangensis* (Wu & Lin, 1977)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
15	*Cirrhinus molitorella* (Valenciennes, 1844)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
16	*Silurus cochinchinensis* (Valenciennes, 1840)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
17	*Clarias fuscus* (Lacepède, 1803)	5		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
18	*Plotosus anguillaris* (Bloch, 1794)	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
19	*Gambusia affinis affinis* (Baird & Girard, 1853)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
20	*Xiphophorus hellerii* (Heckel, 1848)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
21	*Xiphophorus variatus* (Meek, 1904)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
22	*Oryzias curvinotus* (Nichols & Pope, 1927)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
23	*Tylosurus strongylurus* (van Hasselt, 1823)	2		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
24	*Rhynchorhamphus georgii* (Valenciennes, 1847)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
25	*Monopterus albus* (Zuiew, 1793)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
26	*Mugil cephalus* (Linneaus, 1758)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
27	*Chelon subviridis* (Valenciennes, 1836)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
28	*Ambassys gymnocephalus* (Lacepède, 1802)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
29	*Lates calcarifer* (Bloch, 1790)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
30	*Lateolabrax japonicus* (Temminck & Schlegel, 1843)	3		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
31	*Sillago japonica* (Temminck & Schlegel, 1843)	6	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
32	*Sillago shihama* (Forsskål, 1775)	5	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
33	*Gerres poeti* (Cuvier, 1829)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
34	*Gerres filamentosus* (Cuvier, 1829)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
35	*Lutjanus argentimaculatus* (Forsskål, 1775)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
36	*Lutjanus russellii* (Bleeker, 1849)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
37	*Acanthopagrus berda* (Forsskål, 1775)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+	+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
38	*Acanthopagrus latus* (Houttuyn, 1782)	6		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
39	*Terapon jarbua* (Forsskål, 1775)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
40	*Scatophagus argus* (Linnaeus, 1766)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
41	*Oreochromis mossambicus* (Peters, 1852)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+	+	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
42	*Butis butis* (Hamilton, 1822)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
43	*Butis koilomatodon* (Bleeker, 1849)	1		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
44	*Eleotris oxycephala* (Temminck & Schlegel, 1845)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
45	*Eleotris acantopoma acanthopoma* (Bleeker, 1853)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
46	*Eleotris melanosoma* (Bleeker, 1852)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
47	*Luciogobius guttatus* (Gill, 1859)	8	+	n/w	n/w	n/w	n/w	n/w	+	+				n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
48	*Tridentiger bifasciatus* (Steindachner, 1881)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
49	*Tridentiger trigonocephalus* (Gill, 1859)	4		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
50	*Mugilogobius abei* (Jordan & Snyder, 1901)	10	+	n/w	n/w	n/w	n/w	n/w	+					n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
51	*Mugilogobius chulae* (Smith, 1932)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
52	*Mugilogobius obliquifasciatus* (Wu & Ni, 1985)	2		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+	+		n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
53	*Pseudogobius javanicus* (Bleeker, 1856)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
54	*Bathygobius meggetti* (Hora & Mukerji, 1936)	12	+	n/w	n/w	n/w	n/w	n/w	+	+			+	n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
55	*Rhinogobius duospilus* (Herre, 1935)	16		n/w	n/w	n/w	n/w	n/w	+		+	+	+	n/w	+	n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	+	+	+	+	+	+	+	n/w	n/w	n/w	+	n/w	n/w	+	n/w	n/w	n/w	n/w
56	*Rhinogobius giurinus* (Rutter, 1897)	7		n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
57	*Acentrogobius caninus* (Valenciennes, 1837)	6		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
58	*Acentrogobius viridipunctatus* (Valenciennes, 1837)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
59	*Glossogobius giuris* (Hamilton, 1822)	9	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w	+	n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
60	*Glossogobius olivaceus* (Temminck & Schlegel, 1845)	5	+	n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
61	*Siganus fuscescens* (Houttuyn, 1782)	6		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
62	*Macropodus opercularis* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
63	*Channa asiatica* (Linnaeus, 1758)	4		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
64	*Paralichthys olivaceus* (Temminck & Schlegel, 1846)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
65	*Takifugu obscurus* (Abe, 1949)	7	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+		n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w
66	*Takifugu ocellatus* (Linnaeus, 1758)	0		n/w	n/w	n/w	n/w	n/w						n/w		n/w	n/w								n/w			n/w	n/w	n/w		n/w		n/w							n/w	n/w	n/w				n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w								n/w	n/w	n/w		n/w	n/w		n/w	n/w	n/w	n/w
67	*Takifugu niphobles* (Jordan & Snyder, 1901)	8	+	n/w	n/w	n/w	n/w	n/w	+					n/w		n/w	n/w			+					n/w			n/w	n/w	n/w		n/w		n/w						+	n/w	n/w	n/w	+			n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w	n/w						+	+	n/w	n/w	n/w	+	n/w	n/w		n/w	n/w	n/w	n/w

n/w No permanent water

Appendix C

List of Recorded Freshwater Macroinvertebrate Species

Freshwater Macroinvertebrates

Date of Survey: 18, 25 and 26 September 2003

Hong Kong Zhuhai Macao Bridge: Hong Kong Section and North Lantau Highway Connection					
Ecological Baseline Survey: Stream Macrofauna Survey (Wet Season)					
		Date:	18-Sep-03	25-Sep-03	26-Sep-03
Family	Order	Common Name	**Sha Lo Wan**	**San Tau**	**Tai Ho**
Perlidae	Plecoptera	Stoneflies	1		No stream suitable for
Baetidae	Ephemeroptera	Mayflies	5	1	quantitative sampling
Amphipterygidae	Zygoptera	Dragonflies	1		
Philopotamidae	Trichoptera	Caddisflies	1		
Chironomidae	Diptera	Non-biting midge	1	24	
Gammaridae (suborder)	Amphipodae	Amphipod		5	
Method:	Five 3 minutes standard kick sampling.				

Date of Survey: 7, 15 and 16 January 2004

Hong Kong Zhuhai Macao Bridge: Hong Kong Section and North Lantau Highway Connection						
Ecological Baseline Survey: Stream Macrofauna Survey (Dry Season)						
		Date:	07-Jan-04	15-Jan-04	16-Jan-04	16-Jan-04
Family	Order	Common Name	Pak Mon	Hau Hok Wan	Sha Lo Wan	San Shek Wan
Gammaridae (suborder)	Amphipodae	Amphipod	1			
Gyrinidae	Coleoptera	Water Beetle				3
Psephenidae	Coleoptera	Water Beetle				6
Grapsidae	Decapoda	Small Shore Crab	1			
Chironomidae	Diptera	Non-biting midge	14		7	4
Nematocera (suborder)	Diptera	Trueflies		1		
Baetidae	Ephemeroptera	Mayflies				9
Euphemeridae	Ephemeroptera	Mayflies				1
Leptophlebiidae	Ephemeroptera	Mayflies				24
Corydalidae	Megaloptera	Fishflies				1
Euphaeidae	Odonata	Damselflies				1
Libellulidae	Odonata	Dragonflies				3
	Odonata (anterior fragment)	Damselflies/Dragonflies				7
Hydropsychidae	Trichoptera	Caddisflies				1
Method:	Five 3 minutes standard kick sampling.					
Note:	1. Water levels of most streams were lower than during the wet season.					
	2. The stream at San Tau dried up and quantitative survey was no fesible.					
	The stream was also recently channellised.					

Appendix D1

List of Recorded Marine Benthic Macrofauna Species

Marine Benthic Macrofauna

Date of survey: 2 October 2003

Abundance (Counts)	HKS1	HKS2	HKS3	HKS4	HKS5	NLHC1	NLHC2	NLHC3	NLHC4	NLHC5	THW1	THW2	THW3	THW4	THW5	Total
Aglaophamus dibranchis	2	2			1			1		3			3		1	**13**
Amphioplus laevis	1			1	1										1	**4**
Ancistrosyllis pilargiformis			3		1						1			2		**7**
Apionsoma trichocephalus						1										**1**
Callianassa sp.	1															**1**
Capitella capitata										1						**1**
Cirratulus sp.					1	2					4	1	1		1	**10**
Corophium sp.			1	2	1		1				2	3	2	1	2	**15**
Cossurella dimorpha			1	1	1	6										**9**
Dasybranchus caducus					2											**2**
Gattyana sp:					1									1	1	**3**
Glycera onomichiensis											1	2			3	**6**
Hexapus granuliforus												1				**1**
Laonice cirrata						1						2	1		2	**6**
Leocrates chinensis				2	1											**3**
Lumbrineris latreilli														1		**1**
Lumbrineris sp.											2	2				**4**
Macoma candida				1												**1**
Magelona pacifica											1					**1**
Mediomastus californiensis			5	7	12	1	1	2	2	5			3	11	2	**51**
Metapenaeus sp.											1					**1**
Micropodarke dubia			1													**1**
Nassarius sunninctus	2	3		3												**8**
Nassarius sp.				1												**1**
Neoxenophthalmus obscurus	2		7	12	7					1				1		**30**
Nereis sp.											2				2	**4**
Notomastus latericens													2	1		**3**
Paraprionospio pinnata			1			1					2	1			1	**6**
Poecilochaetus serpens											19	3			1	**23**
Phyllodoce (A.) chinensis												1	1	1		**3**
Polydora sp.							1									**1**
Prionospio cirrifera			18	15	6	1			2		3		1	8	1	**55**
Prionospio queenslandica											13				3	**16**
Processa sp.		1										1				**2**
Protankyra sp.														1		**1**
Pseudopythina maipoensis					1											**1**
Pseudopolydora sp.												1				**1**
Scyllis sp.					1											**1**
Sigambra hanaokai		1	9	3	4	2	4	2	2	2	8	3	10	6		**56**
Solen sp.															1	**1**
Terebellides stroemii															1	**1**
Theora lata					1	1										**2**
Typhlocarcinus villosa	1		1										1		1	**4**
Total	*9*	*7*	*47*	*48*	*42*	*16*	*7*	*5*	*6*	*12*	*59*	*21*	*25*	*34*	*24*	**362**

Marine Benthic Macrofauna

Date of survey: 2 October 2003

Biomass (mg)	HKS1	HKS2	HKS3	HKS4	HKS5	NLHC1	NLHC2	NLHC3	NLHC4	NLHC5	THW1	THW2	THW3	THW4	THW5	Total
Aglaophamus dibranchis	18.9	7.6			4.2			4.1		12.4			24.6		1.3	**73.1**
Amphioplus laevis	1.5			2.3	14.1										39.8	**57.7**
Ancistrosyllis pilargiformis			1.6		0.4						0.4			0.6		**3**
Apionsoma trichocephalus						0.3										**0.3**
Callianassa sp.	0.8															**0.8**
Capitella capitata										0.3						**0.3**
Cirratulus sp.					1.8	1.4					1.2	0.8	0.2		0.2	**5.6**
Corophium sp.			0.8	1.7	0.5		0.2				1.5	4.2	0.9	0.2	0.3	**10.3**
Cossurella dimorpha			0.2	5.8	3.3	1.8										**11.1**
Dasybranchus caducus					501.5											**501.5**
Gattyana sp.					0.8									3.8	0.4	**5**
Glycera onomichiensis											87.3	51.7			27.2	**166.2**
Hexapus granuliforus												152.4				**152.4**
Laonice cirrata						0.5						8.1	3.8		0.7	**13.1**
Leocrates chinensis				7.9	0.6											**8.5**
Lumbrineris latreilli														121.5		**121.5**
Lumbrineris sp.											0.7	2.2				**2.9**
Macoma candida				354.3												**354.3**
Magelona pacifica											2.1					**2.1**
Mediomastus californiensis			7.3	6.7	33.1	0.3	0.5	4.3	3	23			1.4	36.5	2.4	**118.5**
Metapenaeus sp.											108.2					**108.2**
Micropodarke dubia			2.6													**2.6**
Nassarius sunninctus	410.9	438.9		287												**1136.8**
Nassarius sp.				857.7												**857.7**
Neoxenophthalmus obscurus	387.6		495.5	2057.2	1366.1					145.9				171.2		**4623.5**
Nereis sp.											3.2				4.5	**7.7**
Notomastus latericens													5.4	17.4		**22.8**
Paraprionospio pinnata			0.3			0.7					0.9	0.6			0.9	**3.4**
Poecilochaetus serpens											17.4	8.9			1	**27.3**
Phyllodoce (A.) chinensis												0.9	1.4	1.6		**3.9**
Polydora sp.							0.2									**0.2**
Prionospio cirrifera			3.1	3	2.1	0.2			0.5		0.3		0.4	1.4	0.1	**11.1**
Prionospio queenslandica											34.3				4.4	**38.7**
Processa sp.		0.6										0.4				**1**
Protankyra sp.														2537.6		**2537.6**
Pseudopythina maipoensis					1.1											**1.1**
Pseudopolydora sp.												5.1				**5.1**
Scyllis sp.					0.2											**0.2**
Sigambra hanaokai		0.9	5.8	1.8	1.9	0.9	5.5	2.7	8.7	0.6	2.7	1.7	7.6	3.4		**44.2**
Solen sp.															32.7	**32.7**
Terebellides stroemii															0.8	**0.8**
Theora lata					8.2	7.4										**15.6**
Typhlocarcinus villosa	114.4		45.4										71.4		178.7	**409.9**
Total	***934.1***	***448***	***562.6***	***3585.4***	***1939.9***	***13.5***	***6.4***	***11.1***	***12.2***	***182.2***	***260.2***	***237***	***117.1***	***2895.2***	***295.4***	**11500**

Marine Benthic Macrofauna

Date of survey: 7 January 2004

Abundance (counts)	HKS1	HKS2	HKS3	HKS4	HKS5	NLHC1	NLHC2	NLHC3	NLHC4	NLHC5	THW1	THW2	THW3	THW4	THW5	Total
Actinia sp.							1					1				2
Aglaophamus dibranchis		2		1	3		2	2	1	1	4		1	2		19
Alpheus sp.							3	5						2		10
Amphinome rostrata	1															1
Amphioplus laevis	1		1	2						1		1	1		2	9
Ancistrosyllis pilargiformis					2											2
Apionsoma trichocephalus								1								1
Aricidea fragilis								1								1
Bhawania goodei								1								1
Callianassa sp.																0
Capitella capitata																0
Charybdis hellerii								1						1	1	3
Cirratulus sp.						1				1					1	3
Corophium sp.							2	9	1		4	1		1	7	25
Cossurella dimorpha																0
Cycladicama sp.								1								1
Dasybranchus caducus																0
Euclymene sp.							1									1
Eucrate haswelli								2								2
Eocuma lata	1															1
Eunice indica					1		31	21						1		54
Gattyana sp.								1								1
Glycera onomichiensis							3	9							7	19
Goniada sp.					1		1			1						3
Heterospio sinica									1	1						2
Hexapus granuliforus				1	1											2
Laonice cirrata													1		1	2
Leocrates chinensis				1										1	1	3
Lepidonotus sp.			1					3								4
Loimia medusa															1	1
Lucifer sp.	1															1
Lumbrineris latreilli																0
Lumbrineris sp.			1	1						1	2	1	1	3	2	12
Lygdamis giardi								1								1
Macoma candida																0
Magelona pacifica							1								2	3
Marphysa sanguinea								1								1
Mediomastus californiensis	10	5	2	8	9		4	11	3	2	3		1	2	2	62
Melinna sp.												1				1
Metapenaeus sp.																0
Micropodarke dubia					1		1	4								6
Moerella cutler															1	1
Murex sp.					1											1
Nassarius sunninctus																0
Nassarius sp.																0
Nectoneanthes ijimai							1									1
Neoxenophthalmus obscurus	3	12	2	4	8			4								33
Nereis sp.																0
Notomastus latericens							1	2				1	1	4		9
Onuphis eremita							1									1
Ophelina grandis					1											1
Ophiodromus obscura								2								2
Paphia undulata			2									1				3
Paralacydonia paradoxa								1								1
Paramphicondrius sp.							1									1
Paranursia abbrevista							1									1
Paraprionospio pinnata				2								1			6	9
Phascolosoma sp.							1									1
Phyllodoce (A.) chinensis							1	3								4
Poecilochaetus serpens								2				1				3
Polydora sp.																0
Potamilla sp.								1								1
Prionospio cirrifera	1	1	1						1	3		1	1		4	13
Prionospio queenslandica		1			1		14	23	1		3	1			11	55
Processa sp.																0
Protankyra sp.																0
Pseudopolydora sp.																0
Pseudopythina maipoensis																0
Raphidopus ciliatus							1	2								3
Ruditapes philippinarum								2								2
Schistomeringos sp.														1		1
Scoloplos sp.					1			3				1				5
Syllis sp.							1		1							2
Sigambra hanaokai	3	1		2	2	4			1	5	4	3	1	1		27
Siphopatella sp.							3									3
Solen sp.																0
Sternaspis sculata				1												1
Sthenolepis japonica							1									1
Stylochus sp.	1															1
Temnopleurus sp.		2				1		1								4
Terebellides stroemii																0
Thalassema sabinum							1									1
Theora lata					1											1
Trigonothracia jinxingae															1	1
Typhlocarcinus villosa							1						1		2	4
Virgularia gustaviana					1											1
Total	*22*	*24*	*10*	*23*	*34*	*6*	*79*	*120*	*10*	*16*	*20*	*15*	*9*	*19*	*52*	459

Marine Benthic Macrofauna

Date of survey: 7 January 2004

Biomass (mg)	HKS1	HKS2	HKS3	HKS4	HKS5	NLHC1	NLHC2	NLHC3	NLHC4	NLHC5	THW1	THW2	THW3	THW4	THW5	Total
Actinia sp.							8.1					64.2				72.3
Aglaophamus dibranchis		15.1		4.3	22.1		1.6	1.3	28.7	0.4	7.4		0.6	5.6		87.1
Alpheus sp.							296.8	364.6						62.7		724.1
Amphinome rostrata	4.7															4.7
Amphioplus laevis	33		2.7	13.5						0.6		106.2	10.7		165.2	331.9
Ancistrosyllis pilargiformis					0.5											0.5
Apionsoma trichocephalus								1.3								1.3
Aricidea fragilis								0.5								0.5
Bhawania goodei								2								2
Callianassa sp.																0
Capitella capitata																0
Charybdis hellerii								416.4						99	5.4	520.8
Cirratulus sp.						0.3				0.3					0.5	1.1
Corophium sp.							2.8	7.3	0.4		2.3	0.7		1.1	5.5	20.1
Cossurella dimorpha																0
Cycladicama sp.								485.2								485.2
Dasybranchus caducus																0
Euclymene sp.							1.9									1.9
Eucrate haswelli								110.2								110.2
Eocuma lata	0.3															0.3
Eunice indica					14.8		295.9	419.9						1.3		731.9
Gattyana sp.								0.5								0.5
Glycera onomichiensis							29.5	127.3							106.7	263.5
Goniada sp.					1.9		1.1			0.5						3.5
Heterospio sinica									0.7	0.9						1.6
Hexapus granuliforus				231.2	66.5											297.7
Laonice cirrata													5.8		0.9	6.7
Leocrates chinensis				5.8										4.9	4.7	15.4
Lepidonotus sp.			1.1					24.8								25.9
Loimia medusa															35.6	35.6
Lucifer sp.	0.5															0.5
Lumbrineris latreilli																0
Lumbrineris sp.			146.3	26.6						43.5	6.1	11.8	2.7	8.4	22.1	267.5
Lygdamis giardi								34.5								34.5
Macoma candida																0
Magelona pacifica							0.8								3.4	4.2
Marphysa sanguinea								32.9								32.9
Mediomastus californiensis	29.3	5.8	1.5	15	25.9		16.2	52.9	8.2	3	5.9		1.5	1.7	2.2	169.1
Melinna sp.												33.4				33.4
Metapenaeus sp.																0
Micropodarke dubia					0.5		0.5	4.6								5.6
Moerella cutler															11.2	11.2
Murex sp.					8266.7											8266.7
Nassarius sunninctus																0
Nassarius sp.																0
Nectoneanthes ijimai							1.3									1.3
Neoxenophthalmus obscurus	314.7	1275.9	362.4	681.3	1304.8			3194.5								7133.6
Nereis sp.																0
Notomastus latericens							153.7	86				46.7	51.4	16.8		354.6
Onuphis eremita							1									1
Ophelina grandis					125.5											125.5
Ophiodromus obscura								12.9								12.9
Paphia undulata			7401.1									1125.2				8526.3
Paralacydonia paradoxa								0.6								0.6
Paramphicondrius sp.							0.4									0.4
Paranursia abbrevista							17.3									17.3
Paraprionospio pinnata				7.3								4.2			29.1	40.6
Phascolosoma sp.							10.7									10.7
Phyllodoce (A.) chinensis							1.7	7.8								9.5
Poecilochaetus serpens								6.6				5.6				12.2
Polydora sp.																0
Potamilla sp.								7								7
Prionospio cirrifera	0.3	0.9	0.5						0.8	1.5		0.5	0.5		1.2	6.2
Prionospio queenslandica		3.4			2.2		56.6	57.5	2.2		2.5	5.2			123.9	253.5
Processa sp.																0
Protankyra sp.																0
Pseudopolydora sp.																0
Pseudopythina maipoensis																0
Raphidopus ciliatus							22.3	72.8								95.1
Ruditapes philippinarum								405.8								405.8
Schistomeringos sp.														0.8		0.8
Scoloplos sp.					0.3			1.7				7				9
Syllis sp.							0.7		1.1							1.8
Sigambra hanaokai	3.1	0.8		3.8	1.3	1.6			1.2	2	2.3	2.2	0.8	1.5		20.6
Siphopatella sp.							58.9									58.9
Solen sp.																0
Sternaspis sculata				8.9												8.9
Sthenolepis japonica							22.2									22.2
Stylochus sp.	14															14
Temnopleurus sp.		45.1				51.5		5.4								102
Terebellides stroemii																0
Thalassema sabinum							604.9									604.9
Theora lata					3.1											3.1
Trigonothracia jinxingae															8.6	8.6
Typhlocarcinus villosa							170.3						28.3		432	630.6
Virgularia gustaviana					4.4											4.4
Total	*399.9*	*1347*	*7915.6*	*997.7*	*9840.5*	*53.4*	*1777.2*	*5944.8*	*43.3*	*52.7*	*26.5*	*1412.9*	*102.3*	*203.8*	*958.2*	31076

Appendix D2

ANOVA Analysis for Marine Benthic Macro-Infauna

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 2 October 2003

Number of Species

Between-Subjects Factors

		N
Area	HKS	5
	NLH	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Number of Species

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	146.533[a]	2	73.267	6.601	.012
Intercept	1179.267	1	1179.267	106.240	.000
AREA	146.533	2	73.267	6.601	.012
Error	133.200	12	11.100		
Total	1459.000	15			
Corrected Total	279.733	14			

a. R Squared = .524 (Adjusted R Squared = .444)

Number of Species

Student-Newman-Keuls[a,b]

Area	N	Subset 1	Subset 2
NLH	5	4.80	
HKS	5		9.40
THW	5		12.40
Sig.		1.000	.180

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.100.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 2 October 2003

Abundance

Between-Subjects Factors

		N
Area	HKS	5
	NLH	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Abundance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1682.533[a]	2	841.267	3.635	.058
Intercept	8736.267	1	8736.267	37.749	.000
AREA	1682.533	2	841.267	3.635	.058
Error	2777.200	12	231.433		
Total	13196.000	15			
Corrected Total	4459.733	14			

a. R Squared = .377 (Adjusted R Squared = .273)

Abundance

Student-Newman-Keuls[a,b]

Area	N	Subset 1
NLH	5	9.20
HKS	5	30.60
THW	5	32.60
Sig.		.075

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 231.433.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 2 October 2003

Biomass

Between-Subjects Factors

		N
Area	HKS	5
	NLH	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Biomass (mg)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5248667.161[a]	2	2624333.581	2.503	.123
Intercept	8817126.673	1	8817126.673	8.409	.013
AREA	5248667.161	2	2624333.581	2.503	.123
Error	12582998.656	12	1048583.221		
Total	26648792.490	15			
Corrected Total	17831665.817	14			

a. R Squared = .294 (Adjusted R Squared = .177)

Biomass (mg)

Student-Newman-Keuls[a,b]

Area	N	Subset 1
NLH	5	45.08000
THW	5	760.98000
HKS	5	1494.0000
Sig.		.105

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1048583.221.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 2 October 2003

Diversity Index

Between-Subjects Factors

		N
Area	HKS	5
	NLH	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Diversity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.343[a]	2	.171	7.295	.008
Intercept	8.886	1	8.886	378.223	.000
AREA	.343	2	.171	7.295	.008
Error	.282	12	2.349E-02		
Total	9.510	15			
Corrected Total	.625	14			

a. R Squared = .549 (Adjusted R Squared = .473)

Diversity

Student-Newman-Keuls[a,b]

Area	N	Subset 1	Subset 2
NLH	5	.57838	
HKS	5	.78264	.78264
THW	5		.94798
Sig.		.057	.114

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.349E-02.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 7 January 2004

Univariate Analysis of Variance

Between-Subjects Factors

		N
Area	HKS	5
	NLHC	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Number of Species

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	70.933[a]	2	35.467	.668	.531
Intercept	2112.267	1	2112.267	39.804	.000
AREA	70.933	2	35.467	.668	.531
Error	636.800	12	53.067		
Total	2820.000	15			
Corrected Total	707.733	14			

a. R Squared = .100 (Adjusted R Squared = -.050)

Post Hoc Tests

Area

Homogeneous Subsets

Number of Species

Student-Newman-Keuls[a,b]

Area	N	Subset 1
HKS	5	9.60
THW	5	11.20
NLHC	5	14.80
Sig.		.516

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 53.067.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 7 January 2004

Univariate Analysis of Variance

Between-Subjects Factors

		N
Area	HKS	5
	NLHC	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Abundance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1825.600[a]	2	912.800	.930	.421
Intercept	14045.400	1	14045.400	14.310	.003
AREA	1825.600	2	912.800	.930	.421
Error	11778.000	12	981.500		
Total	27649.000	15			
Corrected Total	13603.600	14			

a. R Squared = .134 (Adjusted R Squared = -.010)

Post Hoc Tests

Area

Homogeneous Subsets

Abundance

Student-Newman-Keuls[a,b]

Area	N	Subset 1
HKS	5	22.60
THW	5	23.00
NLHC	5	46.20
Sig.		.480

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 981.500.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 7 January 2004

Univariate Analysis of Variance

Between-Subjects Factors

		N
Area	HKS	5
	NLHC	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Biomass (g)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	33.529[a]	2	16.765	1.897	.192
Intercept	64.380	1	64.380	7.287	.019
AREA	33.529	2	16.765	1.897	.192
Error	106.026	12	8.836		
Total	203.936	15			
Corrected Total	139.555	14			

a. R Squared = .240 (Adjusted R Squared = .114)

Post Hoc Tests

Area

Homogeneous Subsets

Biomass (g)

Student-Newman-Keuls[a,b]

Area	N	Subset 1
THW	5	.540740
NLHC	5	1.574280
HKS	5	4.100140
Sig.		.183

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 8.836.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

ANOVA Analysis for Marine Benthic Macro-Infauna

Date of Survey: 7 January 2004

Univariate Analysis of Variance

Between-Subjects Factors

		N
Area	HKS	5
	NLHC	5
	THW	5

Tests of Between-Subjects Effects

Dependent Variable: Diversity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.443E-02[a]	2	3.222E-02	.763	.488
Intercept	11.690	1	11.690	276.889	.000
AREA	6.443E-02	2	3.222E-02	.763	.488
Error	.507	12	4.222E-02		
Total	12.261	15			
Corrected Total	.571	14			

a. R Squared = .113 (Adjusted R Squared = -.035)

Post Hoc Tests

Area

Homogeneous Subsets

Diversity

Student-Newman-Keuls[a,b]

Area	N	Subset 1
HKS	5	.815060
NLHC	5	.861900
THW	5	.971460
Sig.		.474

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 4.222E-02.

a. Uses Harmonic Mean Sample Size = 5.000.

b. Alpha = .05.

Appendix E

List of Intertidal (hard and soft shores) Species

Intertidal

Date of survey: 18 September 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	18-Sep-03
Weather:	Sunny
Site:	San Tau

Summary		
Transect	TST1	TST2
Level (mCD)	1	1.3
Substrate	Pebble	Pebble

		Transect: TST1 (Level: 1 mCD)										Transect: TST2 (Level: 1.3 mCD)										Average Density (individuals per m^2)	
Common Name	**Species**	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	TST1	TST2
Crab	*Charybdis japonica*														1							0	0.4
Small Shore Crab	*Hemigrapsus sanguineus*		1			2	1				3								3	1	1	2.8	2
Small Shore Crab	*Sphaerozius nitidus*									1	1											0.8	0
Hermit Crab								1														0.4	0
Acorn Barnacle	*Balanus* sp.											14	3	3	5	4	6	1				0	14.4
Sea Anemone							2															0.8	0
Limpet	*Cellana* sp.							1	1													0.8	0
Mud Snail	*Cerithidea rhizophorarum*	27	30	2	12	12	13	12	19	2	1	85	70	81	53	63	63	52	35	8	2	52	204.8
Freshwater Nerite	*Clithon* cf. *faba*											5	5	15	1	28	18	22	4			0	39.2
	Dostia violacea	1																				0.4	0
Rough Periwinkle	*Littoraria articulata*																		5	23		0	11.2
Top Shell	*Monodonta labio*	29		16	20	3	2	42	17	4	15	3			8			6	18		17	59.2	20.8
	Nerita polita	3			5			2		1							1				2	4.4	1.2
Smooth Limpet	*Notoacmoea schrenkii*					1	1															0.8	0
																					Total Density (individuals per m^2)	**122.4**	**294**
																					Number of Species	**10**	**8**

Method: 10m line transect and $0.25m^2$ quadrat.

Note: No horseshoe crabs or trails observed.

General Description: Gentle exposed shore with sand, pebble and oyster shell.

Other Observation: Fishermen deploying gill nets; local villager collecting clams (*Tapes philippinarum*) on shoreline.
Abandoned gill nets in the stream channel.
Reef Egret and Little Egret (~5) foraging on the shore.

Intertidal

Date of survey: 25 September 2003

Project:	**Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study**
Date:	25-Sep-03
Weather:	Sunny
Site:	**San Shek Wan**

Transect: 1 — Level: 1.5 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Hermit Crab			5								
Sea Slater	*Ligia exotica*										
	Nerita polita	9	26	1	4						
	Nodilittorina vidua	6		124		52	112	88	4	28	1
	Echinolittorina trochoides					8	52	24	12	20	
Common Whelk	*Thais clavigera*										

Transect: 2 — Level: 1 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*					2				1	
Hermit Crab									2		1
Sea Slater	*Ligia exotica*						1				
	Nerita polita	6	60	6	8	9	16	52	8	5	7
	Nodilittorina vidua	30	8	19	24						
	Echinolittorina trochoides										
Common Whelk	*Thais clavigera*				8	3		10	3		1

Transect: 3 — Level: 0.5 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*		4		4	2		1	2		4
Hermit Crab						2		8		2	
Sea Slater	*Ligia exotica*						4				
	Nerita polita	44	84	28	36	12	40	67	14	26	32
	Nodilittorina vidua										
	Echinolittorina trochoides										
Common Whelk	*Thais clavigera*	12	24		4	2		4	5		24

Summary			
Transect	1	2	3
Level (mCD)	1.5	1	0.5
Substrate	Mudflat	Mudflat	Mudflat
Average Density (individuals per m^2)			
Hemigrapsus sanguineus	0	1.2	6.8
Hermit Crab	2	1.2	4.8
Ligia exotica	0	0.4	1.6
Nerita polita	16	70.8	153.2
Nodilittorina vidua	166	32.4	0
Echinolittorina trochoides	46.4	0	0
Thais clavigera	0	10	30
Total Density (individuals per m^2)	230.4	116	196.4
Number of Species	4	6	5

Method:	10m line transect and 0.25m^2 quadrat.
Note:	No horseshoe crabs.
General Description:	Gentle exposed shore with rocks and pebble.
Other Observation:	A demersal trawler operating in the bay caused sediment resuspension.

Intertidal

Date of survey: 25 September 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	25-Sep-03
Weather:	Sunny
Site:	Sha Lo Wan

Transect: 1, Level: 0.4 mCD; Transect: 2, Level: 1 mCD; Transect: 3, Level: 1.5 mCD

Common Name	Species	T1 Q1	T1 Q2	T1 Q3	T1 Q4	T1 Q5	T1 Q6	T1 Q7	T1 Q8	T1 Q9	T1 Q10	T2 Q1	T2 Q2	T2 Q3	T2 Q4	T2 Q5	T2 Q6	T2 Q7	T2 Q8	T2 Q9	T2 Q10	T3 Q1	T3 Q2	T3 Q3	T3 Q4	T3 Q5	T3 Q6	T3 Q7	T3 Q8	T3 Q9	T3 Q10
Small Shore Crab	*Hemigrapsus sanguineus*	2	2			8		2	2		6										1										
Hermit Crab								3																							
Sea Anemone		1						1	3												2										
Black Mussel	*Septifer virgatus*				1																1										
Limpet	*Cellana* sp.	1		1	12	8																									
	Nerita polita					4		1		1		22	13	4		20	11				8										
	Nodilittorina vidua											1	15	8	16	24	112	52	1	7		20	12	8	56	104	220	184	100	84	40
	Echinolittorina trochoides																					64	40	68	128	28	132	180	44	64	48
Common Whelk	*Thais clavigera*	7	7	13	20	36	12		14	4			8								4										

Summary			
Transect	1	2	3
Level (mCD)	0.4	1	1.5
Substrate	Rocky	Rocky	Rocky
Average Density (individuals per m^2)			
Small Shore Crab	8.8	0.4	0
Hermit Crab	1.2	0	0
Sea Anemone	2	0.8	0
Black Mussel	0.4	0.4	0
Limpet	8.8	0	0
Nerita polita	2.4	31.2	0
Nodilittorina vidua	0	94.4	331.2
Echinolittorina trochoides	0	0	318.4
Common Whelk	45.2	4.8	0
Total Density (individuals per m^2)	68.8	132	649.6
Number of Species	7	6	2

Method:	10m line transect and $0.25m^2$ quadrat.
Note:	No horseshoe crabs.
General Description:	Exposed steep rocky shore.
Other Observation:	Garbage deposit along the shore.

Intertidal

Date of survey: 26 September 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	26-Sep-03
Weather:	Sunny
Site:	Tai Ho Wan

Transect: 1 — Level: 2 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Acorn Barnacle	*Balanus* sp.		1								
Hammer Oyster	*Isognomon isognomon*										
Rock Oyster	*Saccostrea cucullata*										
	Striarca symmetrica										
	Terebralia sulcata										
	Batillaria zonalis										
	Cerithidea microptera										
Littorinid	*Littoraria articulata*										1
Common Top Shell	*Monodonta labio*					1					
	Nerita polita										
Common Whelk	*Thais clavigera*										

Transect: 2 — Level: 1 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*					7	1	2	1		3
Acorn Barnacle	*Balanus* sp.	4	7	16	7	2	3	10	1		
Hammer Oyster	*Isognomon isognomon*										
Rock Oyster	*Saccostrea cucullata*						1				
	Striarca symmetrica			2	2	6		1			
	Terebralia sulcata	1	2				1				
	Batillaria zonalis	5	3	1	1			4		4	1
	Cerithidea microptera	12	5	2	6	2	3	3	2	3	
Littorinid	*Littoraria articulata*										
Common Top Shell	*Monodonta labio*			1	9	3	2	5	2		3
	Nerita polita	1	16	1	3	1	2	2			
Common Whelk	*Thais clavigera*										

Transect: 3 — Level: 0.5 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*			3				3			7
Acorn Barnacle	*Balanus* sp.	12	5	23	7	7		4		1	5
Hammer Oyster	*Isognomon isognomon*						1				
Rock Oyster	*Saccostrea cucullata*										
	Striarca symmetrica	2		1		1		4	3		4
	Terebralia sulcata										
	Batillaria zonalis										
	Cerithidea microptera	16	10	2	10	2	1	2		2	9
Littorinid	*Littoraria articulata*										
Common Top Shell	*Monodonta labio*										
	Nerita polita	11	13	2	7	1	8	16	16		2
Common Whelk	*Thais clavigera*							1	1		

Summary

Common Name	Species	Transect 1	Transect 2	Transect 3
	Level (mCD)	2	1	0.5
	Substrate	Rocky	Pebble	Pebble
	Average Density (individuals per m^2)			
Small Shore Crab	*Hemigrapsus sanguineus*	0	5.6	5.2
Acorn Barnacle	*Balanus* sp.	0.4	20	25.6
Hammer Oyster	*Isognomon isognomon*	0	0	0.4
Rock Oyster	*Saccostrea cucullata*	0	0.4	0
	Striarca symmetrica	0	4.4	6
	Terebralia sulcata	0	1.6	0
	Batillaria zonalis	0	7.6	0
	Cerithidea microptera	0	15.2	21.6
Littorinid	*Littoraria articulata*	0.4	0	0
Common Top Shell	*Monodonta labio*	0.4	10	0
	Nerita polita	0	10.4	30.4
Common Whelk	*Thais clavigera*	0	0	0.8
	Total Density (individuals per m^2)	1.2	75.2	90
	Number of Species	3	9	7

Method:	10m line transect and 0.25m^2 quadrat.
Note:	No horseshoe crabs.
General Description:	Sheltered rocky shore with steep slope.
Other Observation:	1. A black-capped kingfisher (*Halcyon pileata*) seen in the bay.
	2. High Water Mark coverved with fine sediments.

Half-day Additional Survey

Date of Survey: 2 October 2003

Site: San Shek Wan, Sha Lo Wan, Hau Hok Wan, San Tau

No special fauna found.

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Intertidal

Date of survey: 21 October 2003

Project:	**Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study**																													**Summary**		
Date:	21-Oct-03																													Transect	THW1	THW2	THW3
Weather:	Sunny					Level:	1.5	mCD								Level:	1	mCD								Level:	0.5	mCD		Level (mCD)	1.5	1	0.5
Site:	**Tai Ho Wan**	Transect:	THW1 (Mudflat)									Transect:	THW2 (Mudflat)									Transect:	THW3 (Mudflat)							Substrate	Mudflat	Mudflat	Mudflat
Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Average Density (individuals per m^2)		
Crab	*Helice tientsinensis*	1	2	1	2	1	1	1			1				2	1	1			1													4	2	0
Acorn Barnacle	*Balanus* sp.	6	9	6	5							12	4	17		4	4																10.4	16.4	0
Rock Oyster	*Saccostrea cucullata*													7																			0	2.8	0
	Terebralia sulcata	1								1	1																						1.2	0	0
Sand Snail	*Batillaria zonalis*					1	1	2		1	1	4	1	2	2	1		2	6	4	1	1	1	2	1	3		1	1	2	2		2.4	9.2	5.6
Mud Snail	*Cerithidea diadjariensis*	28	68	76	96	88	44	64	84	80	88	52	56	64	64	36	20	32	24	84	56	56	84	64	116	80	116	116	156	208	88		286.4	195.2	433.6
Mud Snail	*Cerithidea rhizophorarum*												2		1		4																0	2.8	0
Fresh Water Nerites	*Clithon* sp.														1							2		1	2		3	7	3	2	4		0	0.4	9.6
Scavenging Snail	*Nassarius* sp.																											1					0	0	0.4
																														Total Density (individuals per m^2)	304.4	228.8	449.2
																														Number of Species	5	7	4
Method:	10m line transect and 0.25m^2 quadrat.																																
Note:	No horseshoe crab observed although a villager indicated juvenile were occasionally caught in gill nets.																																
General Description:	Gentle sheltered mudflat with mangrove.																																

Intertidal

Date of survey: 21 October 2003

Project:	**Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study**
Date:	21-Oct-03
Weather:	Sunny
Site:	**Tung Chung Wan**

Transect: TC1 (Sandflat) — Level: 0.7 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Acorn Barnacle	*Balanus* sp.										
Ark Shell	*Barbatia virescens*										
	Terebralia sulcata										
Sand Snail	*Batillaria zonalis*	2	3	2	3	2	2	1			
Mud Snail	*Cerithidea diadjariensis*	3	7	4	5	9	23	6	8	27	12
Sand Snail	*Cerithidea* sp.										

Transect: TC2 (Sandflat) — Level: 1 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Acorn Barnacle	*Balanus* sp.						17				
Ark Shell	*Barbatia virescens*						3				
	Terebralia sulcata						2	1			
Sand Snail	*Batillaria zonalis*										
Mud Snail	*Cerithidea diadjariensis*	1	4	35	25	42	2	9	7	0	1
Sand Snail	*Cerithidea* sp.							1			

Transect: TC3 (Sandflat) — Level: 1.3 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*						1				
Acorn Barnacle	*Balanus* sp.										
Ark Shell	*Barbatia virescens*										
	Terebralia sulcata										
Sand Snail	*Batillaria zonalis*										
Mud Snail	*Cerithidea diadjariensis*	3	0	5	6	4	1	7	10	1	13
Sand Snail	*Cerithidea* sp.										

Summary

Transect	TC1	TC2	TC3
Level (mCD)	0.7	1	1.3
Substrate	Sandflat	Sandflat	Sandflat
Average Density (individuals per m^2)			
Hemigrapsus sanguineus	0	0	0.4
Balanus sp.	0	6.8	0
Barbatia virescens	0	1.2	0
Terebralia sulcata	0	1.2	0
Batillaria zonalis	6	0	0
Cerithidea diadjariensis	41.6	50.4	20
Cerithidea sp.	0	0.4	0
Total Density (individuals per m^2)	47.6	60.0	20.4
Number of Species	2	5	2

Method:	10m line transect and $0.25m^2$ quadrat.
Note:	No horseshoe crab observed.
General Description:	Gentle sheltered bay with extensive sandflat. Mangrove at higher level.
Other Observation:	Local Villager collecting clams on shoreline.

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Intertidal

Date of survey: 22 October 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	22-Oct-03
Weather:	Sunny
Site:	Sham Wat

		Transect: SW1 (Pebble) Level: 1.2 mCD										Transect: SW2 (Pebble) Level: 0.9 mCD										Transect: SW3 (mudflat) Level: 0.6 mCD										Average Density (individuals per m^2)		
Common Name	**Species**	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SW1	SW2	SW3
Small Shore Crab	*Hemigrapsus sanguineus*	2	6				3	8	4	4		2		5			2	2														10.8	4.4	0
Hermit Crab								1							1						1											0.4	0.8	0
Acorn Barnacle	*Balanus* sp.	6				3		1		1			2							2												4.4	1.6	0
Ark Shell	*Barbatia virescens*													2	3		2	2	3		2											0	5.6	0
Rock Oyster	*Saccostrea cucullata*				14	8				5	6	14	12	18	16	4	10	12	16	24	34											13.2	64	0
Bivalve	*Striarca symmetrica*														1	5		4	3													0	5.2	0
Mud Snail	*Cerithidea diadjariensis*																					8	1	32	20	30	38	42	30	24	14	0	0	95.6
Sand Snail	*Cerithidea* sp.									1																						0.4	0	0
Fresh Water Nerite	*Clithon* sp.	4	1	1	1	16	4		7		8	3					1	2														16.8	2.4	0
Nerite	*Dostia violacea*			1																												0.4	0	0
Littorina	*Littoraria articulata*	204	160	103	44	9	6	1	80	100	2																					283.6	0	0
Scavenging Snail	*Nassarius festivus*											1			1																	0	0.8	0
Nerite	*Nerita costata*											2									1											0	1.2	0
Nerite	*Nerita polita*	16	24	2	7	4		3	1	7	3	1	6	11	12	8	10	22	6	4	6								3			26.8	34.4	1.2
Common Whelk	*Thais clavigera*														2			1														0	1.2	0
																														Total Density (individuals per m^2)		**356.8**	**121.6**	**96.8**
																														Number of Species		9	11	2

Summary

Transect	SW1	SW2	SW3
Level (mCD)	1.2	0.9	0.6
Substrate	Pebble	Pebble	Mudflat

Method: 10m line transect and 0.25m^2 quadrat.

Note: Freshwater ecologist report observing some juvenile horseshoe crabs on the mudflat.

General Description: Sheltered gentle shore with mangrove. Rock/ pebble at the higher level and mudflat at the lower level.

Intertidal

Date of survey: 18 November 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study																					**Summary**	
Date:	18-Nov-03																					Transect	KL1	KL1
Weather:	Cloudy						Leve	0.8	mCD								Leve	1.2	mCD			Level (mCD)	0.8	1.2
Site:	**Kau Liu**	Transect:	1	(Rocky/pebble)								Transect:	2	(Rocky)								Substrate	Rocky	Rocky
Common Name	**Species**	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	**Average Density (individuals per m^2)**		
Small Shore Crab	*Hemigrapsus sanguineus*	1	1	1	4	1																	3.2	0
Hermit Crab											1												0.4	0
Rock Oyster	*Saccostrea cucullata*	96	76	20	52	40	14	36	16	13													145.2	0
Littorinid Snail	*Littoraria articulata*											7	6	9	16	14	14	6	6	36	2		0	46.4
Common Topshell	*Monodonta labio*	8	6	12	44	2	1	2		8	6		12					7					35.6	7.6
Nerite	*Nerita polita*	27	52	12	20	20	19	6	3	2	6												66.8	0
Periwinkle	*Echinolittorina trochoides*																1						0	0.4
																						Total Density (individuals per m^2)	**251.2**	**54.4**
																						Number of Species	5	3
Method:	10m line transect and 0.25m^2 quadrat.																							
Note:	No horseshoe crab observed.																							
General Description:	Exposed rocky shore with sand at the bottom.																							

Intertidal

Date of survey: 18 November 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study																					Summary		
Date:	18-Nov-03																					Transect	TH1	TH2
Weather:	Cloudy						Level:	0.9	mCD								Level:	1.1	mCD			Level (mCD)	0.9	1.1
Site:	**Tai Ho Wan**	Transect:		1	(mud/sand)							Transect:		2	(mud/sand)							Substrate	Mudy	Mudy
Common Name	**Species**	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	**Average Density (individuals per m²)**		
Acorn Barnacle	*Balanus* sp.	4		8	18	4				9	22							8	5				26	5.2
Bivalve	*Terebralia sulcata*		2	2	2													1	1	2			2.4	1.6
Sand Snail	*Batillaria zonalis*								1			3	1										0.4	1.6
Mud Snail	*Cerithidea diadjariensis*	16	8	32	12	7	5	4	8	7	7	4	4	4	8	3	4	12	9	5	10		42.4	25.2
Mud Snail	*Cerithidea rhizophorarum*					1	1	3			2		1		2								2.8	1.2
Sand Snail	*Cerithidea* sp.			2	1																		1.2	0
Nerite	*Dostia violacea*															1							0	0.4
Nerite	*Nerita polita*				1																		0.4	0
																						Total Density (individuals per m²)	**75.6**	**35.2**
																						Number of Species	7	6
Method:	10m line transect and 0.25m² quadrat.																							
Note:	No horseshoe crab observed.																							
General Description:	Gentle sheltered mudflat with mangrove.																							

Intertidal

Date of survey: 19 November 2003

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	19-Nov-03
Weather:	Sunny
Site:	Sha Lo Wan

Transect: 1 (rock) Level: 0.6 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*								6	2	2
Hermit Crab		1			1		1				
Ark Shell	*Barbatia virescens*								2		
Clam	*Cardita leana*						1				
Rock Oyster[1]	*Saccostrea cucullata*					100%	25%	100%	50%		
Common Topshell	*Monodonta labio*									4	
Nerite	*Nerita polita*	11	13	2	2	12	2	8	7	20	2
Periwinkle	*Nodilittorina radiata*										
Periwinkle	*Echinolittorina trochoides*										
Common Whelk	*Thais clavigera*	1	1		1	11	5	8	8	2	1

Transect: 2 (rocky) Level: 1 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*				2	1		2			
Hermit Crab											
Ark Shell	*Barbatia virescens*										1
Clam	*Cardita leana*										
Rock Oyster[1]	*Saccostrea cucullata*									80%	90%
Common Topshell	*Monodonta labio*										
Nerite	*Nerita polita*	9	1	8	15	20	14	14	3	18	22
Periwinkle	*Nodilittorina radiata*										
Periwinkle	*Echinolittorina trochoides*										
Common Whelk	*Thais clavigera*						1			1	2

Transect: 3 (rocky) Level: 1.4 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Hermit Crab											
Ark Shell	*Barbatia virescens*										
Clam	*Cardita leana*										
Rock Oyster[1]	*Saccostrea cucullata*										
Common Topshell	*Monodonta labio*										
Nerite	*Nerita polita*										
Periwinkle	*Nodilittorina radiata*		116	88	36	28	20		32	56	1
Periwinkle	*Echinolittorina trochoides*	2	4	16	20	8	4	24	40	24	
Common Whelk	*Thais clavigera*										

Summary

Transect	SLW1	SLW2	SLW3
Level (mCD)	0.6	1.0	1.4
Substrate	Rocky	Rocky	Rocky
Average Density (individuals per m^2)			
Small Shore Crab	4	2	0
Hermit Crab	1.2	0	0
Ark Shell	0.8	0.4	0
Clam	0.4	0	0
Rock Oyster[1]	28%	17%	0%
Common Topshell	1.6	0	0
Nerite	31.6	49.6	0
Periwinkle (*Nodilittorina radiata*)	0	0	150.8
Periwinkle (*Echinolittorina trochoides*)	0	0	56.8
Common Whelk	15.2	1.6	0
Total Density (individuals per m^2)	54.8	53.6	207.6
Number of Species	8	5	2

Method: 10m line transect and $0.25m^2$ quadrat.

Note: 1. Rock oyster expressed as percentage of cover and not included in the abundance and density calculation.
2. No horseshoe crab observed.

General Description: Exposed steep rocky shore.

Intertidal

Date of survey: 19 November 2003

Project:	**Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study**																					**Summary**		
Date:	19-Nov-03																					Transect	SW1	SW2
Weather:	Sunny						Level:	1	mCD								Level:	1.1	mCD			Level (mCD)	1.2	0.9
Site:	**Sham Wat**	Transect:		1	(pebble)							Transect:		2	(pebble)							Substrate	Pebble	Pebble
Common Name	**Species**	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	**Average Density (individuals per m²)**		
Small Shore Crab	*Hemigrapsus sanguineus*	4	2	2	3	6					4							4	8		6		8.4	7.2
Hermit Crab							1																0.4	0
Acorn Barnacle	*Balanus* sp.											1						1					0	0.8
Ark Shell	*Barbatia virescens*		1				2		1	1						1							2	0.4
Rock Oyster[1]	*Saccostrea cucullata*	20%	5%	5%	10%		5%	5%	10%	40%	30%			10%		10%		5%		10%			13%	4%
Bivalve	*Terebralia sulcata*																1	2	1	1	1		0	2.4
Mud Snail	*Cerithidea diadjariensis*														6	1				1			0	3.2
Fresh Water Nerites	*Clithon* sp.	52	24	120	88	36	100	72	16		20	68	40	44	100	60	28	56	36	14	24		211.2	188
Nerite	*Dostia violacea*												1										0	0.4
Littorinid Snail	*Littoraria articulata*															5		6	47	20	17		0	38
Common Topshell	*Monodonta labio*	8		2		1																	4.4	0
Scavenging snail	*Nassarius festivus*									1													0.4	0
Nerite	*Nerita polita*				1		6		4	36	4		3			2	2						20.4	2.8
																						Total Density (individuals per m²)	247.2	243.2
																						Number of Species	8	10
Method:	10m line transect and 0.25m² quadrat.																							
Note:	1. Rock oyster expressed as percentage of cover and not included in the abundance and density calculation.																							
	2. No horseshoe crab observed.																							
General Description:	Sheltered gentle shore with mangrove. Rocky / Pebble on the higher level with mudflat on the lower level.																							

Intertidal

Date of survey: 7 January 2004

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	07-Jan-2004
Weather:	Sunny
Site:	Tai Ho Wan

Transect: TH1 (muddy) Level: 1.2 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										1
Acorn Barnacle	*Balanus* sp.							30			
Sand Snail	*Batillaria zonalis*			3	1	3		2			
Mud Snail	*Cerithidea diadjariensis*	112	56	56	104	88	44	120	60	80	68
Fresh Water Nerite	*Clithon* sp.	16	8	8	8	9	5	6	11	1	7

Transect: TH2 (muddy) Level: 1.4 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*	1			1						
Acorn Barnacle	*Balanus* sp.						38		17		15
Sand Snail	*Batillaria zonalis*		5	1			3	4	2	2	1
Mud Snail	*Cerithidea diadjariensis*	112	88	80	120	76	76	72	56	40	80
Fresh Water Nerite	*Clithon* sp.					1			1		

Transect: TH3 (muddy) Level: 1.8 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Acorn Barnacle	*Balanus* sp.		1	1	2			2			
Sand Snail	*Batillaria zonalis*			1	2		1		1		
Mud Snail	*Cerithidea diadjariensis*	52	84	96	116	84	76	152	156	136	124
Fresh Water Nerite	*Clithon* sp.			1			1				

Summary

Transect	TH1	TH2	TH3
Level (mCD)	1.2	1.6	1.8
Substrate	Muddy	Muddy	Muddy
Average Density (individuals per m^2)			
Small Shore Crab	0.4	0.8	0
Acorn Barnacle	12	28	2.4
Sand Snail	3.6	7.2	2
Mud Snail	315.2	320	430.4
Fresh Water Nerite	31.6	0.8	0.8
Total Density (individuals per m^2)	362.8	356.8	435.6
Number of Species	5	5	4

Method: 10m line transect and $0.25m^2$ quadrat.

Note: No horseshoe crab observed.

General Description: Gentle sheltered mudflat with mangrove.

Intertidal

Date of survey: 15 January 2004

Project: Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date: 15-Jan-2004
Weather: Sunny, Windy
Site: Hau Hok Wan

		Transect: HHW1 (muddy) Level: 0.7 mCD										Transect: HHW2 (sandy) Level: 0.9 mCD										Transect: HHW3 (rocky) Level: 1.1 mCD										Summary		
																																Transect: HHW1	HHW2	HHW3
																																Level (mCD): 0.7	0.9	1.1
																																Substrate: muddy	sandy	rocky
Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Average Density (individuals per m^2)		
Small Shore Crab	*Hemigrapsus sanguineus*																														1	0	0	0.4
Hermit Crab									1				1																		2	0.4	0.4	0.8
Acorn Barnacle	*Balanus* sp.							1				9			4		6											2				0.4	7.6	0.8
Sea Anemone					1																											0.4	0	0
Ark Shell	*Barbatia virescens*				1																											0.4	0	0
Rock Oyster[1]	*Saccostrea cucullata*	2%		5%	50%						10%				1%							10%	5%	10%	5%	5%	5%	15%	10%	5%	20%	7%	0%	9%
Mud Snail	*Cerithidea rhizophorarum*									3												1	1			3	9		3			1.2	0	6.8
Fresh Water Nerite	*Clithon* sp.	13	2	7		4	2	6		1	5	32	44	84	128	68	100	48	60	21	9	1			2	4		3	26	4	8	16	237.6	19.2
Common Topshel	*Monodonta labio*																						1	1					1	2		0	0	2
Nerite	*Nerita polita*				3																	10	5	4	3	3	2	1	2	2	4	1.2	0	14.4
																																Total Density (individuals per m^2): 20.0	245.6	44.4
																																Number of Species: 7	4	7

Method: 10m line transect and $0.25m^2$ quadrat.

Note: 1. Rock oyster expressed as percentage of cover and not included in the abundance and density calculation.
2. No horseshoe crab observed.

General Description: Sheltered sandy shore.

Intertidal

Date of survey: 15 January 2004

Project:	**Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study**
Date:	15-Jan-2004
Weather:	Sunny, Windy
Site:	Kau Liu

		Transcect: KL1 (sandy) Level: 1 mCD										Transect: KL2 (sandy) Level: 1.2 mCD										Transect: KL3 (rocky) Level: 1.4 mCD									
Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Acorn Barnacle	*Balanus* sp.	22	3					8									1														
Sea Anemone			2																												
Rock Oyster[1]	*Saccostrea cucullata*				2%		5%	2%								5%	1%	1%	5%			5%									
Sand Snail	*Batillaria zonalis*							1																							
Mud Snail	*Cerithidea rhizophorarum*			1	1			2	15	13	46			4	46	4	14	3	1	5	2										
Fresh Water Nerite	*Clithon* sp.														1	3	25				1										
Nerite	*Dostia violacea*								1																						
Littorinid Snail	*Littoraria articulata*											3						1	3	5		4	2		7	12	7		2		1
Common Topshel	*Monodonta labio*																		3			6							2		
Nerite	*Nerita albicilla*																						1					4	6	3	
Nerite	*Nerita polita*						4									2	6	1	5	2	1										

Summary			
Transect	KL1	KL2	KL3
Level (mCD)	1	1.2	1.4
Substrate	sandy	sandy	rocky
Average Density (individuals per m^2)			
Acorn Barnacle	13.2	0.4	0
Sea Anemone	0.8	0	0
Rock Oyster[1]	1%	1%	1%
Sand Snail	0.4	0	0
Mud Snail	31.2	31.6	0
Fresh Water Nerite	0	12	0
Nerite (*Dostia violacea*)	0.4	0	0
Littorinid Snail	0	4.8	14
Common Topshel	0	1.2	3.2
Nerite (*Nerita albicilla*)	0	0	5.6
Nerite (*Nerita polita*)	1.6	6.8	0
Total Density (individuals per m^2)	47.6	56.8	22.8
Number of Species	7	7	4

Method: 10m line transect and 0.25m^2 quadrat.

Note: 1. Rock oyster expressed as percentage of cover and not included in the abundance and density calculation.
2. No horseshoe crab observed.

General Description: Exposed rocky shore with sand at the bottom.

Intertidal

Date of survey: 16 January 2004

Project:	Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study
Date:	16-Jan-2004
Weather:	Overcast with shower
Site:	San Shek Wan

Transect: SSW1 (pebble) — Level: 1 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Small Shore Crab	*Sphaerozius nitidus*										
Sea Slater	*Ligia exotica*										
Sea Anemone		1				1					
Ark Shell	*Barbatia virescens*										2
Rock Oyster[1]	*Saccostrea cucullata*	30%		10%	20%	25%		30%	5%		20%
Littorinid Snail	*Littoraria articulata*										
Common Topshel	*Monodonta labio*	1		1							
Nerite	*Nerita polita*	12	9	3	19	13	12	13	2	23	18
Periwinkle	*Nodilittorina radiata*										
Common Whelk	*Thais clavigera*				4	4	2		1		3

Transect: SSW2 (pebble) — Level: 1.2 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*		1	3	1	4	1			1	
Small Shore Crab	*Sphaerozius nitidus*						1				
Sea Slater	*Ligia exotica*										
Sea Anemone											
Ark Shell	*Barbatia virescens*										
Rock Oyster[1]	*Saccostrea cucullata*										
Littorinid Snail	*Littoraria articulata*										
Common Topshel	*Monodonta labio*									1	
Nerite	*Nerita polita*	3		3	8	10	7	7	27	12	14
Periwinkle	*Nodilittorina radiata*										
Common Whelk	*Thais clavigera*										

Transect: SSW3 (pebble) — Level: 1.4 mCD

Common Name	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Small Shore Crab	*Hemigrapsus sanguineus*										
Small Shore Crab	*Sphaerozius nitidus*										
Sea Slater	*Ligia exotica*					3	1				1
Sea Anemone											
Ark Shell	*Barbatia virescens*										
Rock Oyster[1]	*Saccostrea cucullata*										
Littorinid Snail	*Littoraria articulata*		1	11	11	1	15	35	24	31	12
Common Topshel	*Monodonta labio*										
Nerite	*Nerita polita*										1
Periwinkle	*Nodilittorina radiata*	7	13						6		
Common Whelk	*Thais clavigera*										

Summary

Transect	SSW1	SSW2	SSW3
Level (mCD)	1	1.2	1.4
Substrate	pebble	pebble	pebble
Average Density (individuals per m^2)			
Small Shore Crab (*Hemigrapsus sanguineus*)	0	4.4	0
Small Shore Crab (*Sphaerozius nitidus*)	0	0.4	0
Sea Slater (*Ligia exotica*)	0	0	2
Sea Anemone	0.8	0	0
Ark Shell (*Barbatia virescens*)	0.8	0	0
Rock Oyster[1] (*Saccostrea cucullata*)	14%	0%	0%
Littorinid Snail (*Littoraria articulata*)	0	0	56.4
Common Topshel (*Monodonta labio*)	0.8	0.4	0
Nerite (*Nerita polita*)	49.6	36.4	0.4
Periwinkle (*Nodilittorina radiata*)	0	0	10.4
Common Whelk (*Thais clavigera*)	5.6	0	0
Total Density (individuals per m^2)	57.6	41.6	69.2
Number of Species	6	4	4

Method: 10m line transect and $0.25m^2$ quadrat.

Note: 1. Rock oyster expressed as percentage of cover and not included in the abundance and density calculation.
2. No horseshoe crab observed.

General Description: Gentle exposed shore with rocks and pebble.

Intertidal

Date of survey: 16 January 2004

Project: Hong Kong - Zhuhai - Macao Bridge: Ecological Baseline Study

Date: 16-Jan-2004

Weather: Overcast with shower

Site: Sha Lo Wan

Transect: SLW1 (pebble) Level: 0.8 mCD

Transect: SLW2 (pebble) Level: 1 mCD

Transect: SLW3 (pebble) Level: 1.2 mCD

Common Name	Species	SLW1 Q1	SLW1 Q2	SLW1 Q3	SLW1 Q4	SLW1 Q5	SLW1 Q6	SLW1 Q7	SLW1 Q8	SLW1 Q9	SLW1 Q10	SLW2 Q1	SLW2 Q2	SLW2 Q3	SLW2 Q4	SLW2 Q5	SLW2 Q6	SLW2 Q7	SLW2 Q8	SLW2 Q9	SLW2 Q10	SLW3 Q1	SLW3 Q2	SLW3 Q3	SLW3 Q4	SLW3 Q5	SLW3 Q6	SLW3 Q7	SLW3 Q8	SLW3 Q9	SLW3 Q10
Hermit Crab			1		1	1																									
Sea Slater	*Ligia exotica*																	1													
Sea Anemone		3	2	2					2				1	1	2																
Rock Oyster[1]	*Saccostrea cucullata*											10%	5%	20%	10%	5%	2%	2%	10%	2%	2%										
Bivalve	*Striarca symmetrica*										1																				
Littorinid Snail	*Littoraria articulata*																					37	76	40	96	48	64	72	56	32	27
Nerite	*Nerita polita*	1							4			7	7	6	3	10	8	2	3	2	7	6	8	4	9	3	4	1	8	4	
Common Whelk	*Thais clavigera*	1		1	1				2		1			1		3			1												

Summary

Transect	SLW1	SLW2	SLW3
Level (mCD)	0.8	1.0	1.2
Substrate	pebble	pebble	pebble
Average Density (individuals per m^2)			
Hermit Crab	1.2	0	0
Sea Slater	0	0.4	0
Sea Anemone	3.6	1.6	0
Rock Oyster	0%	7%	0%
Bivalve	0.4	0	0
Littorinid Snail	0	0	219.2
Nerite	2	22	18.8
Common Whelk	2.4	2	0
Total Density (individuals per m^2)	9.6	26	238
Number of Species	5	5	2

Method: 10m line transect and $0.25m^2$ quadrat.

Note: 1. Rock oyster expressed as percentage of cover and not included in the abundance and density calculation.

2. No horseshoe crab observed.

General Description: Sheltered sandy / pebble shore.

Appendix F

Coral Survey Report

THE OCEANWAY CORPORATION LTD

REPORT

FIELD DIVING SURVEYS OF CORALS FOR THE HONG KONG – ZHUHAI – MACAU BRIDGE

AGREEMENT NO: MW 01/2003

October 2003

EXECUTIVE SUMMARY

- Twentry-seven spot dives were conducted within the areas of potential landfall of the Hong Kong – Zhuhai – Macua Bridge and North Lantau Highway Connection.
- Visibility was extremely low and this made the dive surveys inefficient with relatively small distances covered on each dive. Should further quantitative surveys be required methodologies should be revised to take account of the adverse conditions.
- For this report the area was split into four sub-areas based on geographical and zoological distinctions:
  - Sham Wat / San Shek Wan
  - West Chek Lap Kok Channel
  - East Chek Lap Kok Channel
  - East Tung Chung
- No corals were observed in the east or west Chek Lap Kok Channel. An ahermatypic cup coral, i.e., *Balanophyllia*, and a gorgonian soft coral, i.e., *Echinomuricea*, were observed, however, on hard substrate to the east and west of Chek Lap Kok. Abundance was, however, low (cover <5%) and in particular *Echinomuricea* suffered high levels of partial mortality.
- The results of the spot dives suggested it was unnecessary to carry out further in-depth surveys.

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MATERIALS AND METHODS

The survey technique used was a tiered methodology employed to assess sub-littoral benthic communities, in particular, hard and soft corals within the identified potential impact zones. It consists of a suite of three standardized 'nested' survey methods: spot-check dives, Rapid Ecological Assessment (REA) and video transects. In an effort to increase survey efficiency the spot-check dives are used to identify sites where more detailed quantitative surveys, i.e., REA and video assessments, are appropriate. Following the spot dives it was, however, unnecessary to carry out further surveys and, furthermore, due to extremely low visibility in the study area the reliability of such methods would have been questionable.

SPOT-CHECK RECONNAISSANCE DIVES

A SCUBA diver assessed the substrate and other marine benthos for the presence of coral communities. These 'spot-check' dives were distributed in and around each survey area at a density that was sufficient to locate any major coral areas and to reliably assess the type of benthos existing in each survey area. The starting location and direction were chosen to ensure most of the area within the specified depth zone (to the end of the hard substrate) was examined. For each dive the following information was recorded:

- location (GPS);
- depth range;
- visibility;
- estimate of % hard coral and soft coral cover;
- substrate type;
- distance surveyed;
- coral species and other invertebrates present.
- health of any corals located.

In this way, areas with significant quantities of corals were located and suitable locations to carry out further surveys determined. In order to decide upon areas where REA and video surveys were required, the estimate of hard and soft coral is classified into one of four levels; no coral cover, less than 5% cover, between 5% and 10% cover and over 10% cover.

Sample spot dive data sheets can be found in Appendix 3.

RESULTS

A total of 27 spot dives were carried out in the Tung Chung and Chek Lap Kok areas (Figure 1 and Table A1.1: Appendix 1). The study area was broken down into four sub areas and these are shown in Figures A – D. Spot dives were distributed amongst the areas in an attempt to find any corals such that any area with little hard substrate received less attention.

A short description of each area is now given. Raw data maybe found in Appendix 2.

Sham Wat / San Shek Wan

Figures A & B show the locations of each spot dive conducted within the Sham Wat / San Shek Wan area. Ten spot dives (SD 1-10) were conducted within this area. In total 9 taxa were observed during the spot dives conducted within this area. Of these one hard coral and one soft coral were observed. The most ubiquitous taxa were barnacles and the oysters. Of note, the hard ahermatypic coral *Balanophyllia* spp. and the soft coral *Echinomuricea* spp. were also found but these were patchily distributed and overall percentage cover was <5%. Whilst *Balanophyllia* was found on a variety of hard substrate the soft coral *Echinomuricea* was only found on the tops of large boulders and suffered considerable partial mortality. The majority of the corals were found in extremely shallow water, i.e., 1.5 m.

West Chek Lap Kok Channel

Figure B gives the locations of each spot dive within the west Chek Lap Kok area. Eight spot dives (SD 11-18) were conducted within this area. In total 6 taxa were observed during the spot dives conducted within this area. No hard coral or soft corals were however located. Ubiquitous taxa were the green mussel *Perna viridis*, barnacles and oysters. The water on the north side of Lantau was extremely shallow and quickly became mud and sand. The south side of Chek Lap Kok was made up of a quarry rock artificial seawall and had very little sessile fauna.

East Chek Lap Kok Channel

Figure C gives the locations of each spot dive within the East Chek Lap Kok area. Four spot dives (SD 19-22) were conducted within this area. In total 8 taxa were observed during the spot dives conducted within this area. No hard coral or soft corals were however located. Ubiquitous taxa were the green mussel *Perna viridis*, barnacles and oysters. The water on the north side of Lantau in particular Tung Chung Wan was extremely shallow. The south side of Chek Kap Kok was made up of a quarry rock artificial seawall was very little sessile fauna. Outside of the channel SD22 was located on the east of Chek Lap Kok. Some natural rocky substrate was present here and the hard ahermatypic coral *Balanophyllia* spp. and the soft coral *Echinomuricea* spp. were found. Abundance was, however, low with percentage cover of <5%.

East Tung Chung

Figure D gives the locations of each spot dive within the Tung Chung and East Tung Chung area. Five spot dives (SD 23 - 27) were conducted within this area. In total 7 taxa were observed during the spot dives conducted within this area. Of these one soft coral was observed. The most ubiquitous taxa were barnacles and the green mussel *Perna viridis*. The soft coral *Echinomuricea* spp. were also found but were patchily distributed and overall percentage cover was <5%. Extensive reclamation has occurred in this area and very little natural / original substrate was found in the subtidal zone. Artificial quarry rock seawall was therefore the dominant substrate. The majority of the corals were found in extremely shallow water, i.e., 1.5 - 2 m.

SUMMARY AND CONCLUSIONS

Twentry-seven spot dives were conducted on October 15th, 2003 in the surrounding areas of Tung Chung, Chek Lap Kok, Sham Wat and San Shek Wan. These areas were assessed for coral communities that may potentially be impacted by the Hong Kong Section of the Hong Kong – Zhuhai – Macau Bridge and the North Lantau Highway Connection.

During these spot dives surveys underwater visibility was extremely low and this made the surveys inefficient: only relatively small distances covered on each dive. Due to the limited visibility, all ambient light was extinguished below 4 -5 m. Generally, the hard substrate ended at around 3 m water depth and after this, the substrate was sand and mud. Should any further surveys be required in these areas it is suggested that methodologies are revised to take account of these adverse conditions.

The area was split into four sub areas based on geographical and zoological distinctions, i.e., Sham Wat / San Shek Wan, West Chek Lap Kok Channel, East Chek Lap Kok Channel and East Tung Chung. No corals were found in the Chek Lap Kok Channel. An ahermatypic cup coral, i.e., *Balanophyllia*, and a gorgonian soft coral, i.e., *Echinomuricea*, were observed, however, on hard substrate to the east and west of Chek Lap Kok. Abundance was low (cover <5%) and *Echinomuricea* in particular suffered high levels of partial mortality.

The results of the spot dives suggest that it is unnecessary to carry out further in-depth surveys. Since corals are not abundant and patchily distributed, furthermore only two common species were recorded.

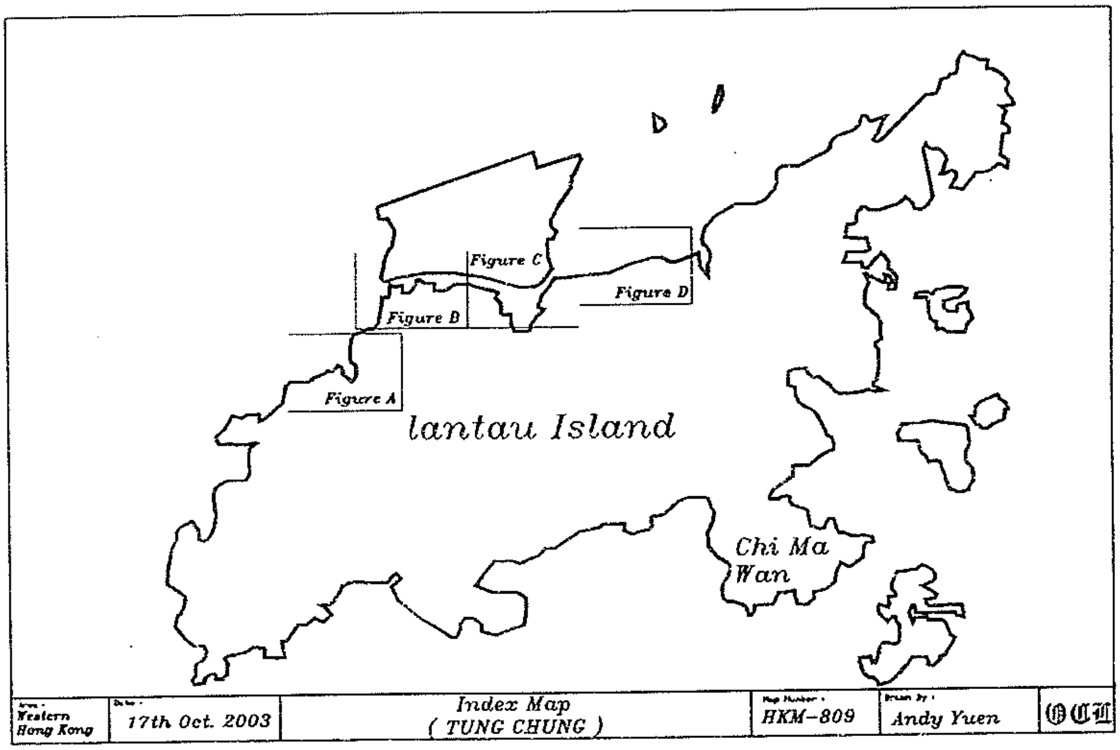


Figure 1. A map showing the 4 areas within which the coral surveys were carried out.

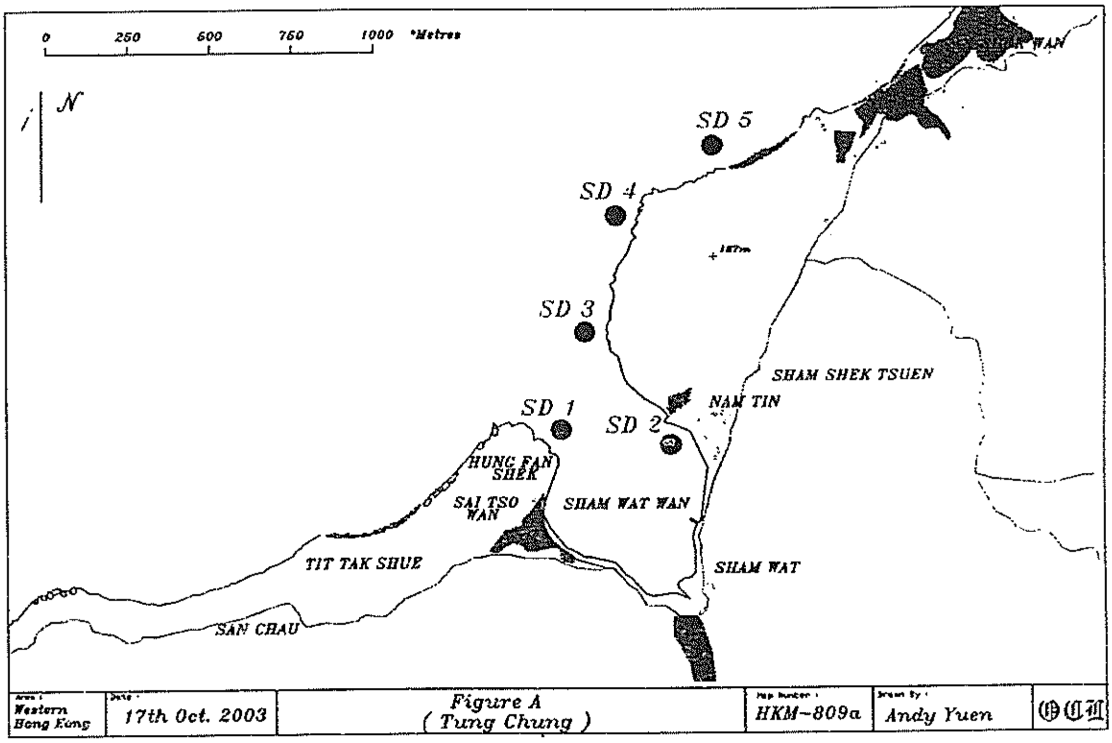


Figure 1. A map showing the 4 areas within which the coral surveys were carried out.

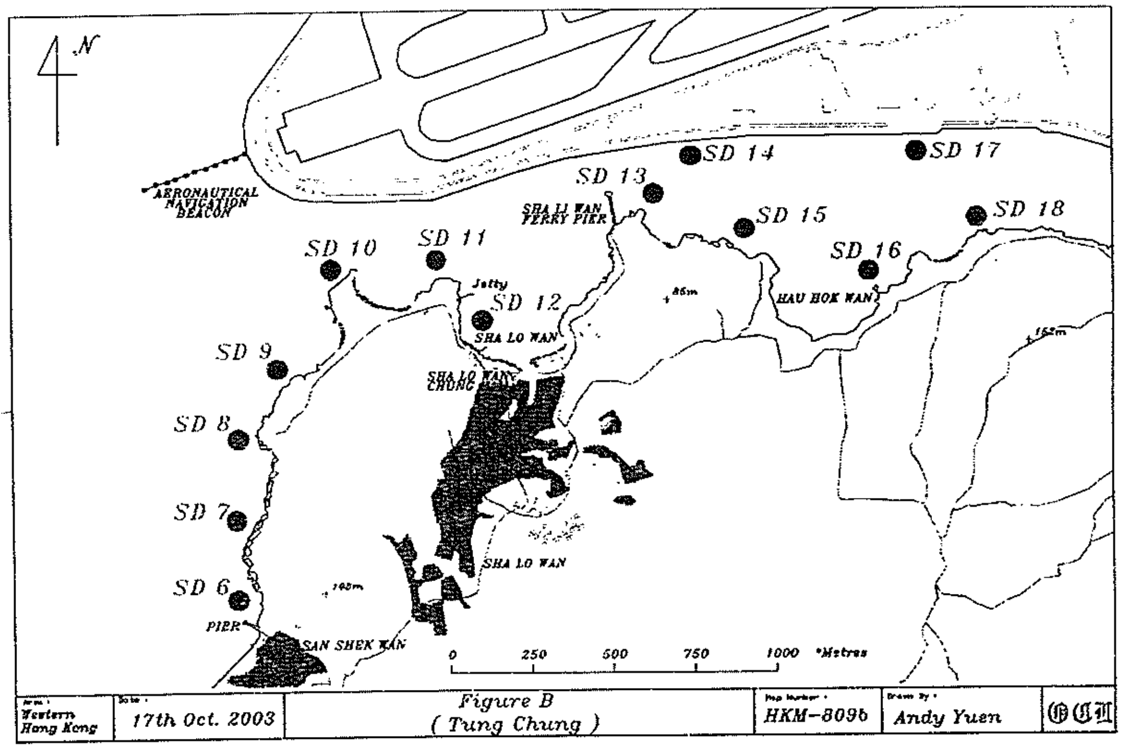


Figure B. A map showing the spot dive locations within the Chek Lap Kok west area.

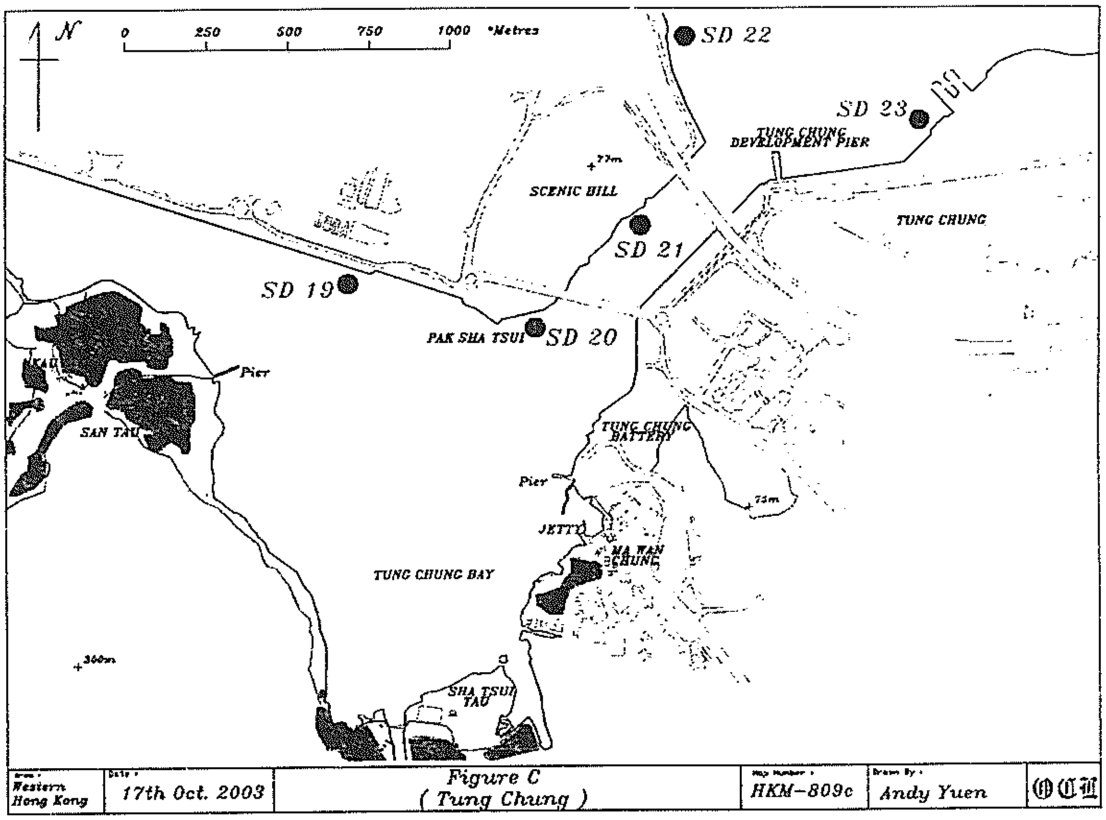


Figure C. A map showing the spot dive locations within the Chek Lap Kok east area.

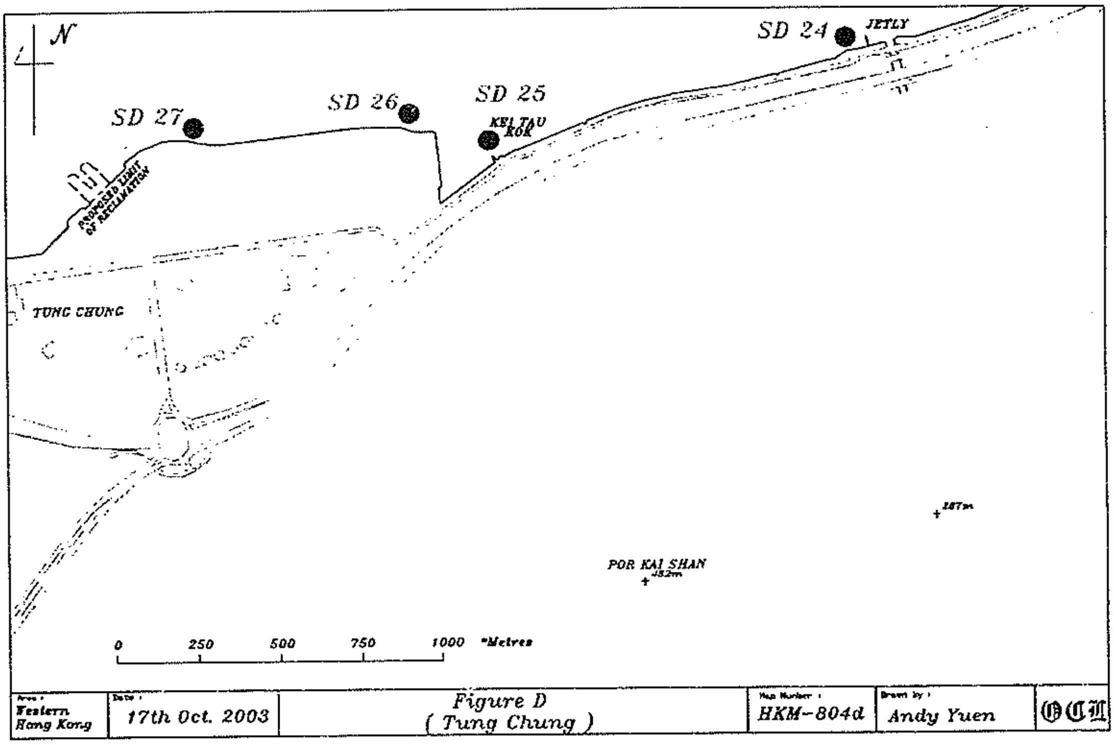


Figure D. A map showing the spot dive locations within the Tung Chung and Tung Chung East area.

APPENDIX 1: GPS COORDINATES

Table A1.1. GPS coordinates of spot dives.

Spot dive Number	GPS coordinate N	E
1	16.468	52.850
2	16.538	52.976
3	16.786	53.060
4	16.829	53.190
5	16.917	53.313
6	17.073	53.491
7	17.190	53.485
8	17.334	53.500
9	17.444	53.578
10	17.568	53.624
11	17.585	53.816
12	17.533	53.853
13	17.690	54.105
14	17.775	54.145
15	17.653	54.277
16	17.568	54.533
17	17.794	54.613
18	17.637	54.942
19	17.608	55.483
20	17.496	55.857
21	17.672	56.062
22	17.982	56.113
23	17.801	56.542
24	18.062	57.867
25	17.892	57.259
26	17.928	57.150
27	17.918	57.679

APPENDIX 2: SPOT DIVE RAW DATA

Table A2.1. Spot dive site information

Dive	Date	Map	Depth		Substrate	Coral	Part.
			Min	Max		Cover	Mort.
.							
S01	15.10.03	A	1.1	3.1	R, M	<5%	50%
S02	15.10.03	A	1	3.4	R, M	<5%	50%
S03	15.10.03	A	0.9	3.2	R, M	<5%	n/a
S04	15.10.03	A	1	4.6	R, M	<5%	50%
S05	15.10.03	A	1.1	3.2	R, M	<5%	50%
S06	15.10.03	A	1.2	3.4	R, M	<1%	50%
S07	15.10.03	A	0.8	3.6	R, M	<1%	50%
S08	15.10.03	A	0.4	3.8	R, M	<1%	50%
S09	15.10.03	A	1.1	4.2	R, M	<1%	50%
S10	15.10.03	A	0.9	3.1	R, M	<1%	50%
S11	15.10.03	B	0.8	3.1	R, M	0	n/a
S12	15.10.03	B	0.8	2.9	R, M	0	n/a
S13	15.10.03	B	1	2.4	R, M	0	n/a
S14	15.10.03	B	1.2	5.6	art SW	0	n/a
S15	15.10.03	B	1	3.1	R, M	0	n/a
S16	15.10.03	B	0.9	3.4	R, M	0	n/a
S17	15.10.03	B	0.8	5.8	art SW	0	n/a
S18	15.10.03	B	0.6	3.2	R, M	0	n/a
S19	15.10.03	C	0.8	5.2	art SW	0	n/a
S20	15.10.03	C	0.9	5.6	art SW	0	n/a
S21	15.10.03	C	0.6	5.8	R, M	0	n/a
S22	15.10.03	C	0.7	6.1	R, M	<5%	50%
S23	15.10.03	D	0.9	5.4	R, M	<1%	50%
S24	15.10.03	D	0.6	6.2	art SW	<1%	50%
S25	15.10.03	D	0.4	4.2	art SW	<1%	50%
S26	15.10.03	D	0.9	6.1	art SW	<1%	50%
S27	15.10.03	D	1.1	6.8	art SW	<1%	50%

Table A2.2 Spot dive species information

Dive	**Hard Coral**	**Ahermatypic**	*Balanophyllia*	Other	**Soft corals**	*Echinomuricea sp.*	Others	**Other Sessile organisms**	*Schizoporella errata*	*Bugula*	Encrusting Red Bryozoan	Anemones	Barnacles	Oysters	*Perna*	Sponges	Tube worms
S01	0		X	0		X	0		X	0	0	0	X	X	0	0	X
S02	0		X	0		X	0		0	0	X	X	X	X	0	0	X
S03	0		X	0		X	0		0	0	X	X	X	X	0	0	0
S04	0		X	0		X	0		0	0	X	X	X	X	X	0	0
S05	0		X	0		X	0		X	0	X	0	X	X	X	0	X
S06	0		0	0		X	0		0	0	0	0	X	X	0	0	0
S07	0		X	0		X	0		0	0	X	X	X	X	X	0	0
S08	0		X	0		X	0		0	0	0	0	0	0	X	0	0
S09	0		X	0		X	0		0	0	0	0	0	0	X	0	0
S10	0		0	0		X	0		0	0	0	0	0	0	X	0	0
S11	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S12	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S13	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S14	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S15	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S16	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S17	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S18	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S19	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S20	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S21	0		0	0		0	0		0	0	X	X	X	X	X	0	X
S22	0		X	0		X	0		0	0	X	X	X	X	X	0	X
S23	0		0	0		X	0		0	0	X	X	X	X	X	0	X
S24	0		0	0		X	0		0	0	X	X	X	X	X	0	X
S25	0		0	0		X	0		0	0	X	X	X	X	X	0	X
S26	0		0	0		X	0		0	0	X	X	X	X	X	0	X
S27	0		0	0		X	0		0	0	X	X	X	X	X	0	X

APPENDIX 3: SAMPLE DATA SHEETS

Table A3.1 Data sheet used to record observations in the spot dives

Dive Location		Taxa observed:
Date		
Team		
Start Time		
Depth Min		
Max		
Distance		Notes:
Substrate		
Coral cover		
Part. Mort.		

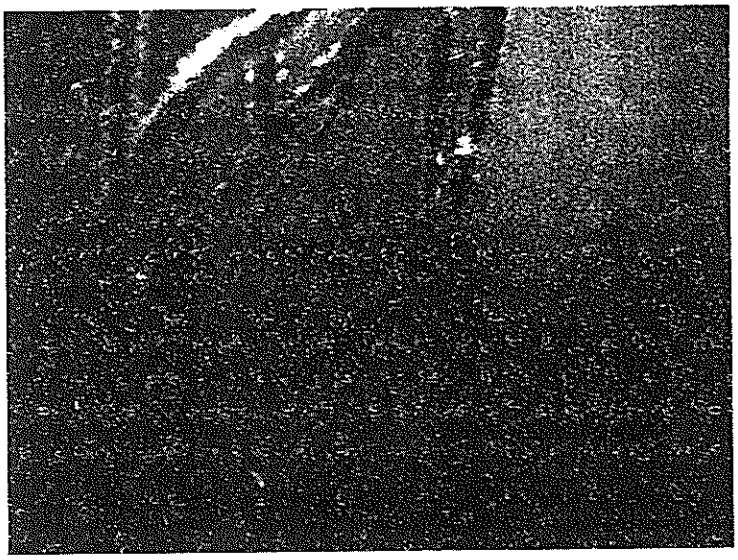
Dive Location		Taxa observed:
Date		
Team		
Start Time		
Depth Min		
Max		
Distance		Notes:
Substrate		
Coral cover		
Part. Mort.		

Dive Location		Taxa observed:
Date		
Team		
Start Time		
Depth Min		
Max		
Distance		Notes:
Substrate		
Coral cover		
Part. Mort.		

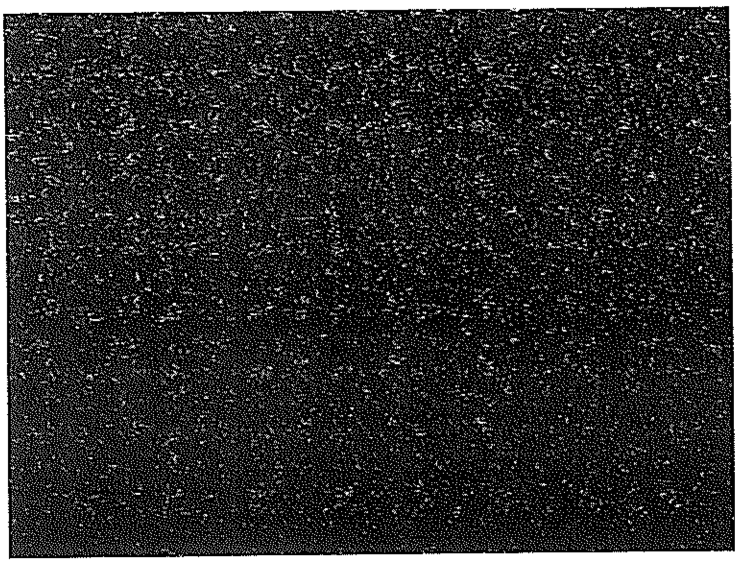
Dive Location		Taxa observed:
Date		
Team		
Start Time		
Depth Min		
Max		
Distance		Notes:
Substrate		
Coral cover		
Part. Mort.		

APPENDIX 4: SELECTED PHOTOGRAPHS

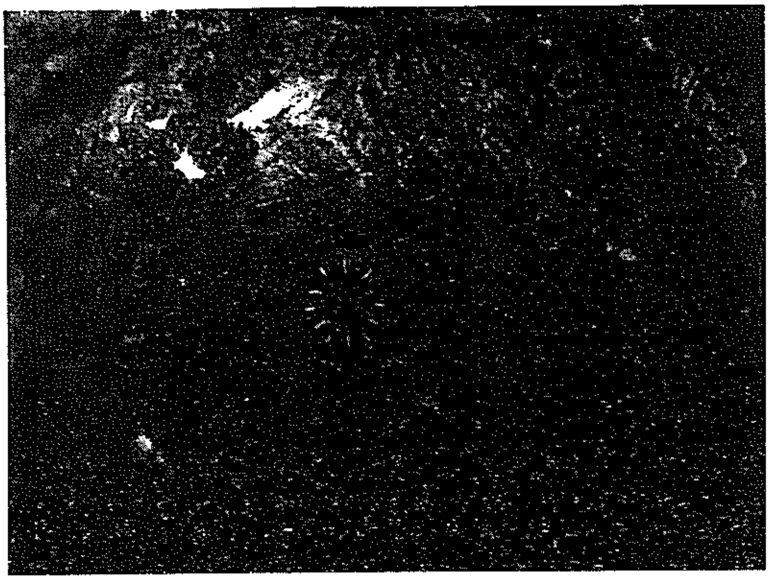
The soft coral *Echinomuricea*. This soft coral was present to the west and east of Chek Lap Kok but was small in size and suffered high levels of partial mortality.



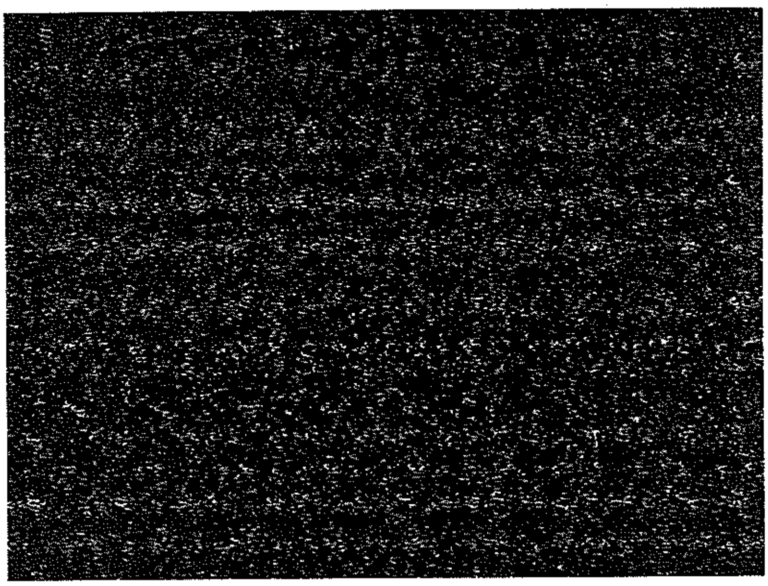
High levels of partial mortality were recorded on the soft coral *Echinomuricea*.



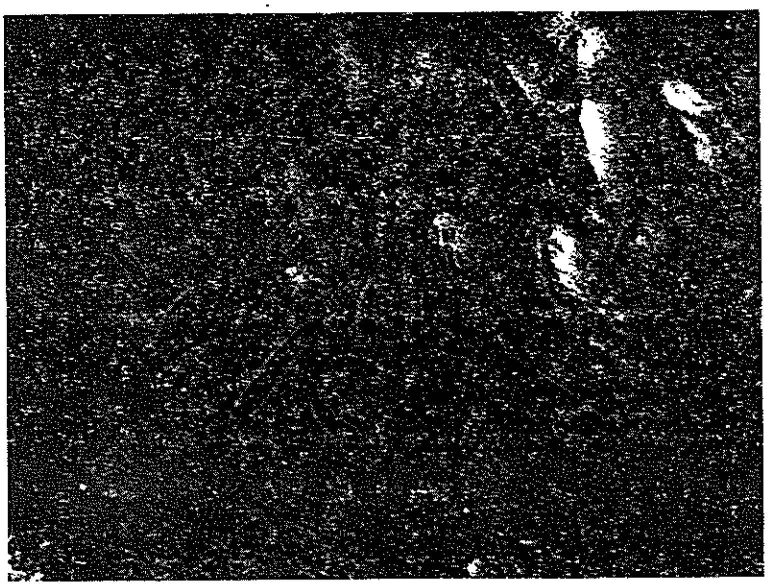
The ahermatypic coral *Balanophyllia* was found in the Sham Wat / San Shek Wan area



To get a clear photograph for identification due to extremely poor visibility a rock was removed to allow a shot to be taken on the boat.



Oysters and mussels (below) were common taxa observed during the diving surveys



Appendix G

List of Recorded Horseshoe Crab Species

Horseshoe Crab Survey Results

Date	Area	Species	No of Individuals	Prosoma width (cm)
18-Sep-03	Hau Hok Wan, San Tau, Sha Lo Wan, Tung Chung Bay	No horseshoe crabs or trails.		
25-Sep-03	Hau Hok Wan, San Shek Wan, San Tau, Sha Lo Wan	No horseshoe crabs or trails.		
26-Sep-03	Pak Mong, Tai Ho Wan	No horseshoe crabs or trails.		
* 2-Oct-03	Hau Hok Wan, San Shek Wan, San Tau, Sha Lo Wan	No horseshoe crabs or trails.		
21-Oct-03	Pak Mong, Pak Sha Tsui, Tai Ho Wan, Tung Chung Bay, Tung Chung Town	No horseshoe crabs or trails.		
22-Oct-03	Hau Hok Wan, San Shek Wan, Sha Lo Wan, Sham Wat Wan	More than 10 juveniles observed at Sham Wat		
* 25-Oct-03	Sham Wat Wan	No horseshoe crabs or trails.		
18-Nov-03	San Tau	*Tachypleus tridentatus*	2	<2
		Tachypleus tridentatus	1	3.7
		Tachypleus tridentatus	2	3.8
		Tachypleus tridentatus	1	3.9
		Tachypleus tridentatus	2	4
		Tachypleus tridentatus	1	5.2
		Tachypleus tridentatus	1	7.2
		Carcinoscorpius rotundicauda	1	5.6
	Total	***Tachypleus tridentatus***	**10**	
		Carcinoscorpius rotundicauda	**1**	
	Tai Ho Wan, Pak Mong, Tung Chung Bay	No horseshoe crabs or trails.		
19-Nov-03	Hau Hok Wan	*Tachypleus tridentatus*	1	1.4
		Tachypleus tridentatus	1	3.7
		Carcinoscorpius rotundicauda	1	4.5
	Total	***Tachypleus tridentatus***	**2**	
		Carcinoscorpius rotundicauda	**1**	
	Sha Lo Wan, San Shek Wan, Sham Wat Wan	No horseshoe crabs or trails.		
07-Jan-04	Pak Mong, Tai Ho Wan	No horseshoe crabs or trails.		
15-Jan-04	Hau Hok Wan, San Tau, Sha Lo Wan, Tung Chung Bay	No horseshoe crabs or trails.		
16-Jan-04	San Shek Wan, Sha Lo Wan, Sham Wat Wan	No horseshoe crabs or trails.		
# 25-Jan-04	Hau Hok Wan	No horseshoe crabs or trails.		
# 17-Feb-04	San Tau	No horseshoe crabs or trails.		
11-Mar-04	San Shek Wan, Sha Lo Wan, Sham Wat Wan	No horseshoe crabs or trails.		
23-Mar-04	Hau Hok Wan, Pak Mong, San Tau, Tai Ho Wan, Tung Chung Bay	No horseshoe crabs or trails.		
23-Apr-04	Sham Wat Wan (West)	*Tachypleus tridentatus*	1	4.0
		Tachypleus tridentatus (molt)	1	3.9
		Tachypleus tridentatus (molt)	1	3.5
		Tachypleus tridentatus (molt)	1	3.0
	Total	***Tachypleus tridentatus***	**1**	
05-May-04	Tung Chung Bay (West)	*Tachypleus tridentatus*	2	3.3
		Tachypleus tridentatus	2	3.8
		Tachypleus tridentatus	4	4.0
		Tachypleus tridentatus	1	4.8
		Tachypleus tridentatus	1	4.9
		Tachypleus tridentatus	2	5.0
		Tachypleus tridentatus	1	5.1
		Tachypleus tridentatus	1	5.3
		Tachypleus tridentatus	1	5.4
	Total	***Tachypleus tridentatus***	**15**	
	Tung Chung Bay - San Tau	*Tachypleus tridentatus*	1	3.9
		Tachypleus tridentatus	1	4.9
		Tachypleus tridentatus	1	5.2
		Tachypleus tridentatus	1	5.4
		Tachypleus tridentatus	1	5.5
		Tachypleus tridentatus	1	7.4
	Total	***Tachypleus tridentatus***	**6**	
	San Tau	*Tachypleus tridentatus*	1	4.9
		Tachypleus tridentatus	3	5.2
		Tachypleus tridentatus	1	6.3
	Total	***Tachypleus tridentatus***	**5**	
06-May-04	Tai Ho Wan	*Carcinoscorpius rotundicauda*	1	1.7
		Carcinoscorpius rotundicauda	1	3.0
		Carcinoscorpius rotundicauda	1	3.1
		Carcinoscorpius rotundicauda	2	3.3
		Carcinoscorpius rotundicauda	1	3.4
		Carcinoscorpius rotundicauda	1	3.5
		Carcinoscorpius rotundicauda	1	3.6
		Carcinoscorpius rotundicauda	3	3.7
		Carcinoscorpius rotundicauda	1	5.0
		Carcinoscorpius rotundicauda	2	5.3
		Carcinoscorpius rotundicauda (molt)	1	2.7
		Carcinoscorpius rotundicauda (molt)	1	3.6
		Carcinoscorpius rotundicauda (molt)	1	4.0
	Total	***Carcinoscorpius rotundicauda***	**14**	

* Half-day Additional Survey
# Short Visit - 25-Jan-04: ~30 minutes
- 17-Feb-04: 12:00 - 12:30

Appendix H

List of Recorded Avifauna Species

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Summary of Avifauna Survey Results

Type of survey	Species name	Common name	Date of survey																																		Sighting Locations																				Habitat
			24-Sep-03	30-Sep-03	2-Oct-03	20-Oct-03	21-Oct-03	23-Oct-03 (Night)	24-Oct-03	28-Oct-03	29-Oct-03	30-Oct-03 (Night)	5-Nov-03	5-Nov-03 (Night)	19-Nov-03	27-Nov-03 (Night)	28-Nov-03	19-Dec-03	22-Dec-03	22-Jan-04	26-Jan-04	27-Jan-04	17-Feb-04 (Night)	18-Feb-04	19-Feb-04 (Night)	23-Feb-04	17-Mar-04	31-Mar-04	15-Apr-04	19-Apr-04 (Night)	27-Apr-04 (Night)	30-Apr-04	11-May-04	12-May-04	27-May-04 (Day and Night)	Sham Wat Bay	Sham Shek Tsuen	San Shek Wan	San Shek Wan Tunnel Option	Sha Lo Wan	Fery Pier	Hau Hok Wan	Chek Lap Kok	Kau Liu	Tin Sam	San Tau	Tung Chung Bay	Hau Wong Temple	Ma Wan Chung	Tung Chung Battery	Cheung Tung Road Hill	Pak Mong	Ngau Kwu Long	Tai Ho Bay	Hok Tau Wan	
Avifauna	*Accipiter gularis*	Japanese Sparrowhawk											✓																									✓																		WL
(118 species)	*Accipiter trivirgatus*	Crested Goshawk				✓																						✓		✓									✓			✓	✓				✓												WL
	Accipiter virgatus	Besra																																	✓						✓																	WL
	Acridotheres cristatellus	Crested Myna	✓		✓	✓									✓		✓	✓	✓			✓				✓		✓	✓			✓	✓				✓					✓	✓		✓		✓			✓	✓	✓		✓		C,DA
	Acrocephalus bistrigiceps	Black-browed Reed Warbler				✓	✓																												✓												✓										SHG
	Actitis hypoleucos	Common Sandpiper	✓		✓	✓	✓								✓			✓			✓							✓		✓			✓		✓		✓				✓		✓			✓	✓	✓								✓		CT
	Aethopyga christinae	Fork-tailed Sunbird															✓												✓								✓									✓												WL
	Alcedo atthis	Common Kingfisher			✓	✓													✓			✓		✓		✓													✓										✓			✓	✓	✓		✓		S, CT
	Amaurornis phoenicurus	White-breasted Waterhen				✓														✓						✓	✓	✓				✓	✓						✓		✓			✓		✓							✓		S, CT, C
	Anthus hodgsoni	Olive-backed Pipit									✓				✓		✓	✓	✓		✓	✓		✓		✓	✓	✓	✓							✓	✓			✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		C, SHG, DA, TS, PW
	Anthus richardi	Richard's Pipit	✓																															✓				✓		✓														W,C
	Apus affinis	Little Swift																									✓		✓					✓	✓				✓	✓					✓										WL, SHG, TS
	Apus pacificus	Pacific Swift																									✓		✓					✓	✓			✓		✓	✓	✓	✓	✓		✓					✓						WL, SHG, TS
	Ardea cinerea	Grey Heron			✓	✓	✓										✓								✓																									✓	✓								✓		CT
	Ardeola bacchus	Chinese Pond Heron	✓		✓		✓		✓						✓				✓		✓	✓				✓		✓	✓	✓				✓		✓	✓			✓		✓			✓	✓	✓								✓		CT
	Bambusicola thoracica	Chinese Bamboo Partridge																																	✓							✓																TS
	Bubo bubo	Eurasian Eagle Owl																													✓																									✓				SHG
	Bubulcus ibis	Cattle Egret	✓																																													✓								CT
	Butastur indicus	Grey-faced Buzzard																									✓																✓													TS
	Buteo buteo	Common Buzzard				✓													✓		✓								✓								✓					✓						✓							✓		WL, SHG, TS
	Butorides striatus	Striated Heron								✓						✓																	✓	✓									✓					✓							✓		S
	Caprimulgus affinis	Savanna Nightjar																													✓																									✓		✓		SHG,TS
	Centropus bengalensis	Lesser Coucal																				✓					✓	✓	✓							✓		✓		✓	✓														✓			✓		WL, SHG
	Centropus sinensis	Greater Coucal	✓			✓															✓	✓		✓			✓		✓					✓	✓			✓				✓		✓	✓		✓					✓		✓		✓		WL, SHG, TS
	Cettia diphone	Japanese Bush Warbler															✓	✓			✓	✓																	✓			✓	✓	✓			✓		✓				✓		✓		DA, SHG
	Cettia fortipes	Brownish-flanked Bush Warbler																				✓																																		✓		SHG
	Chalcophaps indica	Emerald Dove																																✓													✓								WL
	Cisticola juncidis	Zitting Cisticola					✓																												✓																			SHG
	Clamator coromandus	Chestnut-winged Cuckoo																														✓																							✓		WL
	Copsychus saularis	Oriental Magpie Robin	✓	✓	✓	✓	✓								✓		✓	✓	✓		✓	✓		✓	✓		✓		✓			✓	✓	✓			✓	✓			✓		✓	✓		✓		✓			✓	✓	✓		✓		CT
	Corvus macrorhynchus	Large-billed Crow			✓						✓				✓		✓	✓	✓		✓	✓				✓						✓		✓	✓	✓			✓	✓	✓	✓							✓			✓	✓	✓				WL, CT
	Cuculus micropterus	Indian Cuckoo																														✓	✓	✓						✓					✓								✓		✓		WL, TS
	Cyanoptila cyanomelana	Blue-and-white Flycatcher																✓																						✓													WL
	Delichon dasypus	Asian House Martin																									✓												✓															WL,TS
	Dendrocitta formosae	Grey Treepie		✓																																													✓					WL
	Dicaeum cruentatum	Scarlet-backed Flowerpecker															✓																									✓										WL, TS
	Dicrurus hottentotus	Hair-crested Drongo				✓																											✓						✓		✓			✓														WL
	Dicrurus macrocercus	Black Drongo	✓	✓	✓																												✓	✓						✓				✓		✓									✓					CT, WL, SHG, TS
	Egretta alba	Great Egret	✓				✓		✓																✓					✓	✓						✓				✓	✓		✓					✓								✓		CT
	Egretta eulophotes	Swinhoe's Egret																											✓																		✓								CT
	Egretta garzetta	Little Egret	✓	✓	✓	✓	✓		✓	✓					✓		✓	✓			✓	✓			✓	✓	✓	✓	✓	✓				✓	✓		✓				✓	✓	✓	✓		✓		✓			✓							✓		CT
	Egretta intermedia	Intermediate Egret	✓																																													✓								CT
	Egretta sacra	Pacific Reef Egret	✓		✓	✓													✓								✓				✓									✓	✓		✓						✓								✓		CT
	Emberiza aureola	Yellow-breasted Bunting				✓																																							✓		✓								SHG
	Emberiza fucata	Chestnut-eared Bunting																										✓																												✓		CT
	Emberiza pusilla	Little Bunting																									✓								✓																			TS
	Emberiza rutila	Chestnut Bunting					✓						✓																✓								✓	✓		✓																		SHG
	Emberiza spodocephala	Black-faced Bunting													✓			✓	✓		✓						✓	✓	✓									✓				✓	✓	✓		✓		✓				✓	✓		✓		WL, C, SHG
	Eudynamys scolopacea	Common Koel													✓										✓						✓				✓	✓								✓		✓				✓			✓		✓		✓		CT, WL, DA, TS, C
	Eurystomus orientalis	Dollarbird																											✓										✓															WL
	Falco peregrinus	Peregrine Falcon				✓																																	✓															SHG
	Falco tinnunculus	Common Kestrel											✓		✓			✓	✓			✓																	✓		✓											✓	✓		✓		SHG
	Ficedula mugimaki	Mugimaki Flycatcher											✓																									✓																WL
	Ficedula parva	Red-breasted Flycatcher				✓																																	✓															WL
	Francolinus pintadeanus	Chinese Francolin																												✓		✓	✓	✓	✓		✓		✓																✓	✓		✓		TS, SHG
	Garrulax canorus	Hwamei													✓		✓								✓					✓	✓	✓				✓	✓		✓		✓																✓	✓				SHG, WL
	Garrulax perspicillatus	Masked Laughingthrush	✓								✓				✓		✓	✓	✓			✓		✓		✓	✓	✓	✓			✓	✓	✓				✓			✓	✓	✓	✓		✓		✓				✓	✓		✓		SHG, , DA, TS
	Halcyon pileata	Black-capped Kingfisher				✓	✓		✓				✓		✓		✓		✓		✓			✓						✓	✓						✓	✓		✓											✓							✓		CT
	Halcyon smyrnensis	White-throated Kingfisher				✓	✓		✓								✓	✓			✓				✓			✓	✓			✓		✓	✓		✓				✓	✓	✓		✓		✓			✓					✓		CT, S
	Haliaeetus leucogaster	White-bellied Sea Eagle				✓										✓						✓								✓							✓			✓																WL
	Heteroscelus brevipes	Grey-tailed Tattler																															✓	✓															✓								✓		CT
	Hieraaetus fasciatus	Bonelli's Eagle											✓																									✓																SHG
	Hierococcyx sparverioides	Large Hawk Cuckoo																									✓	✓	✓			✓	✓	✓			✓			✓	✓				✓			✓			✓	✓	✓		✓		WL
	Himantopus himantopus	Black-winged Stilt	✓																																								✓										CT
	Hirundapus cochinchinensis	White-vented Needletail																									✓												✓		✓													TS
	Hirundo rustica	Barn Swallow																									✓	✓						✓			✓			✓											✓		✓		✓		DA,C
	Hypsipetes castanonotus	Chestnut Bulbul															✓	✓			✓	✓																✓							✓		✓										WL
	Ketupa zeylonensis	Brown Fish Owl*								✓				✓		✓																																						✓		S, CT, WL
	Lanius cristatus	Brown Shrike																				✓						✓																									✓		✓		TS
	Lanius schach	Long-tailed Shrike	✓	✓	✓	✓	✓				✓				✓		✓	✓			✓	✓				✓	✓	✓	✓						✓	✓		✓		✓	✓	✓		✓		✓		✓			✓	✓	✓		✓		WL, W, C, SHG
	Lonchura punctulata	Scaly-breasted Munia	✓			✓										✓					✓												✓					✓						✓		✓						✓					W, C, SHG, DA
	Luscinia calliope	Siberian Rubythroat				✓	✓				✓		✓		✓		✓	✓	✓		✓	✓		✓		✓	✓	✓	✓							✓	✓		✓	✓	✓	✓	✓		✓		✓				✓	✓		✓		CT, WL, SHG, TS
	Luscinia sibilans	Rufous-tailed Robin																✓			✓																		✓	✓	✓						✓										WL, TS, SHG
	Milvus migrans	Black Kite	✓			✓	✓				✓		✓				✓	✓			✓	✓		✓		✓	✓		✓				✓	✓		✓	✓		✓	✓	✓	✓			✓		✓						✓		✓		WL, TS, SHG, CT
	Monticola solitarius	Blue Rock Thrush																				✓		✓													✓								✓												✓		CT
	Motacilla alba	White Wagtail	✓		✓	✓	✓										✓	✓	✓		✓	✓		✓		✓	✓	✓	✓					✓			✓	✓			✓	✓	✓			✓		✓			✓		✓		✓		C, DA, S, CT
	Motacilla cinerea	Grey Wagtail	✓														✓	✓				✓							✓		✓			✓		✓						✓	✓						✓						✓		✓		C, S
	Motacilla flava	Yellow Wagtail																											✓																		✓								CT
	Muscicapa dauurica	Asian Brown Flycatcher	✓	✓		✓																																	✓		✓			✓												WL, TS
	Myophonus caeruleus	Blue Whistling Thrush		✓							✓				✓		✓		✓		✓			✓		✓							✓			✓					✓	✓					✓					✓	✓		✓		WL, S, CT
	Nycticorax nycticorax	Black-crowned Night Heron								✓				✓	✓	✓									✓																														✓		S, CT
	Orthotomus sutorius	Common Tailorbird	✓			✓								✓		✓	✓	✓		✓	✓		✓			✓	✓	✓			✓	✓	✓				✓			✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		W, C, SHG, DA, TS
	Otus bakkamoena	Collared Scops Owl						✓		✓		✓											✓								✓	✓						✓		✓	✓	✓				✓											✓				WL
	Parus major	Great Tit	✓			✓								✓		✓				✓	✓		✓			✓	✓	✓				✓	✓		✓	✓			✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		CT, WL, C, DA, TS
	Passer montanus	Eurasian Tree Sparrow				✓								✓		✓																		✓						✓				✓					✓					W, C, DA, S
	Phoenicurus auroreus	Daurian Redstart													✓		✓	✓	✓		✓	✓		✓													✓	✓			✓	✓	✓	✓		✓		✓				✓	✓		✓		WL, C, DA, TS
	Phylloscopus borealis	Arctic Warbler	✓			✓																																	✓	✓	✓			✓										WL, TS, CT
	Phylloscopus fuscatus	Dusky Warbler				✓	✓						✓		✓		✓		✓		✓			✓		✓	✓		✓			✓				✓	✓		✓	✓		✓	✓		✓		✓				✓	✓		✓		CT, WL, C, SHG, DA, TS
	Phylloscopus inornatus	Yellow-browed Warbler				✓							✓		✓		✓	✓	✓		✓	✓					✓	✓	✓								✓		✓	✓		✓	✓		✓		✓				✓	✓		✓		CT, WL, TS, C
	Phylloscopus proregulus	Pallas's Leaf Warbler															✓	✓	✓		✓			✓														✓					✓	✓		✓		✓					✓				WL, TS, C
	Phylloscopus tenellipes	Pale-legged Leaf Warbler	✓	✓		✓	✓																														✓			✓					✓						✓					WL, TS
	Pica pica	Common Magpie				✓								✓		✓	✓			✓			✓		✓	✓	✓	✓	✓		✓		✓		✓	✓				✓	✓	✓		✓		✓			✓	✓	✓		✓		CT, WL, DA, TS
	Prinia flaviventris	Yellow-bellied Prinia																			✓			✓		✓												✓															✓				SHG
	Prinia inornata	Plain Prinia																									✓														✓												C
	Pycnonotus aurigaster	Sooty-headed Bulbul																									✓						✓		✓	✓			✓	✓	✓																C
	Pycnonotus jocosus	Red-whiskered Bulbul	✓	✓	✓	✓					✓		✓		✓		✓		✓		✓	✓		✓				✓	✓			✓	✓	✓				✓		✓	✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		CT, WL, W, C, SHG, TS, S
	Pycnonotus sinensis	Chinese Bulbul	✓	✓		✓	✓				✓		✓		✓		✓	✓	✓		✓	✓		✓		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		CT, WL, W, C, SHG, TS, S
	Rallina eurizonoides	Slaty-legged Crake*																												✓	✓						✓									✓										✓		TS
	Saxicola torquata	Common Stonechat				✓												✓										✓																✓										✓		C, SHG, WL
	Scolopax rusticola	Eurasian Woodcock								✓						✓		✓								✓																✓												✓		WL
	Serinus mozambicus	Yellow-fronted Canary																																✓													✓								DA
	Spilornis cheela	Crested Serpent Eagle																											✓								✓																		WL
	Streptopelia chinensis	Spotted Dove	✓		✓	✓	✓								✓		✓				✓	✓		✓		✓	✓	✓	✓			✓	✓	✓		✓	✓			✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		CT, WL, W, C, SHG, TS, S
	Streptopelia orientalis	Oriental Turtle Dove																✓	✓		✓	✓		✓														✓						✓												✓		SHG, TS, C
	Sturnus nigricollis	Black-collared Starling	✓		✓	✓											✓	✓	✓			✓				✓		✓				✓		✓		✓				✓				✓		✓		✓			✓	✓	✓		✓		CT, WL, W, C, SHG, TS, S
	Sturnus sericeus	Red-billed Starling																✓			✓																						✓		✓								CT, WL
	Sturnus sinensis	White-shouldered Starling																						✓				✓					✓							✓	✓																		WL
	Tachybaptus ruficollis	Little Grebe					✓																																✓															CT
	Tarsiger cyanurus	Red-flanked Bluetail															✓				✓	✓														✓			✓	✓	✓			✓		✓			✓		✓				WL, TS, C
	Tringa glareola	Wood Sandpiper																												✓					✓																			CT
	Turdus cardis	Japanese Thrush																✓			✓	✓		✓															✓			✓	✓	✓						✓							✓		WL, TS, C
	Turdus hortulorum	Grey-backed Thrush															✓	✓			✓	✓		✓		✓	✓										✓	✓			✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		WL, TS, C
	Turdus merula	Common Blackbird					✓						✓				✓				✓																✓	✓		✓						✓				✓								TS, C
	Turdus pallidus	Pale Thrush																			✓	✓																					✓			✓									✓		C, WL
	Urocissa erythrorhyncha	Blue Magpie					✓										✓	✓						✓						✓									✓			✓	✓				✓		✓								WL, TS
	Urosphena squameiceps	Asian Stubtail Warbler															✓				✓																		✓			✓	✓	✓	✓				✓								WL, TS
	Zoothera dauma	Scaly Thrush																✓			✓	✓		✓			✓												✓			✓	✓	✓													✓		WL, DA, TS, C
	Zosterops japonicus	Japanese White-eye		✓		✓								✓		✓	✓	✓		✓	✓		✓		✓	✓		✓			✓		✓			✓			✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		CT, WL, W, C, SHG, DA, TS, S

Habitat
C- Cultivated field/Orchard
CT-Coastal
DA- Developed Area
S- Stream/s/Riparian/Pond
PW- Plantation Woodland
ShG- Shrubby Grassland
TS- Tall Shrubland
W- Wasteland
WL-woodland

Avifauna

Date of Survey 24 September 2003

Common Name	Scientific name	Total	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan
Cattle Egret	*Bubulcus ibis*	700			700				
Chinese Pond Heron	*Ardeola bacchus*	41			39	2			
Pacific Reef Egret	*Egretta sacra*	2			1			1	
Little Egret	*Egretta garzetta*	784			773	1	1	8	1
Intermediate Egret	*Egretta intermedia*	10			10				
Great Egret	*Egretta alba*	9			5			4	
Black Kite	*Milvus migrans*	2				1		1	
Black-winged Stilt	*Himantopus himantopus*	1				1			
Common Sandpiper	*Actitis hypoleucos*	2			1	1			
Spotted Dove	*Steptopelia chinensis*	13				8			5
Greater Coucal	*Centropus sinensis*	1					1		
Richard's Pipit	*Anthus richardi*	4						4	
Grey Wagtail	*Motacilla cinerea*	2			2				
White Wagtail	*Motacilla alba*	4		1	1	1			1
Red-whiskered Bulbul	*Pycnonotus jocosus*	21	10			8			3
Chinese Bulbul	*Pycnonotus sinensis*	28	10				12	6	
Oriental Magpie Robin	*Copsychus saularis*	3							3
Common Tailorbird	*Orthotomus sutorius*	2							2
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	1				1			
Arctic Warbler	*Phylloscopus borealis*	6				2	3	1	
Asian Brown Flycatcher	*Muscicapa dauurica*	4				1			3
Masked Laughingthrush	*Garrulax perspicillatus*	18				12	6		
Great Tit	*Parus major*	5				4			1
Long-tailed Shrike	*Lanius schach*	4	2			2			
Black Drongo	*Dicrurus macrocercus*	1	1						
Black-collared Starling	*Sturnus nigricollis*	4		2	2				
Crested Myna	*Acridotheres cristatellus*	15	15						
Scaly-breasted Munia	*Lonchura punctulata*	6	6						

Date of Survey: 30 September 2003

Common Name	Scientific name	Total	Tai Ho Wan	Cheung Tung Road Hill					
Little Egret	*Egretta garzetta*	4	4	34 in southern part of bay					
Red-whiskered Bulbul	*Pycnonotus jocosus*	12		12					
Chinese Bulbul	*Pycnonotus sinensis*	5		5					
Oriental Magpie Robin	*Copsychus saularis*	3		3					
Blue Whistling Thrush	*Myophonus caeruleus*	2		2					
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	2		2					
Asian Brown Flycatcher	*Muscicapa dauurica*	1		1					
Japanese White-eye	*Zosterops japonicus*	12		12					
Long-tailed Shrike	*Lanius schach*	1		1					
Black Drongo	*Dicrurus macrocercus*	3		3					
Grey Treepie	*Dendrocitta formosae*	1		1					

Date of Survey: 2 October 2003 (Half-day Additional Survey)

Common Name	Scientific name	Total	San Tau	Hau Hok Wan	Tung Chung Wan	Sha Lo Wan
Black Drongo	*Dicrurus macrocercus*	1				1
Black-collared Starling	*Sturnus nigricollis*	1			1	
Chinese Pond Heron	*Ardeola bacchus*	2	1	1		
Common Kingfisher	*Alcedo atthis*	1				1
Common Sandpiper	*Actitis hypoleucos*	2	1			1
Crested Myna	*Acridotheres cristatellus*	1		1		
Grey Heron	*Ardea cinerea*	1	1			
Large-billed Crow	*Corvus macrorhynchus*	1		1		
Little Egret	*Egretta garzetta*	2			1	1
Long-tailed Shrike	*Lanius schach*	1			1	
Oriental Magpie Robin	*Copsychus saularis*	2			1	1
Pacific Reef Egret	*Egretta sacra*	1				1
Red-whiskered Bulbul	*Pycnonotus jocosus*	1			1	
Spotted Dove	*Steptopelia chinensis*	1		1		1
White Wagtail	*Motacilla alba*	1				1

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Date of Survey: 20 October 2003

Common Name	Scientific name	Total	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hau Hok Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen
Pacific Reef Egret	*Egretta sacra*	1							1	
Little Egret	*Egretta garzetta*	29			17				12	
Grey Heron	*Ardea cinerea*	1			1					
Black Kite	*Milvus migrans*	2					1	1		
White-bellied Sea Eagle	*Haliaeetus leucogaster*	1							1	
Crested Goshawk	*Accipiter trivirgatus*	1						1		
Common Buzzard	*Buteo buteo*	4						4		
Peregrine Falcon	*Falco peregrinus*	1							1	
White-breasted Waterhen	*Amaurornis phoenicurus*	5			3	2				
Common Sandpiper	*Actitis hypoleucos*	6			3		1		2	
Spotted Dove	*Steptopelia chinensis*	10	2	3			2	3		
Greater Coucal	*Centropus sinensis*	5				3			2	
White-throated Kingfisher	*Halcyon smyrnensis*	1			1					
Black-capped Kingfisher	*Halcyon pileata*	1			1					
Common Kingfisher	*Alcedo atthis*	2			1				1	
White Wagtail	*Motacilla alba*	12		4		3	2	1	2	
Red-whiskered Bulbul	*Pycnonotus jocosus*	48	5			12	9	6	6	10
Chinese Bulbul	*Pycnonotus sinensis*	54	9			25	5	12	3	
Siberian Rubythroat	*Luscinia calliope*	1					1			
Common Stonechat	*Saxicola torquata*	1				1				
Oriental Magpie Robin	*Copsychus saularis*	12	3		4				2	3
Black-browed Reed Warbler	*Acrocephalus bistrigiceps*	1			1					
Common Tailorbird	*Orthotomus sutorius*	12				6		3		3
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	2							1	1
Arctic Warbler	*Phylloscopus borealis*	1							1	
Yellow-browed Warbler	*Phylloscopus inornatus*	8			1	5				2
Dusky Warbler	*Phylloscopus fuscatus*	29	5		6	13			5	
Red-breasted Flycatcher	*Ficedula parva*	1							1	
Asian Brown Flycatcher	*Muscicapa dauurica*	4				1	1		2	
Great Tit	*Parus major*	8				4	1		3	
Japanese White-eye	*Zosterops japonicus*	14				14				
Long-tailed Shrike	*Lanius schach*	2	1						1	
Hair-crested Drongo	*Dicrurus hottentottus*	2				1	1			
Common Magpie	*Pica pica*	4				4				
Black-collared Starling	*Sturnus nigricollis*	6			6					
Crested Myna	*Acridotheres cristatellus*	7	7							
Eurasian Tree Sparrow	*Passer montanus*	7	7							
Scaly-breasted Munia	*Lonchura punctulata*	4							4	
Yellow-breasted Bunting	*Emberiza aureola*	8			2	6				

Date of Survey: 21 October 2003

Common Name	Scientific name	Total	Tung Chung Bay	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Chestnut Bunting	*Emberiza rutila*	3				3
Blue Magpie	*Urocissa erythrorhyncha*	1			1	
Long-tailed Shrike	*Lanius schach*	1			1	
Dusky Warbler	*Phylloscopus fuscatus*	2				2
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	2			2	
Black-browed Reed Warbler	*Acrocephalus bistrigiceps*	1				1
Zitting Cisticola	*Cisticola juncidis*	1				1
Common Blackbird	*Turdus merula*	4				4
Oriental Magpie Robin	*Copsychus saularis*	2				2
Siberian Rubythroat	*Luscinia calliope*	2			1	1
Chinese Bulbul	*Pycnonotus sinensis*	6				6
White Wagtail	*Motacilla alba*	1				1
Black-capped Kingfisher	*Halcyon pileata*	2	1			1
White-throated Kingfisher	*Halcyon smyrnensis*	1	1			
Spotted Dove	*Steptopelia chinensis*	1				1
Common Sandpiper	*Actitis hypoleucos*	3	2			1
Black Kite	*Milvus migrans*	3	1		1	1
Grey Heron	*Ardea cinerea*	1	1			
Great Egret	*Egretta alba*	6	6			
Little Egret	*Egretta garzetta*	25	22			3
Chinese Pond Heron	*Ardeola bacchus*	2				2
Little Grebe	*Tachybaptus ruficollis*	1		1		

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Date of Survey 23 October 2003 (Night)

Common Name	Scientific name	Total	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Collared Scops Owl	*Otus bakkamoena*	2								2	

Date of Survey: 24 October 2003

Common Name	Scientific name	Total	Tai Ho Wan
Chinese Pond Heron	*Ardeola bacchus*	6	6
Little Egret	*Egretta garzetta*	12	12
Great Egret	*Egretta alba*	4	4
White-throated Kingfisher	*Halcyon smyrnensis*	1	1
Black-capped Kingfisher	*Halcyon pileata*	1	1

Date of Survey: 28 October 2003

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Black-crowned Night Heron	*Nycticorax nycticorax*	5		5	
Striated Heron	*Butorides striatus*	1		1	
Little Egret	*Egretta garzetta*	14		14	
Eurasian Woodcock	*Scolopax rusticola*	1		1	
Collared Scops Owl	*Otus bakkamoena*	1	1		
Brown Fish Owl*	*Ketupa zeylonensis*	2		2	

Date of Survey: 29 October 2003

Common Name	Scientific name	Total	Pak Mong
Black Kite	*Milvus migrans*	1	1
Olive-backed Pipit	*Anthus hodgsoni*	3	3
Red-whiskered Bulbul	*Pycnonotus jocosus*	7	7
Chinese Bulbul	*Pycnonotus sinensis*	12	12
Siberian Rubythroat	*Luscinia calliope*	2	2
Blue Whistling Thrush	*Myophonus caeruleus*	3	3
Masked Laughingthrush	*Garrulax perspicillatus*	6	6
Long-tailed Shrike	*Lanius schach*	2	2
Large-billed Crow	*Corvus macrorhynchos*	2	2

Date of Survey: 30 October 2003 (Night)

Common Name	Scientific name	Total	San Shek Wan Tunnel Option
Collared Scops Owl	*Otus bakkamoena*	4	4

Avifauna

Date of Survey: 5 November 2003

Common Name	Scientific name	Total	San Shek Wan Tunnel Option
Black Kite	*Milvus migrans*	3	3
Japanese Sparrowhawk	*Accipiter gularis*	1	1
Bonelli's Eagle	*Hieraaetus fasciatus*	1	1
Common Kestrel	*Falco tinnunculus*	1	1
Black-capped Kingfisher	*Halcyon pileata*	1	1
Red-whiskered Bulbul	*Pycnonotus jocosus*	5	5
Chinese Bulbul	*Pycnonotus sinensis*	20	20
Siberian Rubythroat	*Luscinia calliope*	8	8
Common Blackbird	*Turdus merula*	1	1
Yellow-browed Warbler	*Phylloscopus inornatus*	4	4
Dusky Warbler	*Phylloscopus fuscatus*	4	4
Mugimaki Flycatcher	*Ficedula mugimaki*	1	1
Chestnut Bunting	*Emberiza rutila*	4	4

Date of Survey: 5 November 2003 (Night)

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Black-crowned Night Heron	*Nycticorax nycticorax*	5		5	
Brown Fish Owl	*Ketupa zeylonensis*	1		1	

Date of Survey: 19 November 2003

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Black-crowned Night Heron	*Nycticorax nycticorax*	1		1	
Chinese Pond Heron	*Ardeola bacchus*	4		4	
Little Egret	*Egretta garzetta*	12		12	
Common Kestrel	*Falco tinnunculus*	2	1		1
Common Sandpiper	*Actitis hypoleucos*	1		1	
Spotted Dove	*Steptopelia chinensis*	7	4		3
Common Koel	*Eudynamys scolopacea*	2	2		
Black-capped Kingfisher	*Halcyon pileata*	2		2	
Olive-backed Pipit	*Anthus hodgsoni*	7	2		5
Red-whiskered Bulbul	*Pycnonotus jocosus*	9	7		2
Chinese Bulbul	*Pycnonotus sinensis*	30	8	2	20
Siberian Rubythroat	*Luscinia calliope*	6	4		2
Daurian Redstart	*Phoenicurus auroreus*	2	1		1
Oriental Magpie Robin	*Copsychus saularis*	3	2		1
Blue Whistling Thrush	*Myophonus caeruleus*	3	3		
Common Tailorbird	*Orthotomus sutorius*	5	3		2
Yellow-browed Warbler	*Phylloscopus inornatus*	11	8		3
Dusky Warbler	*Phylloscopus fuscatus*	4	2	1	1
Masked Laughingthrush	*Garrulax perspicillatus*	6	4		2
Hwamei	*Garrulax canorus*	2	2		
Great Tit	*Parus major*	3	3		
Japanese White-eye	*Zosterops japonicus*	35	25		10
Long-tailed Shrike	*Lanius schach*	2	1		1
Common Magpie	*Pica pica*	4	4		
Large-billed Crow	*Corvus macrorhynchos*	2	2		
Crested Myna	*Acridotheres cristatellus*	20	12		8
Eurasian Tree Sparrow	*Passer montanus*	4	4		
Black-faced Bunting	*Emberiza spodocephala*	2	2		

Avifauna

Date of Survey: 27 November 2003 (Night)

Common Name	Scientific name	*Total*	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Black-crowned Night Heron	*Nycticorax nycticorax*	*4*		4	
Striated Heron	*Butorides striatus*	*1*		1	
Eurasian Woodcock	*Scolopax rusticola*	*3*		3	
Brown Fish Owl	*Ketupa zeylonensis*	*1*		1	

Date of Survey: 28 November 2003

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Little Egret	*Egretta garzetta*	*20*			18		1		1		
Grey Heron	*Ardea cinerea*	*2*			2						
Black Kite	*Milvus migrans*	*3*							1	2	
White-bellied Sea Eagle	*Haliaeetus leucogaster*	*1*								1	
Spotted Dove	*Steptopelia chinensis*	*16*	2		8	6					
White-throated Kingfisher	*Halcyon smyrnensis*	*2*	1	1							
Black-capped Kingfisher	*Halcyon pileata*	*1*									1
Olive-backed Pipit	*Anthus hodgsoni*	*11*	3		1	4			3		
Grey Wagtail	*Motacilla cinerea*	*1*			1						
White Wagtail	*Motacilla alba*	*4*		3							1
Red-whiskered Bulbul	*Pycnonotus jocosus*	*84*	4		20	25	5	12	10	8	
Chinese Bulbul	*Pycnonotus sinensis*	*89*	12		20	10	20	5	10	12	
Chestnut Bulbul	*Hypsipetes castanonotus*	*4*								4	
Siberian Rubythroat	*Luscinia calliope*	*29*	4		5	5	8		4	3	
Red-flanked Bluetail	*Tarsiger cyanurus*	*4*						3		1	
Daurian Redstart	*Phoenicurus auroreus*	*5*			2					3	
Oriental Magpie Robin	*Copsychus saularis*	*9*	2		3	4					
Blue Whistling Thrush	*Myophonus caeruleus*	*2*			1		1				
Common Blackbird	*Turdus merula*	*2*	1		1						
Grey-backed Thrush	*Turdus hortulorum*	*2*					2				
Dusky Thrush	*Turdus naumanni*	*2*			2						
Asian Stubtail Warbler	*Urosphena squameiceps*	*4*			1		2			1	
Japanese Bush Warbler	*Cettia diphone*	*6*			4	1			1		
Common Tailorbird	*Orthotomus sutorius*	*4*				2	2				
Pallas's Leaf Warbler	*Phylloscopus proregulus*	*3*	1		1	1					
Yellow-browed Warbler	*Phylloscopus inornatus*	*14*	3		3	4	3		1		
Dusky Warbler	*Phylloscopus fuscatus*	*3*					1		1	1	
Masked Laughingthrush	*Garrulax perspicillatus*	*22*			8	6		8			
Hwamei	*Garrulax canorus*	*1*			1						
Great Tit	*Parus major*	*11*	3		4	1	3				
Fork-tailed Sunbird	*Aethopyga christinae*	*1*				1					
Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	*1*				1					
Japanese White-eye	*Zosterops japonicus*	*50*	3		20	12	5	10			
Long-tailed Shrike	*Lanius schach*	*3*			1			1	1		
Blue Magpie	*Urocissa erythrorhyncha*	*5*				1		4			
Common Magpie	*Pica pica*	*6*			6						
Large-billed Crow	*Corvus macrorhynchos*	*2*							2		
Black-collared Starling	*Sturnus nigricollis*	*2*			2						
Crested Myna	*Acridotheres cristatellus*	*4*			4						
Eurasian Tree Sparrow	*Passer montanus*	*8*	2		6						
Scaly-breasted Munia	*Lonchura punctulata*	*7*	5			2					

Avifauna

Date of Survey: 19 December 2003

Common Name	Scientific name	Total	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Little Egret	*Egretta garzetta*	1						1			
Black Kite	*Milvus migrans*	7						7			
Common Kestrel	*Falco tinnunculus*	1						1			
Eurasian Woodcock	*Scolopax rusticola*	1					1				
Common Sandpiper	*Actitis hypoleucos*	1				1					
Oriental Turtle Dove	*Streptopelia orientalis*	2					2				
White-throated Kingfisher	*Halcyon smyrnensis*	1				1					
Olive-backed Pipit	*Anthus hodgsoni*	22				7		15			
Grey Wagtail	*Motacilla cinerea*	1						1			
White Wagtail	*Motacilla alba*	3		2							1
Chinese Bulbul	*Pycnonotus sinensis*	125	20	5	5	5	50	20	5	15	
Chestnut Bulbul	*Hypsipetes castanonotus*	6				4				2	
Rufous-tailed Robin	*Luscinia sibilans*	1						1			
Siberian Rubythroat	*Luscinia calliope*	3						1		2	
Daurian Redstart	*Phoenicurus auroreus*	3			1		1	1			
Oriental Magpie Robin	*Copsychus saularis*	1					1				
Scaly Thrush	*Zoothera dauma*	3					1	1	1		
Japanese Thrush	*Turdus cardis*	1						1			
Grey-backed Thrush	*Turdus hortulorum*	12	2				7	2	1		
Japanese Bush Warbler	*Cettia diphone*	2					1	1			
Common Tailorbird	*Orthotomus sutorius*	19	3	2	2	5	2	4	1		
Pallas's Leaf Warbler	*Phylloscopus proregulus*	4			2		2				
Yellow-browed Warbler	*Phylloscopus inornatus*	8			3		3			2	
Blue-and-white Flycatcher	*Cyanoptila cyanomelana*	1					1				
Masked Laughingthrush	*Garrulax perspicillatus*	12				4	8				
Great Tit	*Parus major*	5				4		1			
Japanese White-eye	*Zosterops japonicus*	84	25	5		7	20	12	5	10	
Long-tailed Shrike	*Lanius schach*	1						1			
Blue Magpie	*Urocissa erythrorhyncha*	2				2					
Common Magpie	*Pica pica*	4				4					
Large-billed Crow	*Corvus macrorhynchos*	1			1						
Red-billed Starling	*Sturnus sericeus*	40				40					
Black-collared Starling	*Sturnus nigricollis*	6				6					
Crested Myna	*Acridotheres cristatellus*	2				2					
Black-faced Bunting	*Emberiza spodocephala*	2					1	1			

Date of Survey: 22 December 2003

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Chinese Pond Heron	*Ardeola bacchus*	3		3	
Pacific Reef Egret	*Egretta sacra*	1		1	
Common Buzzard	*Buteo buteo*	1		1	
Common Kestrel	*Falco tinnunculus*	4		4	
Oriental Turtle Dove	*Streptopelia orientalis*	4		4	
Black-capped Kingfisher	*Halcyon pileata*	1		1	
Common Kingfisher	*Alcedo atthis*	2		2	
Olive-backed Pipit	*Anthus hodgsoni*	2		2	
White Wagtail	*Motacilla alba*	1		1	
Red-whiskered Bulbul	*Pycnonotus jocosus*	28	1	15	12
Chinese Bulbul	*Pycnonotus sinensis*	45	20	5	20
Siberian Rubythroat	*Luscinia calliope*	1	1		
Daurian Redstart	*Phoenicurus auroreus*	1		1	
Common Stonechat	*Saxicola torquata*	1		1	
Oriental Magpie Robin	*Copsychus saularis*	4		4	
Blue Whistling Thrush	*Myophonus caeruleus*	1		1	
Common Tailorbird	*Orthotomus sutorius*	7	2	2	3
Pallas's Leaf Warbler	*Phylloscopus proregulus*	1	1		
Yellow-browed Warbler	*Phylloscopus inornatus*	1		1	
Dusky Warbler	*Phylloscopus fuscatus*	1		1	
Masked Laughingthrush	*Garrulax perspicillatus*	18	4	9	5
Japanese White-eye	*Zosterops japonicus*	23	5	10	8
Large-billed Crow	*Corvus macrorhynchos*	1			1
Black-collared Starling	*Sturnus nigricollis*	25		25	
Crested Myna	*Acridotheres cristatellus*	25		25	
Black-faced Bunting	*Emberiza spodocephala*	2		2	

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Date of Survey: 26 January 2004

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Chinese Pond Heron	*Ardeola bacchus*	*1*								1	
Little Egret	*Egretta garzetta*	*4*			4						
Black Kite	*Milvus migrans*	*6*						4		2	
Common Buzzard	*Buteo buteo*	*1*								1	
White-breasted Waterhen	*Amaurornis phoenicurus*	*2*					2				
Common Sandpiper	*Actitis hypoleucos*	*1*					1				
Oriental Turtle Dove	*Streptopelia orientalis*	*4*								4	
Spotted Dove	*Steptopelia chinensis*	*14*	2	3			2	2		1	4
Greater Coucal	*Centropus sinensis*	*1*									1
White-throated Kingfisher	*Halcyon smyrnensis*	*2*					1				1
Black-capped Kingfisher	*Halcyon pileata*	*1*									1
Olive-backed Pipit	*Anthus hodgsoni*	*20*	4	2	4	7	2		1		
White Wagtail	*Motacilla alba*	*2*					1				1
Red-whiskered Bulbul	*Pycnonotus jocosus*	*38*	8		5			20		5	
Chinese Bulbul	*Pycnonotus sinensis*	*227*	25	20	5	8	25	10	50	80	4
Chestnut Bulbul	*Hypsipetes castanonotus*	*13*	3			4				6	
Rufous-tailed Robin	*Luscinia sibilans*	*7*			1		1	2	3		
Siberian Rubythroat	*Luscinia calliope*	*16*	2		2	2	2	2	4	2	
Red-flanked Bluetail	*Tarsiger cyanurus*	*19*		3	1	1	2	3	3	6	
Daurian Redstart	*Phoenicurus auroreus*	*18*	1		1	1	1	4	2	7	1
Oriental Magpie Robin	*Copsychus saularis*	*13*	3	1	1	2	2		2	2	
Blue Whistling Thrush	*Myophonus caeruleus*	*6*	1				4			1	
Scaly Thrush	*Zoothera dauma*	*2*							1	1	
Japanese Thrush	*Turdus cardis*	*14*			2	2	3	2	2	3	
Common Blackbird	*Turdus merula*	*4*			1					1	2
Grey-backed Thrush	*Turdus hortulorum*	*75*	4	2	10	10	10	9	9	20	1
Pale Thrush	*Turdus pallidus*	*2*				1	1				
Asian Stubtail Warbler	*Urosphena squameiceps*	*8*	1		1			1	5		
Japanese Bush Warbler	*Cettia diphone*	*3*				1	1			1	
Yellow-bellied Prinia	*Prinia flaviventris*	*1*								1	
Common Tailorbird	*Orthotomus sutorius*	*18*	4	3	2	1	1	2	3	2	
Pallas's Leaf Warbler	*Phylloscopus proregulus*	*4*					2			2	
Yellow-browed Warbler	*Phylloscopus inornatus*	*3*				1	2				
Dusky Warbler	*Phylloscopus fuscatus*	*1*				1					
Great Tit	*Parus major*	*14*				6	4			4	
Japanese White-eye	*Zosterops japonicus*	*110*	25	5	5	25	10	25	5	10	
Long-tailed Shrike	*Lanius schach*	*2*								2	
Common Magpie	*Pica pica*	*7*	3	2	2						
Large-billed Crow	*Corvus macrorhynchos*	*5*		2				1			2
Red-billed Starling	*Sturnus sericeus*	*4*			4						
Black-faced Bunting	*Emberiza spodocephala*	*1*						1			

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Date of Survey: 27 January 2004

Common Name	Scientific name	*Total*	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Chinese Pond Heron	*Ardeola bacchus*	*1*		1	
Little Egret	*Egretta garzetta*	*6*		6	
Black Kite	*Milvus migrans*	*1*		1	
Common Kestrel	*Falco tinnunculus*	*1*			1
Oriental Turtle Dove	*Streptopelia orientalis*	*3*		3	
Spotted Dove	*Steptopelia chinensis*	*3*		3	
Greater Coucal	*Centropus sinensis*	*1*		1	
Lesser Coucal	*Centropus bengalensis*	*1*		1	
Common Kingfisher	*Alcedo atthis*	*1*		1	
Olive-backed Pipit	*Anthus hodgsoni*	*3*		1	2
Grey Wagtail	*Motacilla cinerea*	*1*	1		
White Wagtail	*Motacilla alba*	*2*		2	
Red-whiskered Bulbul	*Pycnonotus jocosus*	*25*	4	12	9
Chinese Bulbul	*Pycnonotus sinensis*	*40*	5	20	15
Chestnut Bulbul	*Hypsipetes castanonotus*	*10*			10
Siberian Rubythroat	*Luscinia calliope*	*13*	4	7	2
Red-flanked Bluetail	*Tarsiger cyanurus*	*2*	2		
Daurian Redstart	*Phoenicurus auroreus*	*2*		2	
Oriental Magpie Robin	*Copsychus saularis*	*2*			2
Blue Rock Thrush	*Monticola solitarius*	*1*		1	
Scaly Thrush	*Zoothera dauma*	*1*		1	
Japanese Thrush	*Turdus cardis*	*1*		1	
Grey-backed Thrush	*Turdus hortulorum*	*9*		7	2
Pale Thrush	*Turdus pallidus*	*1*		1	
Japanese Bush Warbler	*Cettia diphone*	*2*	1	1	
Brownish-flanked Bush Warbler	*Cettia fortipes*	*1*		1	
Common Tailorbird	*Orthotomus sutorius*	*1*		1	
Yellow-browed Warbler	*Phylloscopus inornatus*	*1*		1	
Masked Laughingthrush	*Garrulax perspicillatus*	*6*		6	
Great Tit	*Parus major*	*5*		5	
Japanese White-eye	*Zosterops japonicus*	*6*	6		
Brown Shrike	*Lanius cristatus*	*1*		1	
Long-tailed Shrike	*Lanius schach*	*2*	1		1
Large-billed Crow	*Corvus macrorhynchos*	*2*	2		
Black-collared Starling	*Sturnus nigricollis*	*25*		25	
Crested Myna	*Acridotheres cristatellus*	*40*		40	
Scaly-breasted Munia	*Lonchura punctulata*	*3*			3

Date of Survey: 17 February 2004 (Night)

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
White-bellied Sea Eagle	*Haliaeetus leucogaster*	*1*								1	
Collared Scops Owl	*Otus bakkamoena*	*1*						1			

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Date of Survey: 18 February 2004

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Little Egret	*Egretta garzetta*	*15*	1		12			1			1
Great Egret	*Egretta alba*	*3*	1		1						1
Black Kite	*Milvus migrans*	*2*			1				1		
Oriental Turtle Dove	*Streptopelia orientalis*	*1*								1	
Spotted Dove	*Steptopelia chinensis*	*2*		2							
Common Koel	*Eudynamys scolopacea*	*1*		1							
Greater Coucal	*Centropus sinensis*	*1*		1							
White-throated Kingfisher	*Halcyon smyrnensis*	*1*									1
Black-capped Kingfisher	*Halcyon pileata*	*1*									1
Common Kingfisher	*Alcedo atthis*	*1*		1							
Olive-backed Pipit	*Anthus hodgsoni*	*3*								3	
White Wagtail	*Motacilla alba*	*1*								1	
Red-whiskered Bulbul	*Pycnonotus jocosus*	*18*			8					10	
Chinese Bulbul	*Pycnonotus sinensis*	*26*			12	5				9	
Siberian Rubythroat	*Luscinia calliope*	*1*						1			
Daurian Redstart	*Phoenicurus auroreus*	*2*					1	1			
Oriental Magpie Robin	*Copsychus saularis*	*2*				2					
Blue Rock Thrush	*Monticola solitarius*	*2*	1								1
Blue Whistling Thrush	*Myophonus caeruleus*	*2*					2				
Scaly Thrush	*Zoothera dauma*	*1*								1	
Japanese Thrush	*Turdus cardis*	*4*				3		1			
Grey-backed Thrush	*Turdus hortulorum*	*7*			1			3		3	
Yellow-bellied Prinia	*Prinia flaviventris*	*1*								1	
Common Tailorbird	*Orthotomus sutorius*	*7*				3		1		3	
Pallas's Leaf Warbler	*Phylloscopus proregulus*	*3*								3	
Dusky Warbler	*Phylloscopus fuscatus*	*1*				1					
Masked Laughingthrush	*Garrulax perspicillatus*	*7*				2		5			
Hwamei	*Garrulax canorus*	*1*								1	
Great Tit	*Parus major*	*2*						1		1	
Japanese White-eye	*Zosterops japonicus*	*10*								10	
Blue Magpie	*Urocissa erythrorhyncha*	*2*			2						
Common Magpie	*Pica pica*	*11*						5		6	
White-shouldered Starling	*Sturnus sinensis*	*1*						1			

Date of Survey: 19 February 2004 (Night)

Common Name	Scientific name	*Total*	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Black-crowned Night Heron	*Nycticorax nycticorax*	*3*		3	
Little Egret	*Egretta garzetta*	*1*		1	
Grey Heron	*Ardea cinerea*	*1*		1	
Eurasian Woodcock	*Scolopax rusticola*	*1*		1	
Oriental Magpie Robin	*Copsychus saularis*	*1*		1	

Date of Survey: 23 February 2004

Common Name	Scientific name	*Total*	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Crested Myna	*Acridotheres cristatellus*	*6*	6		
Black-collared Starling	*Sturnus nigricollis*	*1*	1		
Large-billed Crow	*Corvus macrorhynchos*	*1*	1		
Common Magpie	*Pica pica*	*4*		2	2
Long-tailed Shrike	*Lanius schach*	*1*	1		
Japanese White-eye	*Zosterops japonicus*	*1*	1		
Masked Laughingthrush	*Garrulax perspicillatus*	*2*	2		
Dusky Warbler	*Phylloscopus fuscatus*	*1*	1		
Yellow-bellied Prinia	*Prinia flaviventris*	*1*	1		
Grey-backed Thrush	*Turdus hortulorum*	*1*	1		
Blue Whistling Thrush	*Myophonus caeruleus*	*2*		1	1
Siberian Rubythroat	*Luscinia calliope*	*1*		1	
Chinese Bulbul	*Pycnonotus sinensis*	*12*	12		
White Wagtail	*Motacilla alba*	*2*	2		
Olive-backed Pipit	*Anthus hodgsoni*	*3*	3		
Common Kingfisher	*Alcedo atthis*	*1*			1
Spotted Dove	*Steptopelia chinensis*	*1*	1		
Black Kite	*Milvus migrans*	*1*	1		
Little Egret	*Egretta garzetta*	*1*		1	
Chinese Pond Heron	*Ardeola bacchus*	*2*		2	

Avifauna

Date of Survey: 17 March 2004

Common Name	Scientific name	Total	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Pacific Reef Egret	*Egretta sacra*	1						1			
Little Egret	*Egretta garzetta*	8			3			1			4
Black Kite	*Milvus migrans*	8					1		6		1
Crested Goshawk	*Accipiter trivirgatus*	1							1		
Grey-faced Buzzard	*Butastur indicus*	1					1				
White-breasted Waterhen	*Amaurornis phoenicurus*	2			2						
Spotted Dove	*Steptopelia chinensis*	15					2		3	3	7
Large Hawk Cuckoo	*Hierococcyx sparveroides*	1			1						
Greater Coucal	*Centropus sinensis*	2				1	1				
Lesser Coucal	*Centropus bengalensis*	1								1	
White-vented Needletail	*Hirundapus cochinchinensis*	5					2		3		
Pacific Swift	*Apus pacificus*	150						50	100		
Little Swift	*Apus affinis*	15							15		
White-throated Kingfisher	*Halcyon smyrnensis*	1			1						
Barn Swallow	*Hirundo rustica*	1								1	
Asian House Martin	*Delichon dasypus*	2							2		
Olive-backed Pipit	*Anthus hodgsoni*	1									1
White Wagtail	*Motacilla alba*	1							1		
Chinese Bulbul	*Pycnonotus sinensis*	36					6	10	5	5	10
Sooty-headed Bulbul	*Pycnonotus aurigaster*	41					6	9	6	12	8
Siberian Rubythroat	*Luscinia calliope*	2					1				1
Oriental Magpie Robin	*Copsychus saularis*	4				4					
Scaly Thrush	*Zoothera dauma*	1					1				
Grey-backed Thrush	*Turdus hortulorum*	2						2			
Plain Prinia	*Prinia inornata*	1	1								
Common Tailorbird	*Orthotomus sutorius*	4	2			1	1				
Yellow-browed Warbler	*Phylloscopus inornatus*	1	1								
Dusky Warbler	*Phylloscopus fuscatus*	2							2		
Masked Laughingthrush	*Garrulax perspicillatus*	17	5		2	10					
Great Tit	*Parus major*	9				1	2	2	2		2
Japanese White-eye	*Zosterops japonicus*	9	4			5					
Long-tailed Shrike	*Lanius schach*	2	1					1			
Common Magpie	*Pica pica*	6		4							2
Black-faced Bunting	*Emberiza spodocephala*	8	3		4					1	
Little Bunting	*Emberiza pusilla*	1									1

Date of Survey: 31 March 2004

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Chinese Pond Heron	*Ardeola bacchus*	1		1	
Little Egret	*Egretta garzetta*	1		1	
White-breasted Waterhen	*Amaurornis phoenicurus*	1		1	
Common Sandpiper	*Actitis hypoleucos*	1		1	
Spotted Dove	*Steptopelia chinensis*	3	1	1	1
Large Hawk Cuckoo	*Hierococcyx sparveroides*	1			1
Lesser Coucal	*Centropus bengalensis*	1			1
White-throated Kingfisher	*Halcyon smyrnensis*	2		2	
Common Kingfisher	*Alcedo atthis*	3	1	2	
Barn Swallow	*Hirundo rustica*	12	10	2	
Olive-backed Pipit	*Anthus hodgsoni*	2	2		
White Wagtail	*Motacilla alba*	1	1		
Red-whiskered Bulbul	*Pycnonotus jocosus*	10	4	2	4
Chinese Bulbul	*Pycnonotus sinensis*	9	1	4	4
Siberian Rubythroat	*Luscinia calliope*	2	1		1
Common Stonechat	*Saxicola torquata*	1		1	
Common Tailorbird	*Orthotomus sutorius*	4	2	2	
Yellow-browed Warbler	*Phylloscopus inornatus*	1			1
Masked Laughingthrush	*Garrulax perspicillatus*	17	10	2	5
Hwamei	*Garrulax canorus*	3	1		2
Great Tit	*Parus major*	5	2	1	2
Brown Shrike	*Lanius cristatus*	1	1		
Long-tailed Shrike	*Lanius schach*	3	1	2	
Common Magpie	*Pica pica*	2			2
Black-collared Starling	*Sturnus nigricollis*	2		2	
Crested Myna	*Acridotheres cristatellus*	4		4	
Black-faced Bunting	*Emberiza spodocephala*	4	2	1	1
Chestnut-eared Bunting	*Emberiza fucata*	1		1	

Avifauna

Date of Survey: 15 April 2004

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Chinese Pond Heron	*Ardeola bacchus*	*3*					3				
Swinhoe's Egret	*Egretta eulophotes*	*3*			3						
Little Egret	*Egretta garzetta*	*7*			4			1			2
Great Egret	*Egretta alba*	*10*			10						
Black Kite	*Milvus migrans*	*5*				1	2		2		
Crested Serpent Eagle	*Spilornis cheela*	*1*								1	
Crested Goshawk	*Accipiter trivirgatus*	*2*				1				1	
Common Buzzard	*Buteo buteo*	*1*			1						
White-breasted Waterhen	*Amaurornis phoenicurus*	*2*				2					
Common Sandpiper	*Actitis hypoleucos*	*2*					1				1
Spotted Dove	*Steptopelia chinensis*	*8*				6				2	
Large Hawk Cuckoo	*Hierococcyx sparveroides*	*4*				3				1	
Common Koel	*Eudynamys scolopacea*	*1*			1						
Greater Coucal	*Centropus sinensis*	*2*				2					
Lesser Coucal	*Centropus bengalensis*	*1*							1		
Pacific Swift	*Apus pacificus*	*4*								4	
Little Swift	*Apus affinis*	*2*				2					
Black-capped Kingfisher	*Halcyon pileata*	*2*								1	1
Dollarbird	*Eurystomus orientalis*	*1*							1		
Olive-backed Pipit	*Anthus hodgsoni*	*7*				3	4				
Yellow Wagtail	*Motacilla flava*	*1*			1						
Grey Wagtail	*Motacilla cinerea*	*1*					1				
White Wagtail	*Motacilla alba*	*1*				1					
Red-whiskered Bulbul	*Pycnonotus jocosus*	*53*	12	10	6	10	10			5	
Chinese Bulbul	*Pycnonotus sinensis*	*31*	5	5		7			2	12	
Siberian Rubythroat	*Luscinia calliope*	*2*	1			1					
Oriental Magpie Robin	*Copsychus saularis*	*17*	3	2		6	6				
Common Tailorbird	*Orthotomus sutorius*	*19*	3	5	1	4	2		2	2	
Yellow-browed Warbler	*Phylloscopus inornatus*	*1*							1		
Dusky Warbler	*Phylloscopus fuscatus*	*1*			1						
Masked Laughingthrush	*Garrulax perspicillatus*	*8*				3	3		1	1	
Hwamei	*Garrulax canorus*	*1*								1	
Great Tit	*Parus major*	*37*	3	2	1	4	3	10	4	10	
Fork-tailed Sunbird	*Aethopyga christinae*	*1*								1	
Japanese White-eye	*Zosterops japonicus*	*26*	7	5		3	1			10	
Long-tailed Shrike	*Lanius schach*	*3*	1	1	1						
Blue Magpie	*Urocissa erythrorhyncha*	*3*							1	2	
Common Magpie	*Pica pica*	*1*					1				
White-shouldered Starling	*Sturnus sinensis*	*2*							2		
Crested Myna	*Acridotheres cristatellus*	*19*	12	3	2					2	
Black-faced Bunting	*Emberiza spodocephala*	*8*	1		6	1					
Chestnut Bunting	*Emberiza rutila*	*1*								1	

Date of Survey: 19 April 2004 (Night)

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Chinese Pond Heron	*Ardeola bacchus*	*1*									1
Little Egret	*Egretta garzetta*	*1*									1
Great Egret	*Egretta alba*	*1*									1
White-bellied Sea Eagle	*Haliaeetus leucogaster*	*1*								1	
Chinese Francolin	*Francolinus pintadeanus*	*2*								2	
Slaty-legged Crake*	*Rallina eurizonoides*	*3*				2				1	
Wood Sandpiper	*Tringa glareola*	*1*									1
Collared Scops Owl	*Otus bakkamoena*	*6*				2			3	1	
Black-capped Kingfisher	*Halcyon pileata*	*1*									1
Hwamei	*Garrulax canorus*	*6*								6	
Common Magpie	*Pica pica*	*1*								1	

Avifauna

Date of Survey: 27 April 2004 (Night)

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Pacific Reef Egret	*Egretta sacra*	1		1	
Slaty-legged Crake	*Rallina eurizonoides*	1		1	
Collared Scops Owl	*Otus bakkamoena*	2	2		
Eurasian Eagle Owl	*Bubo bubo*	1	1		
Savanna Nightjar	*Caprimulgus affinis*	2	1	1	
White-throated Kingfisher	*Halcyon smyrnensis*	2		2	
Grey Wagtail	*Motacilla cinerea*	1		1	

Date of Survey: 30 April 2004

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Chinese Francolin	*Francolinus pintadeanus*	2		2	
Common Sandpiper	*Actitis hypoleucos*	2		2	
Spotted Dove	*Steptopelia chinensis*	1	1		
Chestnut-winged Cuckoo	*Clamator coromandus*	1		1	
Large Hawk Cuckoo	*Hierococcyx sparveroides*	1		1	
Indian Cuckoo	*Cuculus micropterus*	1		1	
Red-whiskered Bulbul	*Pycnonotus jocosus*	2	1	1	
Chinese Bulbul	*Pycnonotus sinensis*	3	1	1	1
Oriental Magpie Robin	*Copsychus saularis*	1		1	
Common Tailorbird	*Orthotomus sutorius*	2	1	1	
Dusky Warbler	*Phylloscopus fuscatus*	1	1		
Masked Laughingthrush	*Garrulax perspicillatus*	3	1	1	1
Japanese White-eye	*Zosterops japonicus*	1		1	
Common Magpie	*Pica pica*	1		1	
Large-billed Crow	*Corvus macrorhynchos*	2	2		
Black-collared Starling	*Sturnus nigricollis*	1			1
Crested Myna	*Acridotheres cristatellus*	1		1	

Date of Survey: 11 May 2004

Common Name	Scientific name	Total	Pak Mong	Tai Ho Wan	Cheung Tung Road Hill
Striated Heron	*Butorides striatus*	1		1	
Little Egret	*Egretta garzetta*	3		3	
Black Kite	*Milvus migrans*	1	1		
Chinese Francolin	*Francolinus pintadeanus*	2	1		1
White-breasted Waterhen	*Amaurornis phoenicurus*	1		1	
Grey-tailed Tattler	*Heteroscelus brevipes*	3		3	
Spotted Dove	*Steptopelia chinensis*	4		4	
Large Hawk Cuckoo	*Hierococcyx sparveroides*	2	1		1
Indian Cuckoo	*Cuculus micropterus*	1	1		
Common Koel	*Eudynamys scolopacea*	2	1	1	
Greater Coucal	*Centropus sinensis*	1	1		
White-throated Kingfisher	*Halcyon smyrnensis*	1		1	
Red-whiskered Bulbul	*Pycnonotus jocosus*	4			4
Chinese Bulbul	*Pycnonotus sinensis*	13	7		6
Oriental Magpie Robin	*Copsychus saularis*	1		1	
Blue Whistling Thrush	*Myophonus caeruleus*	2		2	
Common Tailorbird	*Orthotomus sutorius*	1	1		
Masked Laughingthrush	*Garrulax perspicillatus*	2		2	
Great Tit	*Parus major*	1		1	
Black Drongo	*Dicrurus macrocercus*	1			1
Crested Myna	*Acridotheres cristatellus*	6	6		

Avifauna

Date of Survey: 12 May 2004

Common Name	Scientific name	*Total*	Chek Lap Kok	Tung Chung Battery	Tung Chung Bay	Tin Sam	Hok Tau Wan	Ferry Pier	Sha Lo Wan	Sham Shek Tsuen	Sham Wat Wan
Striated Heron	*Butorides striatus*	*3*			2		1				
Chinese Pond Heron	*Ardeola bacchus*	*3*							2		1
Little Egret	*Egretta garzetta*	*8*		1	4			1	2		
Black Kite	*Milvus migrans*	*4*							1	3	
Besra	*Accipiter virgatus*	*1*							1		
Chinese Francolin	*Francolinus pintadeanus*	*3*								3	
White-breasted Waterhen	*Amaurornis phoenicurus*	*1*							1		
Common Sandpiper	*Actitis hypoleucos*	*4*							1		3
Grey-tailed Tattler	*Heteroscelus brevipes*	*9*			9						
Spotted Dove	*Steptopelia chinensis*	*28*	1	2		10	6		3	5	1
Emerald Dove	*Chalcophaps indica*	*1*			1						
Large Hawk Cuckoo	*Hierococcyx sparveroides*	*9*		1	4	2		1	1		
Indian Cuckoo	*Cuculus micropterus*	*2*				1			1		
Common Koel	*Eudynamys scolopacea*	*2*	1					1			
Greater Coucal	*Centropus sinensis*	*7*	2			1			4		
Pacific Swift	*Apus pacificus*	*21*	1	2		10	6		2		
Little Swift	*Apus affinis*	*2*				2					
White-throated Kingfisher	*Halcyon smyrnensis*	*4*	1		1			2			
Barn Swallow	*Hirundo rustica*	*22*		2					20		
Grey Wagtail	*Motacilla cinerea*	*2*									2
White Wagtail	*Motacilla alba*	*1*								1	
Red-whiskered Bulbul	*Pycnonotus jocosus*	*38*	4	10		6	4		10	4	
Chinese Bulbul	*Pycnonotus sinensis*	*21*	2	10		5					4
Sooty-headed Bulbul	*Pycnonotus aurigaster*	*2*							2		
Oriental Magpie Robin	*Copsychus saularis*	*5*	2	1					1		1
Common Tailorbird	*Orthotomus sutorius*	*4*				4					
Masked Laughingthrush	*Garrulax perspicillatus*	*36*	5			6	8		4	13	
Hwamei	*Garrulax canorus*	*2*								2	
Great Tit	*Parus major*	*22*	3				4	4	7	4	
Japanese White-eye	*Zosterops japonicus*	*8*	2				6				
Long-tailed Shrike	*Lanius schach*	*3*	1	1					1		
Black Drongo	*Dicrurus macrocercus*	*5*	2			1			2		
Hair-crested Drongo	*Dicrurus hottentotus*	*2*			1			1			
Common Magpie	*Pica pica*	*3*		1			2				
Large-billed Crow	*Corvus macrorhynchos*	*8*							8		
White-shouldered Starling	*Sturnus sinensis*	*2*							2		
Black-collared Starling	*Sturnus nigricollis*	*9*	2		1	2			2		2
Eurasian Tree Sparrow	*Passer montanus*	*1*							1		
Scaly-breasted Munia	*Lonchura punctulata*	*4*							4		
Chinese Bamboo Partridge	*Bambusicola thoracica*	*1*						1			
Yellow-fronted Canary	*Serinus mozambicus*	*1*			1						

Date of Survey: 27 May 2004 (Day and Night)

Common Name	Scientific name	*Total*	San Shek Wan
Chinese Francolin	*Francolinus pintadeanus*	*3*	3
Lesser Coucal	*Centropus bengalensis*	*2*	2
Pacific Swift	*Apus pacificus*	*1*	1
Little Swift	*Apus affinis*	*2*	2
Richard's Pipit	*Anthus richardi*	*1*	1
Chinese Bulbul	*Pycnonotus sinensis*	*4*	4
Hwamei	*Garrulax canorus*	*3*	3
Long-tailed Shrike	*Lanius schach*	*3*	3
Large-billed Crow	*Corvus macrorhynchos*	*2*	2

Appendix I

List of Recorded Terrestrial Mammal Species

Mammal

Date of survey 20 and 25 September 2003

Original Study Area

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Date**	**Hong Kong status***
Cervidae							
Muntiacus muntjac	Indian Muntjac	1	Sha Lo Wan	49Q GE 983675	Tall shrubland	25.09.03	Common

*After Reels (1996)

Infrared-triggered cameras	**Location**	**UTM ref.**	**Habitat**	**No. events**	**Results**
Camera set 1	Kau Liu	49Q HE 007680	Tall shrubland	14	No mammal photos obtained
Camera set 2	Hau Hok Wan	49Q GE 996680	Tall shrubland	1	No mammal photos obtained

Date of survey 22 and 25 September 2003 (Night)

Original Study Area
No species recorded

Date of survey: 2 and 8 October 2003
5 and 8 October 2003 (Night)

Additional Study Area
No species recorded

Date of survey: 23 October 2003 (Night)

Sham Wat and Sham Shek Tsuen headland

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Date**	**Hong Kong status**
Soricidae							
Suncus murinus	Brown Musk Shrew	1	Sham Wat	49Q GE 976655	Village	23.10.03	Probably common

Date of survey: 24 October 2003
27 October 2003 (Day and Night)

Sham Wat and Sham Shek Tsuen headland
No species recorded

Date of survey: 28 October 2003

West of Tai Ho Wan
No species recorded

Date of survey: 5 November 2003 (Day and Night)

Inland study area for San Shek Wan tunnel option
No species recorded

Mammals

Date of survey: 25 November 2003

Chek Lap Kok to Sham Wat
No species recorded

Date of survey: 26 November 2003

Tai Ho Wan
No species recorded

Date of survey: 10 December 2003 (Night)

Chek Lap Kok to Sham Wat
No species observed; infrared-triggered cameras set up for five days

Infrared-triggered cameras	**Location**	**UTM ref.**	**Habitat**	**No. events**	**Results**
Camera set 1	Sham Shek Tsuen headland	49Q GE 978663	Secondary woodland	5	Nil
Camera set 2	Sham Shek Tsuen headland	49Q GE 979665	Secondary woodland	1	Nil

Date of survey: 15 December 2003 (Night)

Tai Ho Wan
No species recorded

Date of survey: 22 January 2004

Chek Lap Kok to Sham Wat
No species observed; infrared-triggered cameras set up for five days

Infrared-triggered cameras	**Location**	**UTM ref.**	**Habitat**	**No. events**	**Results**
Camera set 1	Sham Shek Tsuen headland	49Q GE 978663	Secondary woodland	2	Nil
Camera set 2	Sha Lo Wan headland	49Q GE 985677	Secondary woodland	0	Nil

Date of survey: 27 January 2004

Tai Ho Wan
No species recorded

Date of Survey: 17 February 2004 (Night)

Chek Lap Kok to Sham Wat
No species observed
(several unidentified insectivorous bats across Study Area)

Date of Survey: 19 February 2004 (Night)

Tai Ho Wan
No species observed
(several unidentified insectivorous bats across Study Area)

Mammals

Date of survey: 16 March 2004

Chek Lap Kok to Sham Wat
No species observed

Date of survey: 17 March 2004

Tai Ho Wan
No species observed

Date of survey: 20 April 2004 (Night)

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Muntiacus muntjak	Barking Deer	1	Sham Shek Tsuen	49Q GE 975662	Tall shrubland	Common
			Note: Barking Deer heard in almost same location (49Q GE 976661) by PJL on 17th March			

(several unidentified insectivorous bats across Study Area)

*after Reels, 1996

Date of survey: 27 April 2004 (Night)

Tai Ho Wan
No species observed
(several unidentified insectivorous bats across Study Area)

Date of survey: 9 May 2004

Tai Ho Wan
No species observed

Date of survey: 9 May 2004 (Night)

Tai Ho Wan
No species observed
(several unidentified insectivorous bats across Study Area)

Date of survey: 12 May 2004

Chek Lap Kok to Sham Wat
No species observed

Date of survey: 18 May 2004 (Night)

Chek Lap Kok to Sham Wat
No species observed
(several unidentified insectivorous bats across Study Area)

Date of survey: 18 May 2004 (Day and Night)

Additional Study Area for tunnel portal option
No species observed
(several unidentified insectivorous bats across Study Area)

Appendix J

List of Recorded Dragonfly Species

Dragonflies

Date of survey: 20 and 25 September 2003

Original Study Area

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Libellulidae							
Orthetrum glaucum	Common Blue Skimmer	1	Hau Hok Wan	49Q GE 9967	Stream	25.09.03	Abundant
Orthetrum pruinosum	Common Red Skimmer	2	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20.09.03	Abundant
Orthetrum pruinosum	Common Red Skimmer	2	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Abundant
Orthetrum sabina	Green Skimmer	1	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Abundant
Orthetrum sabina	Green Skimmer	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Abundant
Orthetrum sabina	Green Skimmer	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.09.03	Abundant
Pantala flavescens	Wandering Glider	7	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Abundant
Pantala flavescens	Wandering Glider	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	20.09.03	Abundant
Pantala flavescens	Wandering Glider	1	Ma Wan Chung	49Q HE 0267	Village	20.09.03	Abundant
Pantala flavescens	Wandering Glider	5	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20.09.03	Abundant
Pantala flavescens	Wandering Glider	4	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Abundant
Pantala flavescens	Wandering Glider	1	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Abundant
Pantala flavescens	Wandering Glider	40	Tung Chung Battery	49Q HE 0267	Secondary woodland	25.09.03	Abundant
Pantala flavescens	Wandering Glider	12	Ma Wan Chung	49Q HE 0267	Village	25.09.03	Abundant
Pantala flavescens	Wandering Glider	50	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Abundant
Pantala flavescens	Wandering Glider	60	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Abundant
Pantala flavescens	Wandering Glider	120	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Abundant
Pantala flavescens	Wandering Glider	30	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.09.03	Abundant
Pantala flavescens	Wandering Glider	50	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Abundant
Tramea virginia	Saddlebag Glider	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Common

*After Wilson (1997)

Date of survey: 2 and 8 October 2003

Additional Study Area

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Platycnemididae							
Copera marginipes	Yellow Featherlegs	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Abundant
Copera marginipes	Yellow Featherlegs	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08.10.03	Abundant
Libellulidae							
Acisoma panorpoides	Asian Pintail	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08.10.03	Common
Crocothemis servilia	Crimson Darter	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08.10.03	Abundant
Diplacodes trivialis	Blue Percher	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08.10.03	Abundant
Orthetrum glaucum	Common Blue Skimmer	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Abundant
Orthetrum pruinosum	Common Red Skimmer	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Abundant
Orthetrum sabina	Green Skimmer	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Common
Orthetrum sabina	Green Skimmer	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Common
Pantala flavescens	Wandering Glider	3	West of Pak Mong	49Q HE 0568	Shrubby grassland	02.10.03	Abundant
Pantala flavescens	Wandering Glider	25	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	02.10.03	Abundant
Pantala flavescens	Wandering Glider	5	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Abundant
Pantala flavescens	Wandering Glider	5	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08.10.03	Abundant
Pantala flavescens	Wandering Glider	50+	West of Pak Mong	49Q HE 0568	Shrubby grassland	08.10.03	Abundant
Trithemis festiva	Indigo Dropwing	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Abundant
Trithemis festiva	Indigo Dropwing	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Abundant
Trithemis festiva	Indigo Dropwing	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08.10.03	Abundant
Trithemis festiva	Indigo Dropwing	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08.10.03	Abundant

*After Wilson (2003)

Date of survey: 23 October 2003 (Night)

Sham Wat and Sham Shek Tsuen headland

No species observed

Date of survey: 24, 27, 28 October and 5 November 2003

Sham Wat and Sham Shek Tsuen headland

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Libellulidae							
Orthetrum glaucum	Common Blue Skimmer	2	Sham Wat	49Q GE 9765	Stream	24.10.02	Abundant
Orthetrum pruinosum	Common Red Skimmer	2	Sham Wat	49Q GE 9765	Stream	27.10.03	Abundant
Orthetrum sabina	Green Skimmer	3	Sham Wat	49Q GE 9765	Coastal grass/shrub	27.10.03	Common
Pantala flavescens	Wandering Glider	7	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.02	Abundant
Pantala flavescens	Wandering Glider	3	Sham Wat	49Q GE 9765	Coastal grass/shrub	27.10.03	Abundant
Pantala flavescens	Wandering Glider	4	Sham Shek Tsuen	49Q GE 9766	Disused agricultural fields	27.10.03	Abundant
Trithemis festiva	Indigo Dropwing	1	Sham Wat	49Q GE 9765	Stream	24.10.02	Abundant

West of Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Aeshnidae							
Anax immaculifrons	Fiery Emperor	1	West of Tai Ho Wan	49Q HE 0468	Stream	28.10.03	Common
Libellulidae							
Pantala flavescens	Wandering Glider	2	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Abundant

Inland study area for San Shek Wan tunnel option

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Aeshnidae							
Anax immaculifrons	Fiery Emperor	1	S of Hau Hok Wan	49Q GE 9967	Stream	05.11.03	Common
Libellulidae							
Orthetrum glaucum	Common Blue Skimmer	1	SW of San Tau	49Q HE 0067	Stream	05.11.03	Abundant
Orthetrum sabina	Green Skimmer	3	SW of San Tau	49Q HE 0067	Shrubby grassland/tall shrubland	05.11.03	Common
Pantala flavescens	Wandering Glider	12	SW of San Tau	49Q HE 0067	Shrubby grassland/tall shrubland	05.11.03	Abundant
Pantala flavescens	Wandering Glider	7	S of Hau Hok Wan	49Q GE 9967	Shrubby grassland/tall shrubland	05.11.03	Abundant
Pantala flavescens	Wandering Glider	2	E of San Shek Wan	49Q GE 9966	Shrubby grassland/tall shrubland	05.11.03	Abundant
Trithemis aurora	Crimson Dropwing	3	S of Hau Hok Wan	49Q GE 9967	Stream	05.11.03	Abundant
Trithemis festiva	Indigo Dropwing	3	S of Hau Hok Wan	49Q GE 9967	Stream	05.11.03	Abundant

*After Wilson (2003)

Dragonflies

Date of survey: 25 and 26 November 2003

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Libellulidae							
Orthetrum sabina	Green Skimmer	1	Tin Sam	49Q HE 0167	Shrubby grassland	25.11 03	Common
Orthetrum sabina	Green Skimmer	1	Kau Liu	49Q HE 0068	Tall shrubland	25.11 03	Common
Orthetrum sabina	Green Skimmer	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	25.11 03	Common
Trithemis festiva	Indigo Dropwing	1	San Tau	49Q HE 0167	Stream	25.11.03	Abundant
Trithemis festiva	Indigo Dropwing	1	Sham Wat	49Q GE 9765	Stream	25.11 03	Abundant
Pantala flavescens	Wandering Glider	3	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25.11.03	Abundant
Pantala flavescens	Wandering Glider	1	Ma Wan Chung	49Q HE 0267	Village	25.11 03	Abundant
Pantala flavescens	Wandering Glider	5	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.11 03	Abundant
Pantala flavescens	Wandering Glider	2	San Tau	49Q HE 0167	Secondary woodland	25.11 03	Abundant
Pantala flavescens	Wandering Glider	7	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.11 03	Abundant
Pantala flavescens	Wandering Glider	8	Sham Wat	49Q GE 9765	Coastal grass/shrub	25.11 03	Abundant
Pantala flavescens	Wandering Glider	2	Sham Shek Tsuen	49Q GE 9766	Disused agricultural fields	25.11.03	Abundant

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Platycnemididae							
Copera marginipes	Yellow Featherlegs	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Pond	26.11.03	Abundant
Libellulidae							
Trithemis festiva	Indigo Dropwing	1	Tai Ho Wan	49Q HE 0768	Stream	26.11.03	Abundant
Pantala flavescens	Wandering Glider	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11.03	Abundant
Pantala flavescens	Wandering Glider	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Abundant
Pantala flavescens	Wandering Glider	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26.11.03	Abundant
Pantala flavescens	Wandering Glider	3	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Abundant

*After Wilson (2003)

Date of survey: 10 December 2003 (Night)

Chek Lap Kok to Sham Wat
No species recorded

Date of survey: 15 December 2003 (Night)

Tai Ho Wan
No species recorded

Date of survey: 22 January 2004

Chek Lap Kok to Sham Wat
No species recorded

Date of survey: 27 January 2004

Tai Ho Wan
No species recorded

Date of survey: 17 February 2004 (Night)

Chek Lap Kok to Sham Wat
No species observed

Date of survey: 19 February 2004 (Night)

Tai Ho Wan
No species observed

Dragonflies

Date of survey 16 March 2004

Chek Lap Kok to Sham Wat
No species observed

Date of survey 17 March 2004

Tai Ho Wan

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Hong Kong status***
Platycnemididae						
Copera marginipes	Yellow Featherlegs	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Stream	Abundant
Copera marginipes	Yellow Featherlegs	2	Tai Ho Wan	49Q HE 0768	Stream	Abundant

*After Wilson, 2003

Date of survey: 20 April 2004 (Night)

Chek Lap Kok to Sham Wat
No species observed

Date of survey: 27 April 2004 (Night)

Tai Ho Wan
No species observed

Date of Survey: 9 May 2004

Tai Ho Wan

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Hong Kong status***
Chlorocyphidae						
Rhinocypha perforata	Common Blue Jewel	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Euphaeidae						
Euphaea decorata	Black-banded Gossamerwing	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Platycnemididae						
Copera marginipes	Yellow Featherlegs	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Copera marginipes	Yellow Featherlegs	1	West of Tai Ho Wan	49Q HE 0568	Stream	Abundant
Protoneuridae						
Prodasineura autumnalis	Black Threadtail	8	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Gomphidae						
Leptogomphus elegans	Elegant Clubtail	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Secondary woodland	Common
Libellulidae						
Crocothemis servilia	Crimson Darter	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Lyriothemis elegantissima	Forest Chaser	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Secondary woodland	Common
Orthetrum chrysis	Red-faced Skimmer	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Common
Orthetrum glaucum	Common Blue Skimmer	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Orthetrum sabina	Green Skimmer	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland	Common
Orthetrum sabina	Green Skimmer	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Common
Pantala flavescens	Wandering Glider	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Developed area	Abundant
Trithemis aurora	Crimson Dropwing	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Trithemis festiva	Indigo Dropwing	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Stream	Abundant
Trithemis festiva	Indigo Dropwing	1	West of Tai Ho Wan	49Q HE 0568	Stream	Abundant

Date of Survey: 9 May 2004 (Night)

Tai Ho Wan
No species observed

Dragonflies

Date of Survey 12 May 2004

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Chlorocyphidae						
Rhinocypha perforata	Common Blue Jewel	5	San Tau	49Q HE 0067	Stream	Abundant
Rhinocypha perforata	Common Blue Jewel	2	Sha Lo Wan	49Q GE 9867	Stream	Abundant
Euphaeidae						
Euphaea decorata	Black-banded Gossamerwing	7	San Tau	49Q HE 0067	Stream	Abundant
Euphaea decorata	Black-banded Gossamerwing	3	Sha Lo Wan	49Q GE 9867	Stream	Abundant
Protoneuridae						
Prodasineura autumnalis	Black Threadtail	1	San Tau	49Q HE 0067	Stream	Abundant
Prodasineura autumnalis	Black Threadtail	2	Sha Lo Wan	49Q GE 9867	Stream	Abundant
Gomphidae						
Melligomphus moluamis	Small Hooktail	1	San Tau	49Q HE 0067	Stream	Uncommon
Libellulidae						
Brachydiplax chalybea	Blue Dasher	2	Tung Chung Bay	49Q HE 0166	Pond	Common
Neurothemis tullia	Pied Percher	2	Tung Chung Bay	49Q HE 0166	Pond	Common
Orthetrum glaucum	Common Blue Skimmer	1	San Tau	49Q HE 0067	Village/orchard	Abundant
Orthetrum glaucum	Common Blue Skimmer	1	Sha Lo Wan	49Q GE 9867	Stream	Abundant
Orthetrum glaucum	Common Blue Skimmer	1	Shan Shek Wan	49Q GE 9866	Stream	Abundant
Orthetrum luzonicum	Marsh Skimmer	2	Sha Lo Wan	49Q GE 9867	Stream	Abundant
Pantala flavescens	Wandering Glider	4	San Tau	49Q HE 0067	Village/orchard	Abundant
Pantala flavescens	Wandering Glider	1	Kau Liu to Hau Hok Wan	49Q HE 0068	Tall shrubland	Abundant
Rhyothemis triangularis	Sapphire Flutterer	3	Tung Chung Bay	49Q HE 0166	Pond	Uncommon
Trithemis aurora	Crimson Dropwing	4	Tung Chung Bay	49Q HE 0166	Pond	Abundant
Trithemis aurora	Crimson Dropwing	1	Sha Lo Wan	49Q GE 9867	Stream	Abundant

Date of Survey: 13 May 2004 (Day and Night)

Additional Study Area for tunnel portal option

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Chlorocyphidae						
Rhinocypha perforata	Common Blue Jewel	4	San Tau	49Q HE 0067	Stream	Abundant
Rhinocypha perforata	Common Blue Jewel	2	Sha Lo Wan	49Q GE 9867	Shrubby grassland/Secondary woodland	Abundant
Euphaeidae						
Euphaea decorata	Black-banded Gossamerwing	1	Ngau Au	49Q HE 0166	Small stream	Abundant
Euphaea decorata	Black-banded Gossamerwing	5	San Tau	49Q HE 0067	Stream	Abundant
Euphaea decorata	Black-banded Gossamerwing	5	Sha Lo Wan	49Q GE 9867	Shrubby grassland/Secondary woodland	Abundant
Platycnemididae						
Coeliccia cyanomelas	Blue Forest Damsel	2	San Tau	49Q HE 0067	Stream	Common
Protoneuridae						
Prodasineura autumnalis	Black Threadtail	3	San Tau	49Q HE 0067	Stream	Abundant
Prodasineura autumnalis	Black Threadtail	4	Sha Lo Wan	49Q GE 9867	Shrubby grassland/Secondary woodland	Abundant
Libellulidae						
Orthetrum glaucum	Common Blue Skimmer		Ngau Au	49Q HE 0166	Shrubby grassland	Abundant
Orthetrum sabina	Green Skimmer		Sha Lo Wan	49Q GE 9867	Shrubby grassland/Secondary woodland	Common
Pantala flavescens	Wandering Glider		Ngau Au	49Q HE 0166	Shrubby grassland	Abundant
Pantala flavescens	Wandering Glider		Sha Lo Wan	49Q GE 9867	Shrubby grassland/Secondary woodland	Abundant

Date of Survey: 16 May 2004 (Night)

Chek Lap Kok to Sham Wat
No species observed

Appendix K

List of Recorded Butterfly Species

Butterflies

Date of survey 20 and 25 September 2003

Original Study Area

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Papilionidae							
Graphium agamemnon	Tailed Jay	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20 09 03	Very common
Graphium agamemnon	Tailed Jay	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25 09 03	Very common
Graphium agamemnon	Tailed Jay	2	San Tau	49Q HE 0167	Secondary woodland	20 09 03	Very common
Graphium agamemnon	Tailed Jay	1	Kau Liu	49Q HE 0068	Tall shrubland	20 09 03	Very common
Graphium doson	Common Jay	1	San Tau	49Q HE 0167	Secondary woodland	20 09 03	Uncommon
Graphium sarpedon	Common Bluebottle	1	San Tau	49Q HE 0167	Secondary woodland	20 09 03	Very common
Graphium sarpedon	Common Bluebottle	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25 09 03	Very common
Graphium sarpedon	Common Bluebottle	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	25 09 03	Very common
Papilio clytia	Common Mime	4	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20 09 03	Common
Papilio clytia	Common Mime	5	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25 09 03	Common
Papilio clytia	Common Mime	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	20 09 03	Common
Papilio clytia	Common Mime	2	Tung Chung Battery	49Q HE 0267	Secondary woodland	25 09 03	Common
Papilio clytia	Common Mime	1	Tin Sam	49Q HE 0167	Shrubby grassland	25 09 03	Common
Papilio demoleus	Lime Butterfly	1	Kau Liu	49Q HE 0068	Tall shrubland	20 09 03	Common
Papilio demoleus	Lime Butterfly	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20 09 03	Common
Papilio demoleus	Lime Butterfly	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25 09 03	Common
Papilio demoleus	Lime Butterfly	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25 09 03	Common
Papilio memnon	Great Mormon	2	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Papilio memnon	Great Mormon	1	Sha Lo Wan	49Q GE 9967	Abandoned/disused agriculture	25 09 03	Very common
Papilio memnon	Great Mormon	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	25 09 03	Very common
Papilio polytes	Common Mormon	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20 09 03	Very common
Papilio polytes	Common Mormon	2	San Tau	49Q HE 0167	Secondary woodland	20 09 03	Very common
Papilio polytes	Common Mormon	2	Kau Liu	49Q HE 0068	Tall shrubland	20.09 03	Very common
Papilio polytes	Common Mormon	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09 03	Very common
Papilio polytes	Common Mormon	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25 09 03	Very common
Papilio polytes	Common Mormon	7	San Tau	49Q HE 0167	Secondary woodland	25 09 03	Very common
Papilio polytes	Common Mormon	3	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25 09 03	Very common
Papilio polytes	Common Mormon	1	Sha Lo Wan	49Q GE 9967	Abandoned/disused agriculture	25 09 03	Very common
Papilio polytes	Common Mormon	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09 03	Very common
Papilio protenor	Spangle	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	20.09.03	Very common
Papilio protenor	Spangle	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20 09 03	Very common
Papilio protenor	Spangle	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Very common
Pathysa antiphates	Five-bar Swordtail	2	San Tau	49Q HE 0167	Secondary woodland	20.09 03	Common
Pathysa antiphates	Five-bar Swordtail	3	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Common
Pathysa antiphates	Five-bar Swordtail	1	San Tau	49Q HE 0167	Secondary woodland	25.09 03	Common
Pieridae							
Catopsilia pomona	Lemon Emigrant	2	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Common
Catopsilia pomona	Lemon Emigrant	1	Ma Wan Chung	49Q HE 0267	Village	25.09.03	Common
Catopsilia pomona	Lemon Emigrant	2	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Common
Catopsilia pyranthe	Mottled Emigrant	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20.09.03	Common
Catopsilia pyranthe	Mottled Emigrant	2	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Common
Eurema brigitta	Small Grass Yellow	1	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Uncommon
Eurema hecabe	Common Grass Yellow	1	Ma Wan Chung	49Q HE 0267	Village	20.09.03	Very common
Eurema hecabe	Common Grass Yellow	2	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20.09.03	Very common
Eurema hecabe	Common Grass Yellow	3	Kau Liu	49Q HE 0068	Tall shrubland	20 09 03	Very common
Eurema hecabe	Common Grass Yellow	2	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Very common
Eurema hecabe	Common Grass Yellow	2	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Very common
Ixias pyrene	Yellow Orange Tip	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Uncommon
Pieris canidia	Indian Cabbage White	1	Tin Sam	49Q HE 0167	Shrubby grassland	25.09.03	Very common
Nymphalidae							
Cupha erymanthis	Rustic	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Very common
Cupha erymanthis	Rustic	2	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Very common
Cupha erymanthis	Rustic	12	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Very common
Cupha erymanthis	Rustic	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Very common
Cupha erymanthis	Rustic	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	25.09.03	Very common
Cupha erymanthis	Rustic	3	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Very common
Cupha erymanthis	Rustic	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Very common
Euploea core	Common Indian Crow	3	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Very common
Euploea core	Common Indian Crow	4	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25.09.03	Very common
Euploea core	Common Indian Crow	1	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Very common
Euploea core	Common Indian Crow	4	Tung Chung Battery	49Q HE 0267	Secondary woodland	25 09.03	Very common
Euploea core	Common Indian Crow	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Very common
Euploea core	Common Indian Crow	4	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Euploea core	Common Indian Crow	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Very common
Euploea midamus	Blue-spotted Crow	1	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Very common
Euploea midamus	Blue-spotted Crow	1	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Very common
Euploea midamus	Blue-spotted Crow	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Very common
Euploea midamus	Blue-spotted Crow	3	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Very common
Hypolimnas bolina	Great Eggfly	2	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Very common
Hypolimnas bolina	Great Eggfly	2	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Very common
Hypolimnas misippus	Danaid Eggfly	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Uncommon
Ideopsis similis	Ceylon Blue Glassy Tiger	1	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	25.09.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	3	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Very common
Junonia almana	Peacock Pansy	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	25.09.03	Common
Junonia hierta	Yellow Pansy	2	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Uncommon
Kaniska canace	Blue Admiral	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Common
Melanitis leda	Common Evening Brown	1	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Neptis hylas	Common Sailer	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Very common
Neptis hylas	Common Sailer	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Very common
Lycaenidae							
Abisaria echerius	Plum Judy	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.09.03	Very common
Abisaria echerius	Plum Judy	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Very common
Acytolepis puspa	Common Hedge Blue	3	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Common
Iraota timoleon	Silver Streak Blue	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Uncommon
Jamides bochus	Dark Cerulean	3	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Common
Zizeeria maha	Pale Grass Blue	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	20.09.03	Very common
Zizeeria maha	Pale Grass Blue	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	20.09.03	Very common
Zizeeria maha	Pale Grass Blue	10	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Very common
Zizeeria maha	Pale Grass Blue	1	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Very common
Zizeeria maha	Pale Grass Blue	3	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Very common
Zizeeria maha	Pale Grass Blue	3	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Zizeeria maha	Pale Grass Blue	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Very common
Hesperiidae							
Parnara guttata	Common Straight Swift	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Common

* After Young & Yiu (2002)

Butterflies

Date of survey 2 and 8 October 2003

Additional Study Area

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Papilionidae							
Graphium agamemnon	Tailed Jay	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Very common
Graphium agamemnon	Tailed Jay	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Graphium agamemnon	Tailed Jay	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	08 10 03	Very common
Graphium sarpedon	Common Bluebottle	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Very common
Graphium sarpedon	Common Bluebottle	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Very common
Papilio clytia	Common Mime	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Common
Papilio clytia	Common Mime	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Common
Papilio clytia	Common Mime	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Common
Papilio demoleus	Lime Butterfly	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Common
Papilio helenus	Red Helen	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Papilio memnon	Great Mormon	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	02 10 03	Very common
Papilio paris	Paris Peacock	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08 10 03	Very common
Papilio polytes	Common Mormon	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	02 10 03	Very common
Papilio polytes	Common Mormon	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Papilio polytes	Common Mormon	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	08 10 03	Very common
Papilio protenor	Spangle	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Papilio protenor	Spangle	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Very common
Pathysa antiphates	Five-bar Swordtail	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Common
Pathysa antiphates	Five-bar Swordtail	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Common
Pieridae							
Catopsilia pomona	Lemon Emigrant	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Common
Catopsilia pyranthe	Mottled Emigrant	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Common
Eurema hecabe	Common Grass Yellow	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	02 10 03	Very common
Eurema hecabe	Common Grass Yellow	4	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Very common
Eurema hecabe	Common Grass Yellow	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Very common
Hebomoia glaucippe	Great Orangetip	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	02 10 03	Common
Nymphalidae							
Athyma perius	Common Sergeant	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Common
Athyma perius	Common Sergeant	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Common
Athyma selenophora	Staff Sergeant	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Common
Charaxes bernardus	Tawny Rajah	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Common
Cupha erymanthis	Rustic	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	02 10 03	Very common
Cupha erymanthis	Rustic	6	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Cupha erymanthis	Rustic	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Very common
Danaus genutia	Common Tiger	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Very common
Euploea midamus	Blue-spotted Crow	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Euploea midamus	Blue-spotted Crow	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Hypolimnas bolina	Great Eggfly	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	02 10 03	Very common
Hypolimnas bolina	Great Eggfly	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Hypolimnas bolina	Great Eggfly	2	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Very common
Junonia almana	Peacock Pansy	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Common
Melanitis leda	Common Evening Brown	1	Tai Ho Wan	49Q HE 0768	Tall shrubland	02 10 03	Very common
Mycalesis mineus	Dark Brand Bush Brown	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Very common
Neptis hylas	Common Sailer	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Very common
Polyura nepenthes	Shan Nawab	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	02 10 03	Uncommon
Polyura nepenthes	Shan Nawab	1	NE of Tai Ho Wan	49Q HE 0769	Tall shrubland	08 10 03	Uncommon
Polyura nepenthes	Shan Nawab	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08 10 03	Uncommon
Vanessa indica	Indian Red Admiral	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	08 10 03	Common
Ypthima baldus	Common Five-ring	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	02 10 03	Very common
Ypthima baldus	Common Five-ring	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Very common
Ypthima baldus	Common Five-ring	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Ypthima baldus	Common Five-ring	5	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Very common
Ypthima baldus	Common Five-ring	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Very common
Ypthima lisandra	Straight Five-ring	1	Tai Ho Wan	49Q HE 0768	Tall shrubland	02 10 03	Common
Lycaenidae							
Abisara echerius	Plum Judy	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Very common
Abisara echerius	Plum Judy	4	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Abisara echerius	Plum Judy	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Very common
Abisara echerius	Plum Judy	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	08 10 03	Very common
Acytolepis puspa	Common Hedge Blue	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Common
Acytolepis puspa	Common Hedge Blue	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08 10 03	Common
Chilades lajus	Lime Blue	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Very common
Everes lacturnus	Tailed Cupid	5	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02 10 03	Common
Everes lacturnus	Tailed Cupid	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Common
Everes lacturnus	Tailed Cupid	4	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08 10 03	Common
Lampides boeticus	Long-tailed Blue	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Common
Zizeeria maha	Pale Grass Blue	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	02 10 03	Very common
Zizeeria maha	Pale Grass Blue	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Very common
Zizeeria maha	Pale Grass Blue	7	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Very common
Zizeeria maha	Pale Grass Blue	8	West of Pak Mong	49Q HE 0568	Shrubby grassland	08 10 03	Very common
Hesperiidae							
Ampittia dioscorides	Bush Hopper	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Uncommon
Ampittia dioscorides	Bush Hopper	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08 10 03	Uncommon
Astictopterus jama	Forest Hopper	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	02 10 03	Common
Astictopterus jama	Forest Hopper	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	08 10 03	Common
Parnara guttata	Common Straight Swift	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02 10 03	Common
Parnara guttata	Common Straight Swift	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	08 10 03	Common
Suastus gremius	Indian Palm Bob	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	08 10 03	Common

*After Young & Yiu (2002)

Butterflies

Date of survey 23 October 2003 (Night)

Sham Wat and Sham Shek Tsuen headland
No species observed

Date of survey 24, 27, 28 October and 5 November 2003

Sham Wat and Sham Shek Tsuen headland

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Papilionidae							
Graphium agamemnon	Tailed Jay	1	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Graphium sarpedon	Common Bluebottle	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	24.10.03	Very common
Graphium sarpedon	Common Bluebottle	1	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Papilio clytia	Common Mime	2	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Common
Papilio clytia	Common Mime	1	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Common
Papilio helenus	Red Helen	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	24.10.03	Very common
Papilio helenus	Red Helen	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	27.10.03	Very common
Papilio polytes	Common Mormon	4	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Very common
Papilio polytes	Common Mormon	2	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Papilio polytes	Common Mormon	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	24.10.03	Very common
Papilio polytes	Common Mormon	2	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Papilio xuthus	Swallowtail	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	27.10.03	Uncommon
Pieridae							
Catopsilia pomona	Lemon Emigrant	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Common
Eurema hecabe	Common Grass Yellow	10	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Very common
Eurema hecabe	Common Grass Yellow	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	24.10.03	Very common
Eurema hecabe	Common Grass Yellow	4	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Eurema hecabe	Common Grass Yellow	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	27.10.03	Very common
Nymphalidae							
Cupha erymanthis	Rustic	1	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Cupha erymanthis	Rustic	1	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Danaus chrysippus	Plain Tiger	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Uncommon
Danaus genutia	Common Tiger	2	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Very common
Danaus genutia	Common Tiger	3	Sham Wat	49Q GE 9765	Coastal grass/shrub	27.10.03	Very common
Euploea midamus	Blue-spotted Crow	5	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Euploea midamus	Blue-spotted Crow	2	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	2	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Ideopsis similis	Ceylon Blue Glassy Tiger	1	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Mycalesis zonata	South China Bush Brown	2	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Common
Neptis hylas	Common Sailer	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	27.10.03	Very common
Lycaenidae							
Abisara echerius	Plum Judy	2	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Abisara echerius	Plum Judy	2	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common
Acytolepis puspa	Common Hedge Blue	2	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Common
Acytolepis puspa	Common Hedge Blue	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	27.10.03	Common
Chilades lajus	Lime Blue	2	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Very common
Chilades lajus	Lime Blue	5	Sham Wat	49Q GE 9765	Coastal grass/shrub	27.10.03	Very common
Jamides bochus	Dark Cerulean	4	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Common
Lampides boeticus	Long-tailed Blue	7	Sham Wat	49Q GE 9765	Coastal grass/shrub	24.10.03	Common
Zizeeria maha	Pale Grass Blue	8	Sham Wat	49Q GE 9765	Secondary woodland	24.10.03	Very common
Zizeeria maha	Pale Grass Blue	1	Sham Wat	49Q GE 9765	Secondary woodland	27.10.03	Very common

West of Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Pieridae							
Eurema hecabe	Common Grass Yellow	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Very common
Nymphalidae							
Mycalesis mineus	Dark Brand Bush Brown	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Very common
Ypthima baldus	Common Five-ring	3	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Very common
Lycaenidae							
Abisara echerius	Plum Judy	12	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Very common
Euchrysops cnejus	Gram Blue Cupid	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Common
Spindasis lohita	Long-banded Silverline	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Uncommon
Zizina otis	Lesser Grass Blue	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	28.10.03	Common

Inland study area for San Shek Wan tunnel option

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Papilionidae							
Graphium sarpedon	Common Bluebottle	1	SW of San Tau	49Q HE 0067	Shrubby grassland/Tall shrubland	05.11.03	Very common
Papilio paris	Paris Peacock	1	S of Hau Hok Wan	49Q GE 9967	Shrubby grassland/Tall shrubland	05.11.03	Very common
Papilio polytes	Common Mormon	2	SW of San Tau	49Q HE 0067	Shrubby grassland/Tall shrubland	05.11.03	Very common
Pieridae							
Catopsilia pomona	Lemon Emigrant	2	E of San Shek Wan	49Q GE 9966	Shrubby grassland/Tall shrubland	05.11.03	Common
Eurema hecabe	Common Grass Yellow	6	S of Hau Hok Wan	49Q GE 9967	Shrubby grassland/Tall shrubland	05.11.03	Very common
Nymphalidae							
Euploea midamus	Blue-spotted Crow	4	S of Hau Hok Wan	49Q GE 9967	Shrubby grassland/Tall shrubland	05.11.03	Very common
Hypolimnas bolina	Great Egg-fly	1	SW of San Tau	49Q HE 0067	Shrubby grassland/Tall shrubland	05.11.03	Very common
Ypthima baldus	Common Five-ring	7	S of Hau Hok Wan	49Q GE 9967	Shrubby grassland/Tall shrubland	05.11.03	Very common
Lycaenidae							
Abisara echerius	Plum Judy	3	SW of San Tau	49Q HE 0067	Shrubby grassland/Tall shrubland	05.11.03	Very common
Abisara echerius	Plum Judy	2	S of Hau Hok Wan	49Q GE 9967	Shrubby grassland/Tall shrubland	05.11.03	Very common
Abisara echerius	Plum Judy	2	E of San Shek Wan	49Q GE 9966	Shrubby grassland/Tall shrubland	05.11.03	Very common
Acytolepis puspa	Common Hedge Blue	2	E of San Shek Wan	49Q GE 9966	Shrubby grassland/Tall shrubland	05.11.03	Common

* After Young & Yiu (2002)

Butterflies

Date of survey 25 November 2003

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Papilionidae							
Graphium sarpedon	Common Bluebottle	1	Kau Liu	49Q HE 0068	Tall shrubland	25 11 03	Very common
Graphium sarpedon	Common Bluebottle	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	25 11 03	Very common
Graphium sarpedon	Common Bluebottle	1	Sham Wat	49Q GE 9765	Secondary woodland	25 11 03	Very common
Papilio clytia	Common Mime	2	San Tau	49Q HE 0167	Secondary woodland	25 11 03	Common
Papilio clytia	Common Mime	1	Tin Sam	49Q HE 0167	Shrubby grassland	25 11 03	Common
Papilio clytia	Common Mime	1	Sham Wat	49Q GE 9765	Secondary woodland	25 11 03	Common
Papilio polytes	Common Mormon	1	Kau Liu	49Q HE 0068	Tall shrubland	25 11 03	Common
Papilio polytes	Common Mormon	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25 11 03	Common
Papilio polytes	Common Mormon	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	25 11 03	Common
Papilio polytes	Common Mormon	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25 11 03	Very common
Papilio polytes	Common Mormon	1	Sham Wat	49Q GE 9765	Secondary woodland	25 11 03	Very common
Pieridae							
Delias pasithoe	Red-base Jezebel	3	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	1	Ma Wan Chung	49Q HE 0267	Developed area	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	5	San Tau	49Q HE 0167	Secondary woodland	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	2	Tin Sam	49Q HE 0167	Shrubby grassland	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	3	Kau Liu	49Q HE 0068	Tall shrubland	25 11 03	Very common
Delias pasithoe	Red-base Jezebel	2	Sham Wat	49Q GE 9765	Secondary woodland	25 11 03	Very common
Eurema hecabe	Common Grass Yellow	2	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25 11 03	Very common
Eurema hecabe	Common Grass Yellow	1	Tung Chung Battery	49Q HE 0267	Secondary woodland	25 11 03	Very common
Eurema hecabe	Common Grass Yellow	4	San Tau	49Q HE 0167	Secondary woodland	25 11 03	Very common
Eurema hecabe	Common Grass Yellow	2	Tin Sam	49Q HE 0167	Shrubby grassland	25 11 03	Very common
Eurema hecabe	Common Grass Yellow	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25 11 03	Very common
Eurema hecabe	Common Grass Yellow	5	Sham Wat	49Q GE 9765	Secondary woodland	25 11 03	Very common
Eurema laeta	Spotless Grass Yellow	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25 11 03	Uncommon
Nymphalidae							
Cupha erymanthis	Rustic	3	Kau Liu	49Q HE 0068	Tall shrubland	25 11 03	Very common
Cupha erymanthis	Rustic	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25 11 03	Very common
Cupha erymanthis	Rustic	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	25 11 03	Very common
Cupha erymanthis	Rustic	3	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25 11 03	Very common
Cupha erymanthis	Rustic	1	Sham Wat	49Q GE 9765	Secondary woodland	25 11 03	Very common
Danaus chrysippus	Plain Tiger	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	25 11 03	Uncommon
Danaus genutia	Common Tiger	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25 11 03	Very common
Danaus genutia	Common Tiger	2	Tin Sam	49Q HE 0167	Shrubby grassland	25 11 03	Very common
Danaus genutia	Common Tiger	6	Sham Wat	49Q GE 9765	Coastal grass/shrub	25 11 03	Very common
Melanitis leda	Common Evening Brown	2	San Tau	49Q HE 0167	Secondary woodland	25 11 03	Very common
Melanitis leda	Common Evening Brown	1	Kau Liu	49Q HE 0068	Tall shrubland	25 11 03	Very common
Melanitis leda	Common Evening Brown	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25 11 03	Very common
Mycalesis mineus	Dark Brand Bush Brown	6	San Tau	49Q HE 0167	Secondary woodland	25.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	5	Kau Liu	49Q HE 0068	Tall shrubland	25.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	4	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	Sham Wat	49Q GE 9765	Secondary woodland	25.11.03	Very common
Mycalesis zonata	South China Bush Brown	2	Kau Liu	49Q HE 0068	Tall shrubland	25.11.03	Common
Mycalesis zonata	South China Bush Brown	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25.11.03	Common
Neptis hylas	Common Sailer	1	San Tau	49Q HE 0167	Secondary woodland	25.11.03	Very common
Neptis hylas	Common Sailer	1	Kau Liu	49Q HE 0068	Tall shrubland	25.11.03	Very common
Neptis hylas	Common Sailer	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25.11.03	Very common
Lycaenidae							
Abisaria echerius	Plum Judy	3	San Tau	49Q HE 0167	Secondary woodland	25.11.03	Very common
Abisaria echerius	Plum Judy	2	Tin Sam	49Q HE 0167	Shrubby grassland	25.11.03	Very common
Abisaria echerius	Plum Judy	4	Kau Liu	49Q HE 0068	Tall shrubland	25.11.03	Very common
Abisaria echerius	Plum Judy	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.11.03	Very common
Abisaria echerius	Plum Judy	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.11.03	Very common
Abisaria echerius	Plum Judy	1	Sham Wat	49Q GE 9765	Secondary woodland	25.11.03	Very common
Acytolepis puspa	Common Hedge Blue	2	Sham Wat	49Q GE 9765	Coastal grass/shrub	25.11.03	Common
Heliophorus epicles	Purple Sapphire	1	Tin Sam	49Q HE 0167	Shrubby grassland	25.11.03	Common
Lampides boeticus	Long-tailed Blue	1	Tin Sam	49Q HE 0167	Shrubby grassland	25.11.03	Common
Lampides boeticus	Long-tailed Blue	2	Sham Wat	49Q GE 9765	Coastal grass/shrub	25.11.03	Common
Zizeeria maha	Pale Grass Blue	2	Tung Chung Battery	49Q HE 0267	Secondary woodland	25.11.03	Very common
Zizeeria maha	Pale Grass Blue	3	Ma Wan Chung	49Q HE 0267	Developed area	25.11.03	Very common
Zizeeria maha	Pale Grass Blue	2	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.11.03	Very common
Zizeeria maha	Pale Grass Blue	5	Sham Wat	49Q GE 9765	Secondary woodland	25.11.03	Very common
Hesperiidae							
Ampittia dioscorides	Bush Hopper	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.11.03	Uncommon
Astictopterus jama	Forest Hopper	1	San Tau	49Q HE 0167	Secondary woodland	25.11.03	Common
Astictopterus jama	Forest Hopper	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	25.11.03	Common
Parnara guttata	Common Straight Swift	1	Tin Sam	49Q HE 0167	Shrubby grassland	25.11.03	Common

*After Young & Yiu (2002)

Butterflies

Date of survey 26 November 2003

Tai Ho Wan

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Date**	**Hong Kong status***
Papilionidae							
Graphium sarpedon	Common Bluebottle	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	26 11 03	Very common
Papilio clytia	Common Mime	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26 11 03	Common
Papilio clytia	Common Mime	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	26 11 03	Common
Papilio helenus	Red Helen	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	26 11 03	Very common
Papilio polytes	Common Mormon	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26 11 03	Very common
Papilio polytes	Common Mormon	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26 11 03	Very common
Pieridae							
Delias pasithoe	Red-base Jezebel	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	26 11 03	Very common
Delias pasithoe	Red-base Jezebel	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26 11 03	Very common
Delias pasithoe	Red-base Jezebel	4	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26 11 03	Very common
Delias pasithoe	Red-base Jezebel	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26 11 03	Very common
Eurema hecabe	Common Grass Yellow	3	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11 03	Very common
Eurema hecabe	Common Grass Yellow	2	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11 03	Very common
Eurema hecabe	Common Grass Yellow	5	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11 03	Very common
Nymphalidae							
Athyma perius	Common Sergeant	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11 03	Common
Cupha erymanthis	Rustic	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11 03	Very common
Cupha erymanthis	Rustic	4	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	26.11 03	Very common
Cupha erymanthis	Rustic	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Very common
Danaus genutia	Common Tiger	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11 03	Very common
Danaus genutia	Common Tiger	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Very common
Hypolimnas bolina	Great Eggfly	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26 11 03	Very common
Junonia almana	Peacock Pansy	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Common
Junonia atlites	Grey Pansy	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11.03	Common
Junonia atlites	Grey Pansy	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26.11.03	Common
Junonia lemonias	Lemon Pansy	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26.11.03	Uncommon
Melanitis leda	Common Evening Brown	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26.11 03	Very common
Melanitis leda	Common Evening Brown	1	Tai Ho Wan	49Q HE 0768	Tall shrubland	26.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	4	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	26.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Very common
Mycalesis mineus	Dark Brand Bush Brown	4	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Very common
Mycalesis zonata	South China Bush Brown	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	26.11.03	Common
Mycalesis zonata	South China Bush Brown	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Common
Neptis hylas	Common Sailer	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	26.11.03	Very common
Ypthima baldus	Common Five-ring	3	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11.03	Very common
Ypthima baldus	Common Five-ring	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	26.11.03	Very common
Ypthima baldus	Common Five-ring	3	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Very common
Lycaenidae							
Abisara echerius	Plum Judy	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11.03	Very common
Abisara echerius	Plum Judy	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	26.11.03	Very common
Abisara echerius	Plum Judy	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Very common
Abisara echerius	Plum Judy	2	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Very common
Acytolepis puspa	Common Hedge Blue	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	26.11.03	Common
Acytolepis puspa	Common Hedge Blue	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Common
Zizeeria maha	Pale Grass Blue	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	26.11.03	Very common
Zizeeria maha	Pale Grass Blue	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	26.11.03	Very common
Zizeeria maha	Pale Grass Blue	3	West of Pak Mong	49Q HE 0568	Shrubby grassland	26.11.03	Very common
Hesperiidae							
Astictopterus jama	Forest Hopper	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	26.11.03	Common

Date of survey: 10 December 2003 (Night)

Chek Lap Kok to Sham Wat
No species recorded

Date of survey: 15 December 2003 (Night)

Tai Ho Wan
No species recorded

Date of survey: 22 and 27 January 2004

Chek Lap Kok to Sham Wat

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Date**	**Hong Kong status***
Pieridae							
Delias pasithoe	Red-base Jezebel	1	Kau Liu	49Q HE 0068	Tall shrubland	22.01.04	Very common
Pieris canidia	Indian Cabbage White	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	22.01.04	Very common
Nymphalidae							
Cupha erymanthis	Rustic	1	San Tau	49Q HE 0167	Secondary woodland	22.01.04	Very common

Tai Ho Wan

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Date**	**Hong Kong status***
Pieridae							
Delias pasithoe	Red-base Jezebel	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Shrubby grassland	27.01.04	

Date of survey: 17 February 2004 (Night)

Chek Lap Kok to Sham Wat

Species	**Common name**	**Abundance**	**Location**	**UTM ref.**	**Habitat**	**Date**	**Hong Kong status***
Nymphalidae							
Melanitis leda	Common Evening Brown	1	Sham Wat	49Q GE 9765	Secondary woodland	17.02.04	Very common
Lycaenidae							
Abisaria echerius	Plum Judy	1	Sham Wat	49Q GE 9765	Coastal grass/shrub	17.02.04	Very common

*After Young & Yiu, 2002

Date of survey 19 February 2004 (Night)

Tai Ho Wan
No species observed

Butterflies

Date of survey 16 March 2004

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Papilionidae						
Graphium agamemnon	Tailed Green Jay	2	San Tau	49Q HE 0167	Secondary woodland	Very common
Graphium sarpedon	Common Bluebottle	1	San Tau	49Q HE 0167	Secondary woodland	Very common
Graphium sarpedon	Common Bluebottle	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	Very common
Papilio clytia	Common Mime	2	San Tau	49Q HE 0167	Secondary woodland	Common
Papilio clytia	Common Mime	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	Common
Papilio clytia	Common Mime	1	Kau Liu	49Q HE 0068	Tall shrubland	Common
Papilio demoleus	Lime Butterfly	1	San Tau	49Q HE 0167	Cultivated fields	Common
Papilio demoleus	Lime Butterfly	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	Common
Papilio helenus	Red Helen	2	San Tau	49Q HE 0167	Secondary woodland	Very common
Papilio helenus	Red Helen	1	Kau Liu	49Q HE 0068	Tall shrubland	Very common
Papilio helenus	Red Helen	2	Sham Wat	49Q GE 9765	Secondary woodland	Very common
Papilio helenus	Red Helen	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Papilio paris	Paris Peacock	1	San Tau	49Q HE 0167	Secondary woodland	Very common
Papilio paris	Paris Peacock	1	Kau Liu	49Q HE 0068	Tall shrubland	Very common
Papilio polytes	Common Mormon	4	San Tau	49C HE 0167	Cultivated fields	Very common
Papilio polytes	Common Mormon	2	Kau Liu	49Q HE 0068	Tall shrubland	Very common
Papilio polytes	Common Mormon	3	Sham Wat	49Q GE 9765	Secondary woodland	Very common
Papilio polytes	Common Mormon	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Papilio protenor	Spangle	2	San Tau	49Q HE 0167	Secondary woodland	Very common
Pathysa antiphates	Fivebar Swordtail	2	San Tau	49Q HE 0167	Secondary woodland	Common
Pathysa antiphates	Fivebar Swordtail	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	Common
Pieridae						
Appias albina	Common Albatross	1	San Tau	49Q HE 0167	Cultivated fields	Rare
Eurema hecabe	Common Grass Yellow	3	San Tau	49Q HE 0167	Cultivated fields	Very common
Eurema hecabe	Common Grass Yellow	2	Sham Wat	49Q GE 9765	Secondary woodland	Very common
Eurema hecabe	Common Grass Yellow	4	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Eurema hecabe	Common Grass Yellow	3	Sham Wat	49Q GE 9765	Coastal grass/shrub	Very common
Pieris canidia	Indian Cabbage White	5	San Tau	49Q HE 0167	Cultivated fields	Very common
Pieris canidia	Indian Cabbage White	3	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	Very common
Pieris canidia	Indian Cabbage White	2	Kau Liu	49Q HE 0068	Tall shrubland	Very common
Pieris canidia	Indian Cabbage White	2	Chek Lap Kok	49Q HE 0268	Shrubby grassland	Very common
Pieris canidia	Indian Cabbage White	8	Sha Lo Wan	49Q GE 9867	Tall shrubland	Very common
Nymphalidae						
Cupha erymanthis	Rustic	1	San Tau	49Q HE 0167	Secondary woodland	Very common
Cupha erymanthis	Rustic	2	Sham Wat	49Q GE 9765	Secondary woodland	Very common
Cupha erymanthis	Rustic	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Faunis eumeus	Common Faun	4	San Tau	49Q HE 0167	Secondary woodland	Common
Faunis eumeus	Common Faun	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Common
Junonia iphita	Chocolate Pansy	1	San Tau	49Q HE 0167	River	Uncommon
Kaniska canace	Blue Admiral	1	San Tau	49Q HE 0167	River	Common
Kaniska canace	Blue Admiral	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	Common
Lethe confusa	Common White-banded Brown	1	San Tau	49Q HE 0167	Secondary woodland	Very common
Lethe confusa	Common White-banded Brown	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Lethe confusa	Common White-banded Brown	1	Kau Liu	49Q HE 0068	Tall shrubland	Very common
Mycalesis mineus	Dark Brand Bush Brown	4	San Tau	49Q HE 0167	Secondary woodland	Very common
Mycalesis mineus	Dark Brand Bush Brown	3	Sham Wat	49Q GE 9765	Secondary woodland	Very common
Mycalesis mineus	Dark Brand Bush Brown	6	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Mycalesis zonata	South China Bush Brown	1	San Tau	49Q HE 0167	Secondary woodland	Common
Neptis hylas	Common Sailer	1	San Tau	49Q HE 0167	Secondary woodland	Very common
Neptis hylas	Common Sailer	1	Kau Liu	49Q HE 0068	Tall shrubland	Very common
Parathyma sulpitia	Five-dot Sergeant	1	San Tau	49Q HE 0167	Secondary woodland	Common
Lycaenidae						
Abisara echerius	Plum Judy	2	San Tau	49Q HE 0167	Secondary woodland	Very common
Abisara echerius	Plum Judy	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	Very common
Abisara echerius	Plum Judy	3	Sham Wat	49Q GE 9765	Secondary woodland	Very common
Abisara echerius	Plum Judy	3	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	Very common
Zemeros flegyas	Punchinello	1	San Tau	49Q HE 0167	Secondary woodland	Common
Zemeros flegyas	Punchinello	1	Sham Wat	49Q GE 9765	Secondary woodland	Common
Zizeeria maha	Pale Grass Blue	7	San Tau	49Q HE 0167	Cultivated fields	Very common
Zizeeria maha	Pale Grass Blue	5	Sham Wat	49Q GE 9765	Coastal grass/shrub	Very common
Zizeeria maha	Pale Grass Blue	3	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	Very common
Hesperiidae						
Odontoptilum angulatum	Chestnut Angle	1	San Tau	49Q HE 0167	River	Common
Odontoptilum angulatum	Chestnut Angle	1	Sham Wat	49Q GE 9765	Secondary woodland	Common

Date of survey: 17 March 2004

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Papilionidae						
Graphium sarpedon	Common Bluebottle	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Very common
Graphium sarpedon	Common Bluebottle	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Graphium sarpedon	Common Bluebottle	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	Very common
Papilio bianor	Chinese Peacock	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Papilio helenus	Red Helen	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Very common
Papilio helenus	Red Helen	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Papilio helenus	Red Helen	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	Very common
Papilio paris	Paris Peacock	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Very common
Papilio paris	Paris Peacock	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Papilio polytes	Common Mormon	3	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Papilio polytes	Common Mormon	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Papilio polytes	Common Mormon	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	Very common
Papilio protenor	Spangle	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Very common
Pathysa antiphates	Fivebar Swordtail	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Pieridae						
Eurema hecabe	Common Grass Yellow	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Eurema hecabe	Common Grass Yellow	4	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Pieris canidia	Indian Cabbage White	5	Pak Mong to Ngau Kwu Long	49Q HE 0668	Developed area	Very common
Pieris canidia	Indian Cabbage White	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Nymphalidae						
Athyma selenophora	Staff Sergeant	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Cupha erymanthis	Rustic	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Very common
Cupha erymanthis	Rustic	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Cupha erymanthis	Rustic	2	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Faunis eumeus	Common Faun	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Faunis eumeus	Common Faun	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Common
Mycalesis mineus	Dark Brand Bush Brown	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Very common
Mycalesis mineus	Dark Brand Bush Brown	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	Very common
Neptis hylas	Common Sailer	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Neptis hylas	Common Sailer	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Common
Rohana parisatis	Black Prince	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Lycaenidae						
Abisara echerius	Plum Judy	4	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Abisara echerius	Plum Judy	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Abisara echerius	Plum Judy	3	West of Pak Mong	49Q HE 0568	Shrubby grassland	Very common
Acytolepis puspa	Common Hedge Blue	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common
Acytolepis puspa	Common Hedge Blue	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Common
Zizeeria maha	Pale Grass Blue	3	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Zizeeria maha	Pale Grass Blue	4	Tai Ho Wan	49Q HE 0768	Shrubby grassland	Very common
Zizeeria maha	Pale Grass Blue	6	West of Pak Mong	49Q HE 0568	Shrubby grassland	Very common
Hesperiidae						
Odontoptilum angulatum	Chestnut Angle	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	Common

Butterflies

Date of survey 20 April 2004 (Night)

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Hesperiidae						
Erionota torus	Banana Skipper	1	Sham Wat	49Q GE 9765	Cultivated field	Common

Date of Survey 27 April 2004 (Night)

Tai Ho Wan
No species observed

Date of Survey 9 May 2004

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Papilionidae						
Graphium doson	Common Jay	4	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Uncommon
Graphium sarpedon	Common Bluebottle	7	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Graphium sarpedon	Common Bluebottle	1	East of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Papilio bianor	Chinese Peacock	4	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Papilio clytia	Common Mime	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Papilio paris	Paris Peacock	9	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Papilio paris	Paris Peacock	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Papilio helenus	Red Helen	5	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Papilio memnon	Great Mormon	7	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Papilio polytes	Common Mormon	16	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Papilio polytes	Common Mormon	3	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Papilio polytes	Common Mormon	1	East of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Papilio protenor	Spangle	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Pathysa antiphates	Fivebar Swordtail	4	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Pieridae						
Cepora nerissa	Common Gull	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Catopsilia pyranthe	Mottled Emigrant	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Eurema blanda	Three-spot Grass Yellow	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Uncommon
Eurema hecabe	Common Grass Yellow	12	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Eurema hecabe	Common Grass Yellow	4	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Eurema hecabe	Common Grass Yellow	3	East of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Eurema laeta	Spotless Grass Yellow	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Uncommon
Ixias pyrene	Yellow Orangetip	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Uncommon
Pieris canidia	Indian Cabbage White	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Nymphalidae						
Athyma nefte	Colour Sergeant	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Athyma selenophora	Staff Sergeant	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Charaxes bernardus	Tawny Rajah	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Cupha erymanthis	Rustic	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Cyrestis thyodamas	Mapwing	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Euploea midamus	Blue-spotted Crow	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Euploea midamus	Blue-spotted Crow	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Hestina assimilis	Red Ring-skirt	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Mycalesis mineus	Dark Brand Bush Brown	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Mycalesis mineus	Dark Brand Bush Brown	2	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Mycalesis mineus	Dark Brand Bush Brown	1	East of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Mycalesis zonata	South China Bush Brown	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Neptis hylas	Common Sailer	7	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Neptis hylas	Common Sailer	2	East of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Phaedyma columella	Short-banded Sailer	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Uncommon
Symbrenthia lilaea	Jester	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Ypthima baldus	Common Five-ring	3	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Ypthima baldus	Common Five-ring	4	East of Tai Ho Wan	49Q HE 0769	Shrubby grassland	Very common
Lycaenidae						
Abisara echerius	Plum Judy	2	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Very common
Acytolepis puspa	Common Hedge Blue	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Acytolepis puspa	Common Hedge Blue	1	West of Tai Ho Wan	49Q HE 0568	Shrubby grassland	Common
Heliophorus epicles	Purple Sapphire	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Jamides bochus	Dark Cerulean	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Common
Nacaduba kurava	Rounded Six-line Blue	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common
Rapala manea	Slate Flash	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Uncommon
Zizeeria maha	Pale Grass Blue	7	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/Secondary woodland	Very common

Date of Survey 9 May 2004 (Night)

Tai Ho Wan
No species observed

*After Young & Yiu, 2002

Butterflies

Date of Survey 12 May 2004

Chek Lap Kok to Sham Wat

Species	Common name	Location	Habitat	Hong Kong status*
Hesperiidae				
Erionota torus	Banana Skipper	Sham Wat	Village banana plantation	Common

Chek Lap Kok to Sham Wat

Species	Common name	Location	Habitat	Hong Kong status*
Papilionidae				
Graphium agamemnon	Tailed Green Jay	Tung Chung Bay	Developed area	Very common
Graphium agamemnon	Tailed Green Jay	San Tau	Village/orchard	Very common
Graphium agamemnon	Tailed Green Jay	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Graphium doson	Common Jay	Tung Chung Bay	Developed area	Uncommon
Graphium doson	Common Jay	Tung Chung Bay	Shrubby grassland/Secondary woodland	Uncommon
Graphium doson	Common Jay	San Tau	Village/orchard	Uncommon
Graphium doson	Common Jay	Kau Liu to Hau Hok Wan	Tall shrubland	Uncommon
Graphium doson	Common Jay	Sha Lo Wan	Village/orchard	Uncommon
Graphium sarpedon	Common Bluebottle	Tung Chung Bay	Developed area	Very common
Graphium sarpedon	Common Bluebottle	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Graphium sarpedon	Common Bluebottle	San Tau	Village/orchard	Very common
Graphium sarpedon	Common Bluebottle	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Papilio bianor	Chinese Peacock	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Papilio bianor	Chinese Peacock	San Tau	Village/orchard	Common
Papilio clytia	Common Mime	San Tau	Village/orchard	Common
Papilio clytia	Common Mime	Kau Liu to Hau Hok Wan	Tall shrubland	Common
Papilio clytia	Common Mime	Sha Lo Wan	Village/orchard	Common
Papilio demoleus	Lime Butterfly	Tung Chung Bay	Developed area	Common
Papilio helenus	Red Helen	Tung Chung Bay	Developed area	Very common
Papilio helenus	Red Helen	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Papilio helenus	Red Helen	San Tau	Village/orchard	Very common
Papilio helenus	Red Helen	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Papilio helenus	Red Helen	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Very common
Papilio memnon	Great Mormon	Tung Chung Bay	Developed area	Very common
Papilio memnon	Great Mormon	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Papilio memnon	Great Mormon	San Tau	Village/orchard	Very common
Papilio paris	Paris Peacock	Tung Chung Bay	Developed area	Very common
Papilio paris	Paris Peacock	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Papilio paris	Paris Peacock	San Tau	Village/orchard	Very common
Papilio paris	Paris Peacock	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Papilio paris	Paris Peacock	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Very common
Papilio paris	Paris Peacock	Sha Lo Wan	Village/orchard	Very common
Papilio polytes	Common Mormon	Tung Chung Bay	Developed area	Very common
Papilio polytes	Common Mormon	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Papilio polytes	Common Mormon	San Tau	Village/orchard	Very common
Papilio polytes	Common Mormon	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Papilio polytes	Common Mormon	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Very common
Papilio polytes	Common Mormon	Sha Lo Wan	Village/orchard	Very common
Papilio protenor	Spangle	San Tau	Village/orchard	Very common
Papilio protenor	Spangle	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Very common
Papilio xuthus	Swallowtail	San Tau	Village/orchard	Rare
Papilio xuthus	Swallowtail	San Shek Wan	Developed area	Rare
Pathysa antiphates	Fivebar Swordtail	Tung Chung Bay	Developed area	Common
Pathysa antiphates	Fivebar Swordtail	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Pathysa antiphates	Fivebar Swordtail	San Tau	Village/orchard	Common
Pieridae				
Catopsilia pomona	Lemon Emigrant	Tung Chung Bay	Developed area	Common
Catopsilia pomona	Lemon Emigrant	Kau Liu to Hau Hok Wan	Tall shrubland	Common
Catopsilia pyranthe	Mottled Emigrant	San Tau	Village/orchard	Common
Cepora nerissa	Common Gull	Kau Liu to Hau Hok Wan	Tall shrubland	Common
Cepora nerissa	Common Gull	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Common
Cepora nerissa	Common Gull	Sha Lo Wan	Village/orchard	Common
Delias pasithoe	Red-base Jezebel	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Eurema brigitta	Small Grass Yellow	Kau Liu to Hau Hok Wan	Tall shrubland	Uncommon
Eurema hecabe	Common Grass Yellow	Tung Chung Bay	Developed area	Very common
Eurema hecabe	Common Grass Yellow	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Eurema hecabe	Common Grass Yellow	San Tau	Village/orchard	Very common
Eurema hecabe	Common Grass Yellow	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Eurema hecabe	Common Grass Yellow	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Very common
Eurema laeta	Spotless Grass Yellow	Tung Chung Bay	Shrubby grassland/Secondary woodland	Uncommon
Hebomoia glaucippe	Great Orangetip	Tung Chung Bay	Developed area	Common
Hebomoia glaucippe	Great Orangetip	San Tau	Village/orchard	Common
Hebomoia glaucippe	Great Orangetip	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Common
Hebomoia glaucippe	Great Orangetip	Sha Lo Wan	Village/orchard	Common
Ixias pyrene	Yellow Orangetip	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Uncommon
Ixias pyrene	Yellow Orangetip	Sha Lo Wan	Village/orchard	Uncommon
Pieris canidia	Indian Cabbage White	Tung Chung Bay	Developed area	Very common
Pieris canidia	Indian Cabbage White	San Tau	Village/orchard	Very common
Pieris canidia	Indian Cabbage White	Sha Lo Wan	Village/orchard	Very common
Nymphalidae				
Athyma nefte	Colour Sergeant	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Athyma nefte	Colour Sergeant	San Tau	Village/orchard	Common
Athyma selenophora	Staff Sergeant	San Tau	Village/orchard	Common
Cethosia biblis	Hong Kong Lacewing	Tung Chung Bay	Shrubby grassland/Secondary woodland	Rare
Cethosia biblis	Hong Kong Lacewing	San Tau	Village/orchard	Rare
Charaxes bernardus	Tawny Rajah	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Charaxes bernardus	Tawny Rajah	San Tau	Village/orchard	Common
Cupha erymanthis	Rustic	Tung Chung Bay	Developed area	Very common
Cupha erymanthis	Rustic	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Cupha erymanthis	Rustic	San Tau	Village/orchard	Very common
Cupha erymanthis	Rustic	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Cyrestis thyodamas	Mapwing	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Cyrestis thyodamas	Mapwing	San Tau	Village/orchard	Common
Cyrestis thyodamas	Mapwing	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Common
Danaus genutia	Common Tiger	Sham Wat	Developed area	Very common
Euthalia phemius	White-edged Blue Baron	San Tau	Village/orchard	Common
Faunis eumeus	Common Faun	San Tau	Village/orchard	Very common
Junonia iphita	Chocolate Pansy	San Tau	Stream	Uncommon
Lethe confusa	Common White-banded Brown	San Tau	Village/orchard	Very common
Lethe confusa	Common White-banded Brown	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Neptis hylas	Common Sailer	Tung Chung Bay	Developed area	Very common
Neptis hylas	Common Sailer	Tung Chung Bay	Shrubby grassland/Secondary woodland	Very common
Neptis hylas	Common Sailer	San Tau	Village/orchard	Very common
Neptis hylas	Common Sailer	Kau Liu to Hau Hok Wan	Tall shrubland	Very common
Neptis hylas	Common Sailer	Sha Lo Wan	Village/orchard	Very common
Parasarpa dudu	Commodore	Tung Chung Bay	Shrubby grassland/Secondary woodland	Uncommon
Parathyma sulpitia	Five-dot Sergeant	San Tau	Village/orchard	Common
Parathyma sulpitia	Five-dot Sergeant	Kau Liu to Hau Hok Wan	Tall shrubland	Common
Phaedyma columella	Short-banded Sailer	Sha Lo Wan	Village/orchard	Uncommon
Polyura nepenthes	Shan Nawab	San Tau	Village/orchard	Uncommon
Polyura nepenthes	Shan Nawab	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Uncommon
Rohana parisatis	Black Prince	San Tau	Village/orchard	Uncommon
Rohana parisatis	Black Prince	San Tau	Stream	Uncommon
Rohana parisatis	Black Prince	Kau Liu to Hau Hok Wan	Tall shrubland	Uncommon
Rohana parisatis	Black Prince	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Uncommon
Symbrenthia lilaea	Jester	Sha Lo Wan	Village/orchard	Common
Ypthima baldus	Common Five-ring	Hau Hok Wan to Sha Lo Wan	Shrubby grassland	Very common
Lycaenidae				
Abisara echerius	Plum Judy	San Tau	Village/orchard	Very common
Acytolepis puspa	Common Hedge Blue	Tung Chung Bay	Developed area	Common
Acytolepis puspa	Common Hedge Blue	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Acytolepis puspa	Common Hedge Blue	San Tau	Village/orchard	Common
Arhopala birmana	Burmese Bush Blue	San Tau	Village/orchard	Rare
Artipe eryx	Green Flash	Kau Liu to Hau Hok Wan	Tall shrubland	Uncommon
Mahathala ameria	Falcate Oak Blue	Kau Liu to Hau Hok Wan	Tall shrubland	Uncommon
Neopithecops zalmora	Quaker	Tung Chung Bay	Developed area	Uncommon
Neopithecops zalmora	Quaker	Tung Chung Bay	Shrubby grassland/Secondary woodland	Uncommon
Zemeros flegyas	Punchinello	Tung Chung Bay	Shrubby grassland/Secondary woodland	Common
Zizeeria maha	Pale Grass Blue	Tung Chung Bay	Developed area	Very common
Zizeeria maha	Pale Grass Blue	San Tau	Village/orchard	Very common
Hesperiidae				
Bibasis gomata	Pale Awlet	San Tau	Village/orchard	Uncommon
Iambrix salsala	Chestnut Bob	Kau Liu to Hau Hok Wan	Tall shrubland	Uncommon

*After Young & Yiu, 2002

Butterflies

Date of Survey 13 May 2004 (Day and Night)

Additional Study Area for tunnel portal option

Species	Common name	Abundance	Location	UTM ref.	Habitat	Hong Kong status*
Papilionidae						
Lamproptera curius	Dragontail	5	San Tau	49Q HE 008675	Stream	Rare
Papilio bianor	Chinese Peacock	1	San Tau	49Q HE 0067	Stream	Common
Papilio helenus	Red Helen	3	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Papilio memnon	Great Mormon	1	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Papilio paris	Paris Peacock	3	San Tau	49Q HE 0067	Stream	Very common
Papilio polytes	Common Mormon	4	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Papilio polytes	Common Mormon	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common
Pieridae						
Catopsilia pyranthe	Mottled Emigrant	1	San Tau	49Q HE 0067	Stream	Common
Cepora nerissa	Common Gull	2	San Tau	49Q HE 0067	Stream	Common
Delias pasithoe	Red-base Jezebel	2	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Eurema hecabe	Common Grass Yellow	3	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Eurema hecabe	Common Grass Yellow	1	San Tau	49Q HE 0067	Stream	Very common
Eurema hecabe	Common Grass Yellow	4	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common
Eurema laeta	Spotless Grass Yellow	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Uncommon
Hebomoia glaucippe	Great Orangetip	1	Ngau Au	49Q HE 0166	Shrubby grassland	Common
Hebomoia glaucippe	Great Orangetip	1	San Tau	49Q HE 0067	Stream	Common
Hebomoia glaucippe	Great Orangetip	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Common
Ixias pyrene	Yellow Orangetip	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Uncommon
Nymphalidae						
Athyma nefte	Colour Sergeant	1	San Tau	49Q HE 0067	Stream	Common
Athyma selenophora	Staff Sergeant	1	San Tau	49Q HE 0067	Stream	Common
Cupha erymanthis	Rustic	3	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Cupha erymanthis	Rustic	2	San Tau	49Q HE 0067	Stream	Very common
Cupha erymanthis	Rustic	2	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common
Cyrestis thyodamas	Mapwing	1	San Tau	49Q HE 0067	Stream	Common
Cyrestis thyodamas	Mapwing	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Common
Junonia iphita	Chocolate Pansy	1	San Tau	49Q HE 0067	Stream	Uncommon
Lethe confusa	Common White-banded Brown	1	San Tau	49Q HE 0067	Stream	Very common
Neptis hylas	Common Sailer	3	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Neptis hylas	Common Sailer	1	San Tau	49Q HE 0067	Stream	Very common
Neptis hylas	Common Sailer	2	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common
Parathyma sulpitia	Five-dot Sergeant	1	San Tau	49Q HE 0067	Stream	Common
Rohana parisatis	Black Prince	5	San Tau	49Q HE 0067	Stream	Uncommon
Rohana parisatis	Black Prince	3	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Uncommon
Ypthima baldus	Common Five-ring	4	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Ypthima baldus	Common Five-ring	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common
Lycaenidae						
Abisara echerius	Plum Judy	2	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Abisara echerius	Plum Judy	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common
Acytolepis puspa	Common Hedge Blue	1	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Neopithecops zalmora	Quaker	1	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Uncommon
Zemeros flegyas	Punchinello	1	San Tau	49Q HE 0067	Stream	Common
Zizeeria maha	Pale Grass Blue	3	Ngau Au	49Q HE 0166	Shrubby grassland	Very common
Zizeeria maha	Pale Grass Blue	5	Sha Lo Wan	49Q GE 9867	Shrubby grassland/secondary woodland	Very common

Date of Survey: 18 May 2004 (Night)

Chek Lap Kok to Sham Wat
No species observed

Appendix L

List of Recorded Herpetofauna Species

Herpetofauna

Date of survey: 20 and 25 September 2003
22 and 25 September 2003 (Night)

Original Study Area

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Bufonidae							
Bufo melanostictus	Asian Common Toad	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	22.09.03	Very abundant
Bufo melanostictus	Asian Common Toad	1	Chek Lap Kok	49Q HE 0268	Shrubby grassland	25.09.03	Very abundant
Bufo melanostictus	Asian Common Toad	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Very abundant
Bufo melanostictus	Asian Common Toad	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.09.03	Very abundant
Bufo melanostictus	Asian Common Toad	1	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very abundant
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	1	Kau Liu	49Q HE 002678	Stream	25.09.03	Common**
Microhylidae							
Kaloula pulchra	Asiatic Painted Frog	2	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Common
Kaloula pulchra	Asiatic Painted Frog	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Common
Gekkonidae							
Gehyra mutilata	Four-clawed Gecko	1	San Tau	49Q HE 0167	Village buildings	25.09.03	Uncommon
Gekko chinensis	Chinese Gecko	2	San Tau	49Q HE 0167	Secondary woodland	22.09.03	Very common
Gekko chinensis	Chinese Gecko	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	22.09.03	Very common
Gekko chinensis	Chinese Gecko	2	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.09.03	Very common
Gekko chinensis	Chinese Gecko	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Very common
Gekko chinensis	Chinese Gecko	2	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	22	Chek Lap Kok	49Q HE 0268	Pavilion	22.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	8	San Tau	49Q HE 0167	Secondary woodland	22.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	16	San Tau	49Q HE 0167	Village buildings	22.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	5	Kau Liu	49Q HE 0068	Tall shrubland	22.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	9	Sha Lo Wan	49Q GE 9867	Village buildings	22.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	25.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	25	San Tau	49Q HE 0167	Village buildings	25.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	10	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Very common
Hemidactylus bowringii	Bowring's Gecko	19	Chek Lap Kok	49Q HE 0268	Pavilion	25.09.03	Very common
Agamidae							
Calotes versicolor	Changeable Lizard	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Common
Calotes versicolor	Changeable Lizard	1	Hau Wong Temple	49Q HE 0266	Disturbed / wasteland	25.09.03	Common
Calotes versicolor	Changeable Lizard	1	San Tau	49Q HE 0167	Secondary woodland	25.09.03	Common
Scincidae							
Ateuchosaurus chinensis	Chinese Forest Skink	1	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Common on Lantau
Eumeces quadrilineatus	Blue-tailed Skink	3	Kau Liu	49Q HE 0068	Tall shrubland	20.09.03	Uncommon to abundant
Eumeces quadrilineatus	Blue-tailed Skink	1	Hau Hok Wan	49Q GE 9967	Shrubby grassland	20.09.03	Uncommon to abundant
Eumeces quadrilineatus	Blue-tailed Skink	1	Kau Liu	49Q HE 0068	Tall shrubland	25.09.03	Uncommon to abundant
Mabuya longicaudata	Long-tailed Skink	1	San Tau	49Q HE 0167	Secondary woodland	20.09.03	Fairly common and widespread

Date of survey: 2 and 8 October 2003
5 and 8 October 2003 (Night)

Additional Study Area
Herpetofauna

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Bufonidae							
Bufo melanostictus	Asian Common Toad	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Very abundant
Bufo melanostictus	Asian Common Toad	1	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	05.10.03	Very abundant
Bufo melanostictus	Asian Common Toad	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	05.10.03	Very abundant
Bufo melanostictus	Asian Common Toad	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	05.10.03	Very abundant
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	1	Tai Ho Wan	49Q HE 073689	Stream	02.10.03	Common**
Rana limnocharis	Paddy Frog	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Very common
Rana limnocharis	Paddy Frog	2	NE of Tai Ho Wan	49Q HE 0769	Shrubby grassland	05.10.03	Very common
Rana limnocharis	Paddy Frog	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	05.10.03	Very common
Rhacophoridae							
Polypedates megacephalus	Brown Tree Frog	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	05.10.03	Common
Microhylidae							
Kaloula pulchra	Asiatic Painted Frog	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Common
Kaloula pulchra	Asiatic Painted Frog	1	West of Pak Mong	49Q HE 0568	Shrubby grassland	02.10.03	Common
Kaloula pulchra	Asiatic Painted Frog	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	05.10.03	Common
Gekkonidae							
Gekko chinensis	Chinese Gecko	4	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Very common
Gekko chinensis	Chinese Gecko	3	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Very common
Gekko chinensis	Chinese Gecko	6	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	05.10.03	Very common
Gekko chinensis	Chinese Gecko	3	Tai Ho Wan	49Q HE 0768	Shrubby grassland	05.10.03	Very common
Hemidactylus bowringii	Bowring's Gecko	16	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	02.10.03	Very common
Hemidactylus bowringii	Bowring's Gecko	8	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Very common
Hemidactylus bowringii	Bowring's Gecko	3	West of Pak Mong	49Q HE 0568	Shrubby grassland	02.10.03	Very common
Hemidactylus bowringii	Bowring's Gecko	2	West of Pak Mong	49Q HE 0568	Shrubby grassland	05.10.03	Very common
Hemidactylus bowringii	Bowring's Gecko	22	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	05.10.03	Very common
Hemidactylus bowringii	Bowring's Gecko	8	Tai Ho Wan	49Q HE 0768	Shrubby grassland	05.10.03	Very common
Agamidae							
Calotes versicolor	Changeable Lizard	2	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Common
Calotes versicolor	Changeable Lizard	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Common
Calotes versicolor	Changeable Lizard	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	08.10.03	Common
Scincidae							
Eumeces chinensis	Chinese Skink	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Very common
Eumeces chinensis	Chinese Skink	1	Tai Ho Wan	49Q HE 0768	Shrubby grassland	02.10.03	Very common
Scincella reevesii	Reeves' Smooth Skink	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Very common
Colubridae							
Oligodon formosanus	Taiwan Kukri Snake	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Secondary woodland	02.10.03	Not generally common

Date of Survey: 2 October 2003

Half-Day Additional Survey
Herpetofauna

Species	Common name	Abundance	Location	UTM ref.	Date	Hong Kong status*
Agamidae						
Calotes versicolor	Changeable Lizard	1	Sha Lo Wan	49Q HE 0668	02.10.03	Common
Calotes versicolor	Changeable Lizard	1	San Tau	49Q HE 0668	02.10.03	Common

* After Karsen *et al.* (1998)
** Conservation concern (Fellowes *et al.* 2002)

Herpetofauna

Date of survey: 24, 27, 28 October and 5 November 2003
23, 27 October and 5 November 2003 (Night)

Sham Wat and Sham Shek Tsuen headland

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*	Notes
Bufonidae								
Bufo melanostictus	Asian Common Toad	1	Sham Wat	49Q GE 9765	Developed area	27.10.03	Very abundant	
Rhacophoridae								
Polypedates megacephalus	Brown Tree Frog	3	Sham Wat	49Q GE 9765	Secondary woodland	23.10.03	Common/abundant	
Gekkonidae								
Gekko chinensis	Chinese Gecko	3	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	23.10.03	Very common	
Gekko chinensis	Chinese Gecko	3	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	27.10.03	Very common	
Hemidactylus bowringii	Bowring's Gecko	14	Sham Wat	49Q GE 9765	Developed area	23.10.03	Very common	
Hemidactylus bowringii	Bowring's Gecko	1	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	24.10.03	Very common	
Hemidactylus bowringii	Bowring's Gecko	17	Sham Wat	49Q GE 9765	Developed area	27.10.03	Very common	
Hemidactylus bowringii	Bowring's Gecko	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	27.10.03	Very common	
Elapidae								
Naja atra	Chinese Cobra	1	Sham Shek Tsuen headland	49Q GE 979664	Stream	23.10.03	Uncommon**	A freshly sloughed skin

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Viperidae							
Trimeresurus albolabris	Bamboo Snake	1	Pak Mong	49Q HE 0768	Developed area	28.10.03	Common

Inland study area for San Shek Wan tunnel option

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	1	S of Hok Tau	49Q GE 9967	Stream	05.11.03	Common**
Gekkonidae							
Gekko chinensis	Chinese Gecko	3	SW of San Tau	49Q HE 0067	Shrubby grassland/tall shrubland	05.11.03	Very common
Scincidae							
Eumeces quadrilineatus	Blue-tailed Skink	1	E of San Shek Wan	49Q GE 9966	Shrubby grassland/tall shrubland	05.11.03	Rare - abundant
Scincella reevesii	Reeves' Smooth Skink	2	SW of San Tau	49Q HE 0067	Shrubby grassland/tall shrubland	05.11.03	Abundant
Scincella reevesii	Reeves' Smooth Skink	1	E of San Shek Wan	49Q GE 9966	Shrubby grassland/tall shrubland	05.11.03	Abundant

Date of survey: 25 and 26 November 2003
10 and 15 December 2003 (Night)

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Gekkonidae							
Gekko chinensis	Chinese Gecko	1	San Tau	49Q HE 0167	Secondary woodland	25.11.03	Very common
Gekko chinensis	Chinese Gecko	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.11.03	Very common
Hemidactylus bowringii	Bowring's Gecko	3	San Tau	49Q HE 0167	Developed area	25.11.03	Very common
Hemidactylus bowringii	Bowring's Gecko	1	Sha Lo Wan	49Q GE 9867	Developed area	25.11.03	Very common
Hemidactylus bowringii	Bowring's Gecko	2	Sham Wat	49Q GE 9765	Developed area	25.11.03	Very common
Scincidae							
Eumeces quadrilineatus	Blue-tailed Skink	1	Sha Lo Wan	49Q GE 9867	Tall shrubland	25.11.03	Uncommon to abundant

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Gekkonidae							
Gekko chinensis	Chinese Gecko	2	Sham Shek Tsuen headland	49Q GE 9766	Tall shrubland	10.12.03	Very common
Gekko chinensis	Chinese Gecko	4	San Tau	49Q HE 0167	Secondary woodland	10.12.03	Very common
Hemidactylus bowringii	Bowring's Gecko	8	Chek Lap Kok	49Q HE 0268	Shrubby grassland	10.12.03	Very common
Hemidactylus bowringii	Bowring's Gecko	18	Sha Lo Wan	49Q GE 9867	Developed area	10.12.03	Very common

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Gekkonidae							
Gekko chinensis	Chinese Gecko	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	26.11.03	Very common
Scincidae							
Mabuya longicaudata	Long-tailed Skink	1	Tai Ho Wan	49Q HE 0768	Stream	26.11.03	Fairly common and widespread

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Gekkonidae							
Gekko chinensis	Chinese Gecko	6	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	15.12.03	Very common
Gekko chinensis	Chinese Gecko	2	Tai Ho Wan	49Q HE 0768	Shrubby grassland	15.12.03	Very common
Hemidactylus bowringii	Bowring's Gecko	23	Pak Mong to Ngau Kwu Long	49Q HE 0668	Developed area	15.12.03	Very common

Date of survey: 22 and 27 January 2004

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*	Notes
Gekkonidae								
Gekko chinensis	Chinese Gecko	1	San Tau	49Q HE 0167	Secondary woodland	22.01.04	Very common	
Gekko chinensis	Chinese Gecko	1	Sha Lo Wan	49Q GE 9867	Secondary woodland	22.01.04	Very common	

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Gekkonidae							
Gekko chinensis	Chinese Gecko	1	Pak Mong to Ngau Kwu Long	49Q HE 0668	Village woodland	27.01.04	Very common

* After Karsen *et al.* (1998)
** Conservation concern (Fellowes *et al.* 2002)

Herpetofauna

Date of survey: 17 and 19 February 2004 (Night)

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Bufonidae							
Bufo melanostictus	Asian Common Toad	5	Hau Wong Temple	49Q HE 0266	Streams/Riparian	17 02 04	Common
Gekkonidae							
Gekko chinensis	Chinese Gecko	1	San Tau	49Q HE 0167	Secondary woodland	17 02 04	Very common
Gekko chinensis	Chinese Gecko	5	Sha Lo Wan	49Q GE 9867	Tall shrubland	17 02 04	Very common
Hemidactylus bowringii	Bowring's Gecko	4	Sha Lo Wan	49Q GE 9867	Developed area	17 02 04	Very common

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Bufonidae							
Bufo melanostictus	Asian Common Toad	1	Pak Mong	49Q HE 0768	Shrubby grassland	19 02 04	Common

* After Karsen *et al.* (1998)

Date of survey: 16 March 2004

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Gekkonidae							
Gekko chinensis	Chinese Gecko	3	San Tau	49Q HE 0167	Secondary woodland	16 03 04	Very common
Gekko chinensis	Chinese Gecko	2	Sha Lo Wan	49Q GE 9867	Tall shrubland	16.03.04	Very common

Date of survey: 17 March 2004

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Agamidae							
Calotes versicolor	Changeable Lizard	1	Pak Mong	49Q HE 0768	Shrubby grassland	17 03.04	Common

* After Karsen *et al.* (1998)

Date of survey: 20 April 2004 (Night)

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	1	Sham Wat	49Q GE 977656	Small stream	20.04.04	Common**
Rana exilispinosa	Lesser Spiny Frog	4	Hau Hok Wan	49Q GE 999677	Stream	20.04.04	Common**
Rana guentheri	Günther's Frog	5	Sham Wat	49Q GE 9765	Stream	20.04.04	Very common
Rana guentheri	Günther's Frog	8	Shan Shek Wan	49Q GE 9866	Disused farmland	20.04.04	Very common
Rana guentheri	Günther's Frog	27	Sha Lo Wan	49Q GE 9967	Disused farmland	20.04.04	Very common
Rana guentheri	Günther's Frog	3	San Tau	49Q HE 0167	Disused farmland	20.04.04	Very common
Rana limnocharis	Paddy Frog	3	Shan Shek Wan	49Q GE 9866	Disused farmland	20.04.04	Very common
Rana limnocharis	Paddy Frog	2	Sha Lo Wan	49Q GE 9967	Disused farmland	20.04.04	Very common
Rana limnocharis	Paddy Frog	3	San Tau	49Q HE 0167	Disused farmland	20.04.04	Very common
Rhacophoridae							
Polypedates megacephalus	Brown Tree Frog	1	Sham Wat	49Q GE 9765	Developed area	20.04.04	Very common
Polypedates megacephalus	Brown Tree Frog	8	Shan Shek Wan	49Q GE 9866	Disused farmland	20.04.04	Very common
Polypedates megacephalus	Brown Tree Frog	14	Sha Lo Wan	49Q GE 9967	Disused farmland	20.04.04	Very common
Polypedates megacephalus	Brown Tree Frog	5	San Tau	49Q HE 0167	Disused farmland	20.04.04	Very common
Microhylidae							
Kaloula pulchra	Asiatic Painted Frog	3	Shan Shek Wan	49Q GE 9866	Disused farmland	20.04.04	Common
Kaloula pulchra	Asiatic Painted Frog	3	Sha Lo Wan	49Q GE 9967	Disused farmland	20.04.04	Common
Kaloula pulchra	Asiatic Painted Frog	4	San Tau	49Q HE 0167	Disused farmland	20.04.04	Common
Microhyla pulchra	Marbled Pigmy Frog	3	Shan Shek Wan	49Q GE 9866	Disused farmland	20.04.04	Common
Gekkonidae							
Gekko chinensis	Chinese Gecko	5	Shan Shek Wan	49Q GE 9866	Secondary woodland	20.04.04	Very common
Gekko chinensis	Chinese Gecko	5	Sha Lo Wan	49Q GE 9867	Developed area	20.04.04	Very common
Gekko chinensis	Chinese Gecko	2	San Tau	49Q HE 0167	Developed area	20.04.04	Very common
Gekko gecko	Tokay Gecko	7	Sham Wat	49Q GE 978657	Shrubby grassland	20.04.04	Rare
Gekko gecko	Tokay Gecko	4	Shan Shek Wan	49Q GE 983667	Developed area ***	20.04.04	Rare
					***Single individual also observed here by PJL, 17th March		
Gekko gecko	Tokay Gecko	1	San Tau	49Q HE 011676	Developed area	20.04.04	Rare
Hemidactylus bowringii	Bowring's Gecko	23	Shan Shek Wan	49Q GE 9866	Developed area	20.04.04	Very common
Hemidactylus bowringii	Bowring's Gecko	4	Sha Lo Wan	49Q GE 9867	Developed area	20.04.04	Very common
Hemidactylus bowringii	Bowring's Gecko	12	San Tau	49Q HE 0167	Developed area	20.04.04	Very common

Date of survey: 27 April 2004 (Night)

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	1	West of Tai Ho Wan	49Q HE 051684	Stream	27.04.04	Common**
Rana exilispinosa	Lesser Spiny Frog	1	East of Tai Ho Wan	49Q HE 074694	Stream	27.04.04	Common**
Rana guentheri	Günther's Frog	3	Pak Mong	49Q HE 0768	Stream	27.04.04	Very common
Rana guentheri	Günther's Frog	4	East of Pak Mong	49Q HE 0668	Streams/Riparian	27.04.04	Very common
Rana guentheri	Günther's Frog	2	Tai Ho Wan	49Q HE 0668	Stream	27.04.04	Very common
Rana limnocharis	Paddy Frog	5	East of Pak Mong	49Q HE 0668	Streams/Riparian	27.04.04	Very common
Rhacophoridae							
Polypedates megacephalus	Brown Tree Frog	3	Pak Mong	49Q HE 0768	Secondary woodland	27.04.04	Very common
Polypedates megacephalus	Brown Tree Frog	1	East of Pak Mong	49Q HE 0668	Shrubby grassland	27.04.04	Very common
Polypedates megacephalus	Brown Tree Frog	1	Tai Ho Wan	49Q HE 0668	Shrubby grassland	27.04.04	Very common
Microhylidae							
Kaloula pulchra	Asiatic Painted Frog	1	Pak Mong	49Q HE 0768	Stream	27.04.04	Common
Kaloula pulchra	Asiatic Painted Frog	2	East of Pak Mong	49Q HE 0668	Streams/Riparian	27.04.04	Common
Gekkonidae							
Gekko chinensis	Chinese Gecko	3	Pak Mong	49Q HE 0768	Secondary woodland	27.04.04	Very common
Gekko chinensis	Chinese Gecko	2	Tai Ho Wan	49Q HE 0668	Shrubby grassland	27.04.04	Very common
Hemidactylus bowringii	Bowring's Gecko	11	Pak Mong	49Q HE 0768	Developed area	27.04.04	Very common
Hemidactylus bowringii	Bowring's Gecko	4	Tai Ho Wan	49Q HE 0668	Developed area	27.04.04	Very common

*After Karsen et al. 1998
**Conservation concern (Fellowes et al. 2002)

Herpetofauna

Date of Survey: 9 May 2004

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Colubridae							
Ptyas mucosus	Common Rat Snake	1	Pak Mong to Tai Ho Wan	49Q HE 0668	Shrubby grassland/secondary woodland	09.05.04	Common

Date of Survey: 9 May 2004 (Night)

Tai Ho Wan

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	1	West of Tai Ho Wan	49Q HE 051684	Stream	09.05.04	Common**
Rana guentheri	Günther's Frog	2	Pak Mong to Tai Ho Wan	49Q HE 0668	Marsh	09.05.04	Very common
Rana guentheri	Günther's Frog	2	East of Tai Ho Wan	49Q HE 0668	Stream	09.05.04	Very common
Rhacophoridae							
Polypedates megacephalus	Brown Tree Frog	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Secondary woodland	09.05.04	Very common
Polypedates megacephalus	Brown Tree Frog	1	East of Tai Ho Wan	49Q HE 0668	Shrubby grassland	09.05.04	Very common
Gekkonidae							
Gekko chinensis	Chinese Gecko	3	Pak Mong to Tai Ho Wan	49Q HE 0668	Secondary woodland	09.05.04	Very common
Hemidactylus bowringii	Bowring's Gecko	18	Pak Mong to Tai Ho Wan	49Q HE 0768	Developed area	09.05.04	Very common

Date of Survey: 12 May 2004

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae							
Rana guentheri	Gunther's Frog	8	Sha Lo Wan	49Q GE 9867	Small pond	12.05.04	Very common
Scincidae							
Eumeces chinensis	Chinese Skink	2	Tung Chung Bay	49Q HE 0166	Developed area	12.05.04	Very common
Mabuya longicaudata	Long-tailed Skink	1	San Tau	49Q HE 0067	Village/orchard	12.05.04	Common
Agamidae							
Calotes versicolor	Changeable Lizard	1	Tung Chung Bay	49Q HE 0166	Developed area	12.05.04	Common
Colubridae							
Ptyas mucosus	Common Rat Snake	1	Tung Chung Bay	49Q HE 0166	Coastal mangrove	12.05.04	Common

Date of Survey: 18 May 2004

Chek Lap Kok to Sham Wat

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae							
Rana exilispinosa	Lesser Spiny Frog	2	Hau Hok Wan	49Q GE 999677	Stream	18.05.04	Common**
Rana guentheri	Günther's Frog	6	Sham Wat	49Q GE 9765	Stream	18.05.04	Very common
Rana guentheri	Günther's Frog	3	Shan Shek Wan	49Q GE 9866	Disused farmland	18.05.04	Very common
Rana guentheri	Günther's Frog	11	Sha Lo Wan	49Q GE 9967	Disused farmland	18.05.04	Very common
Rana guentheri	Günther's Frog	2	San Tau	49Q HE 0167	Disused farmland	18.05.04	Very common
Rana limnocharis	Paddy Frog	1	Shan Shek Wan	49Q GE 9866	Disused farmland	18.05.04	Very common
Rhacophoridae							
Polypedates megacephalus	Brown Tree Frog	3	Shan Shek Wan	49Q GE 9866	Disused farmland	18.05.04	Very common
Polypedates megacephalus	Brown Tree Frog	5	Sha Lo Wan	49Q GE 9967	Disused farmland	18.05.04	Very common
Polypedates megacephalus	Brown Tree Frog	2	San Tau	49Q HE 0167	Disused farmland	18.05.04	Very common
Microhylidae							
Kaloula pulchra	Asiatic Painted Frog	1	Sha Lo Wan	49Q GE 9967	Disused farmland	18.05.04	Common
Kaloula pulchra	Asiatic Painted Frog	2	San Tau	49Q HE 0167	Disused farmland	18.05.04	Common
Gekkonidae							
Gekko chinensis	Chinese Gecko	8	Shan Shek Wan	49Q GE 9866	Secondary woodland	18.05.04	Very common
Gekko chinensis	Chinese Gecko	11	Sha Lo Wan	49Q GE 9967	Developed area	18.05.04	Very common
Gekko chinensis	Chinese Gecko	3	San Tau	49Q HE 0167	Developed area	18.05.04	Very common
Hemidactylus bowringii	Bowring's Gecko	14	Shan Shek Wan	49Q GE 9866	Developed area	18.05.04	Very common
Hemidactylus bowringii	Bowring's Gecko	18	Sha Lo Wan	49Q GE 9967	Developed area	18.05.04	Very common
Hemidactylus bowringii	Bowring's Gecko	21	San Tau	49Q HE 0167	Developed area	18.05.04	Very common

Date of Survey: 18 May 2004 (Day and Night)

Additional Study Area for tunnel portal option

Species	Common name	Abundance	Location	UTM ref.	Habitat	Date	Hong Kong status*
Ranidae						18.05.04	
Rana exilispinosa	Lesser Spiny Frog	2	San Tau	49Q HE 005673	Stream	18.05.04	Common**
Rana exilispinosa	Lesser Spiny Frog	1	Sha Lo Wan	49Q GE 991668	Stream	18.05.04	Common**
Rana guentheri	Günther's Frog	3	Ngau Au	49Q HE 0166	Small stream	18.05.04	Very common
Rana guentheri	Günther's Frog	2	Sha Lo Wan	49Q GE 9867	Stream	18.05.04	Very common
Rhacophoridae							
Polypedates megacephalus	Brown Tree Frog	2	San Tau	49Q HE 0067	Tall shrubland	18.05.04	Very common
Polypedates megacephalus	Brown Tree Frog	3	Sha Lo Wan	49Q GE 9867	Tall shrubland	18.05.04	Very common
Gekkonidae							
Gekko chinensis	Chinese Gecko	2	Ngau Au	49Q HE 0166	Shrubby grassland	18.05.04	Very common
Hemidactylus bowringii	Bowring's Gecko	6	Ngau Au	49Q HE 0166	Developed area	18.05.04	Very common

*After Karsen et al. 1998
**Conservation concern (Fellowes et al. 2002)

Appendix M

List of Recorded Vegetation Species

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Vegetation

Date of survey: September 2003 to May 2004

Plant Species Recroded within the Study Area

Area	A	North Lantau (from Tung Chung to Sham Wat)
	B	North Lantau (from Tung Chung to Tai Ho Wan)
	C	Chap Lap Kok Area
Relative Abundance	1	rare
	2	uncommon
	3	common
	4	abundant
	5	very abundant

	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Tree	*Bambusa* sp.	n/a	2			2	2	2										2	2	2						2	2
Tree	*Acacia confusa*	c	3	3	4	2	2	2										2	2		1	1	2			2	2
Tree	*Acacia maginum*	p			3																						
Tree	*Aconychia pedunculata*	vc	2	2		3	3	2	3	3	2	1	1	2													
Tree	*Actinidia latifolia*	rest				1																					
Tree	*Adina pilulifera*	vc	2			2	2		2	2		1															
Tree	*Alangium chinense*	c	2	2	1	3	2	2	2	1		1	1														
Tree	*Antidesma bunius*	c				2	2																				
Tree	*Aporosa dioica*	vc	3	3	2	3	3	3			2	2	2	1													
Tree	*Aquilaria sinensis*	c #	1	1		1	1	1										1	1								
Tree	*Archidendron clypearia*	c	2	2		2		1																			1
Tree	*Archidendron lucida*	c	2	2		2	2		1	1																	
Tree	*Averrhoa carambola*	p																2	2							2	2
Tree	*Bauhinia* sp.	p			3																						
Tree	*Bischofia javanica*	c				1	1											1								1	
Tree	*Bridelia penangiana*	c				2	2																				
Tree	*Bridelia tomentosa*	vc	3	3	1	3	3	3	2	2	1							2	2								
Tree	*Callicarpa nudiflora*	c		1		1	1		1									1									
Tree	*Cassia surattensis*	p			3													1	1	2						1	
Tree	*Castanopsis fissa*	p					1																				
Tree	*Casuarina equisetifolia*	p	2	2	2	1	1											2	2	1			1				
Tree	*Celtis biondii*	rest				2	2		2																		
Tree	*Celtis tetrandra*	c	3	3	2	3	3	2	1	1	2							2	2		2					2	2
Tree	*Celtis timorensis*	rest	2			2	1		1									2	1		1					1	
Tree	*Cerbera manghas*	c	1			2	2	1	2	2	2			2	2	2											
Tree	*Cinnamomum parthenoxylon*	c																									
Tree	*Citrus* sp.	p																2	2							3	3
Tree	*Clausena lansium*	c						1										2	2							3	3
Tree	*Cleistocalyx operculata*	c				1	1	1													1	1					
Tree	*Cratoxylum cochinchinense*	vc	3	3	3	2	2	2	3	3	3	2	2	2													
Tree	*Cyclobalanopsis myrsinaefolia*	c										2															
Tree	*Delonix regia*	p																1									
Tree	*Dimocarpus longan*	rest*	3	3	3	2	2	2										2	2							4	4
Tree	*Diospyros erianthe*	vc				1																					
Tree	*Diospyros morrisiana*	vc							2	2																	
Tree	*Dodonaea viscosa*	r													1												
Tree	*Ehretia longiflora*	rest				1	1		2	2																	
Tree	*Eriobotrya japonica*	p																1								1	1
Tree	*Eucalyptus robusta*	p	1	2	3	1												1			1	1	1				
Tree	*Exoecarcia agallocha*	c													2	1											
Tree	*Ficus fistulosa*	c				2	2																				

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Vegetation

Date of survey: September 2003 to May 2004

	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Tree	*Ficus hirta*	c	3	3	3	3	3	2	2												1	1				1	
Tree	*Ficus hispida*	c	2	2	2	2	2	2													1	1		1	1	1	1
Tree	*Ficus microcarpa*	c	2	2		2	2	1	2	2											1	1				1	1
Tree	*Ficus variegata*	c	2	2		3	3	2	2	2					1	1					1	1					
tree	*Ficus virens*	c				2	2	2										1									
Tree	*Glochidion hirsutum*	c				1	1		2	2											1			1	1	1	1
Tree	*Glochidion zeylancium*	c																1	1		1	1		1	1	1	1
Tree	*Gmelina chinensis*	c				1	1		1	1																	
Tree	*Gossampinus malabarica*	p																1									
Tree	*Hibiscus tiliaceous*	c	1	1	3	3	3	2	2	2	2	1	1	1	1	1		1	1								
Tree	*Homalium cochinchinensis*	c							2	2	1	2	2	2													
Tree	*Hylocereus undatus*	p				1	1														1	1				1	1
Tree	*Lasianthus chinensis*	c				1	1																				
Tree	*Lasianthus wallichii*	rest	1	1		1	1	1																			
Tree	*Leucaena leucocephala*	vc	2	2				1										2	2	2	2	2	2			2	2
Tree	*Litchi chinensis*	rest*				2	2											1	2		1	1				4	4
Tree	*Litsea cubeba*	c	2	2		2	2	1	2	1																	
Tree	*Litsea glutinosa*	vc	3	3	3	3	3	3	2	2		1	1	1	1			1	1		1	1				1	1
Tree	*Lophostemon conferta*	p			3																						
Tree	*Macaranga tanarius*	c	2	2	2	2	2	2										3	3		2	2	2	1			
Tree	*Mallotus apelta*	c	2	2		2	2	1	2			1	1														
Tree	*Mallotus paniculata*	vc	4	4	4	3	3	3	3	3	1	1	1													1	
Tree	*Mangifera indica*	c																1	1							2	
Tree	*Melaleuca leucadendron*	p	2	1	2																1						
Tree	*Melia azedarach*	c	2	2	2										1			1	1	2	2	2		1		1	1
Tree	*Melicope pteleifolia*	c				2			2																		
Tree	*Microcos paniculata*	c	3	3	3	3	3	2	2	2	1			1								1					
Tree	*Nerium indicum*	p			2									1													
tree	*Ormosia emarginata*	c					2																				
Tree	*Phyllanthus emblica*	vc	2	1	2	1	1		2	2	3	2	2	2	1												
Tree	*Phyllanthus reticulatus*	c	1	2		3	2		2	1																	
Tree	*Pinus elliiottii*	c																									
Tree	*Pinus massoniana*	c	2	3	2	3	3		2	2								1	1	1			1				
Tree	*Psidium guajava*	c																2	2		2	2					
Tree	*Rapanea neriifolia*	c				2	2																				
Tree	*Rhus chinensis*	c	2	2	2	2	2	2	2	2	2			1													
Tree	*Rhus hypoleuca*	c				1	2		1	2	1																
Tree	*Rhus succedanea*	c	2	2	1	2	2	2	2	2	2		1	1							1	1				1	
Tree	*Sapium discolor*	vc	2	2	2	2	2	2	2	2	1							1	1	1						1	
tree	*Sapium sebiferum*	vc	2	2	2	2	2		2												1	1		1		1	
Tree	*Sarcandra glabra*	vc	1	1		2	2																				
Tree	*Saurauia tristyla*	c				1	1																				
Tree	*Schefflera octophylla*	vc	3	2	2	3	3	3	3	3				1													
Tree	*Scolopia chinenise*	c				1	1		1																		
Tree	*Scolopia saeva*	c	1	1		3	2	3	2	2		1	1								1	1					
Tree	*Sterculia lanceolata*	vc	2	2	2	3	3	3	2	2								1	1	1							
Tree	*Styrax suberifolia*	c				1	1		1																		
Tree	*Syzygium hencei*	c				2																					
Tree	*Syzygium jambos*	c	2	2	1	2	2	2	1	1								1	1					2	2		
Tree	*Syzygium levinei*	c				2	1																				
Tree	*Tarenna mollissima*	c				2	1		2	1																	
Tree	*Thespesia populnea*	rest													2	2											
Tree	*Thevetia peruviana*	vc			2													2	2								
Tree	*Trema orientalis*	c												1													
Tree	*Vitex negundo var cannabifolia*	rest	1		1	2	2		2	2								1			1	1					
Tree	*Vitex negundo var negundo*	c	3		3	3	3	2							3	3		2	2	1	1	1	1	1		2	2
Tree	*Vitex quinata*	c													3	3											
Tree	*Zanthoxylum avicennae*	c			1	2	2	1	1	1																	

Vegetation

Date of survey: September 2003 to May 2004

	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Shrub	*Abelmoschus moschatus*	rest																			1					1	
Shrub	*Acanthus ilicifolius*	c													3	3											
Shrub	*Aegiceras corniculatum*	c													3	3											
Shrub	*Albizia corniculata*	c							2	2																	
Shrub	*Alchornea trewioides*	vc				1			1			2	2	1				2	2		1	1	1				
Shrub	*Antirhea chinensis*	vc	1	1		2	1		2	2	2			2													
Shrub	*Ardisia crenata*	c	2	2		2	2	2	1	1																	
Shrub	*Ardisia quinquegona*	vc				2	2	1																			
Shrub	*Aster baccharoides*	vc	1						1	1		3	3		1												
Shrub	*Atalantia buxifolia*	c				1	1		3	2	2	3	2	2	2												
Shrub	*Avicennia marina*	c													3	3											
Shrub	*Baeckea frutescens*	vc	2	2					2	2	1	3	3	3													
Shrub	*Boehmeria nivea*	rest																			2	2					
Shrub	*Breynia fruticosa*	vc	2	2		2	2	1	3	3	2	3	3	3								1					
Shrub	*Brucea javanica*	c				1	2		1					2				1				1					
Shrub	*Bruguiera gymnorrhiza*	rest													3	3											
Shrub	*Callicarpa nudiflora*	c				1	1		1	1	1			1													
Shrub	*Cassia occidentalis*	vc												1													
Shrub	*Clerodendrum chinense*	c																2	2							1	1
Shrub	*Clerodendrum cyrtophyllum*	c																2	2							2	2
Shrub	*Clerodendrum fortunatum*	c				1			2	2	2	2	2	2							1						
Shrub	*Clerodendrum inerme*	c													3	3											
Shrub	*Crotolaria mucronata*	c																2	2		3	3	2				
Shrub	*Croton crassifolius*	vc							2	2		2	2	1													
Shrub	*Croton lachnocarpus*	vc				1			2	2																	
Shrub	*Daphniphyllum calycinum*	c				2	2		2	2		1															
Shrub	*Daphniphyllum oldhami*	c	2	2	1	2	2	1	2	2	2	1	1	1													
Shrub	*Desmodium gangeticum*	c			2																1	2	2				
Shrub	*Dichroa febrifuga*	c				1												1	1		1	1					
Shrub	*Diospyros morrisiana*	vc							2	2																	
Shrub	*Diospyros vaccinioides*	vc				1	1		2	2	1	2	2	2													
Shrub	*Diplospora dubia*	c				1	1		2	2	1	2	1	1													
shrub	*Euonymus laxiflorus*	c				1	1																				
Shrub	*Euonymus nitidus*	vc	2	2		2	2	1	1	1		1	1	1													
Shrub	*Eurya japonica*	vc					2		3	3	3	2	2	3													
Shrub	*Eurya nitida*	vc	1	1		1	1		1	1																	
Shrub	*Ficus variolosa*	vc						1	2	2	2	3	3	3													
Shrub	*Garcinia oblongifolia*	vc				1	1	1	3	3	1																
Shrub	*Gardenia jasminoides*	c					2	1	2	2	1	1	1	1													
Shrub	*Glochidion eriocarpum*	c	2	2	1	2	2	2	2	2	2	2	2	2				1	1	1				1		1	
Shrub	*Glochidion wrightii*	vc					1																			1	
Shrub	*Helicteres angustifolia*	vc	1	1				1	1	1		3	3	3							2	2	1				
Shrub	*Ilex asprella*	vc	3	3	1	3	3	3	3	3		2	2	1													
Shrub	*Ilex pubescens*	vc	1	1		2	2	2	2	2																	
Shrub	*Itea chinensis*	vc							2	2	2	2	2														
Shrub	*Kalanchoe pinnata*	c													3	2											
Shrub	*Kandelia candel*	c													3	3											
Shrub	*Lantana camara*	vc	1	1	1		1	1							1			2	2	3	3	3	3	1	1	3	3
Shrub	*Litsea rotundifolia*	vc	3	3	1	3	3	3	3	3	3	3	3	3													
Shrub	*Lumnitzera racemosa*	c													2	1											
Shrub	*Maesa perlarius*	c	2	1		2	2	2	2	2								1	1								
Shrub	*Melastoma candidum*	c	2	2		1			2	2	2	2	2	2				1	1		1	1		2	2	2	2
Shrub	*Melastoma sanguineum*	c	2	2			2		3	3	3	3	3	3													
Shrub	*Mesona chinensis*	c											2	1													
Shrub	*Osbeckia chinensis*	vc									1			1													
Shrub	*Paliurus ramosissimus*	c							1	1			1		1												
Shrub	*Pandanus tectorius*	vc			1	1	1	1	1	1	1	1	1	1	2	2	1							1	1	1	
Shrub	*Pandanus urophyllus*	vc	1	1	1	1	1	1	1																		

Vegetation

Date of survey: September 2003 to May 2004

	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Shrub	*Pavetta hongkongensis*	c +				1	1		1	1																	
Shrub	*Phoneix hanceana*	c							2	2	2	2	2	2													
Shrub	*Phyllanthus cochinchinensis*	vc	2	2	1	3	3	2	2	2	2	2	2	2													
Shrub	*Phyllanthus emblica*	vc				1	1		2	2	2	2	2	2													
Shrub	*Phyllanthus urinaria*	c																1	1		1	1					
Shrub	*Pittosporum glabratum var glabratum*	vc	1	1			2	2	2	2																	
Shrub	*Pluchea indica*	c													2	2											
Shrub	*Pogostemon auricularius*	c																			1			1			
Shrub	*Psychotria rubra*	vc	2	2	1	3	3	3	2	3	2	1	1	1				1	1								
Shrub	*Pteroloma triquetrum*	c										2	2	1				2	2	2	2	2	2			1	1
Shrub	*Rhamnus crenata*	c							2	2		1	1														
Shrub	*Rhaphiolepis indica*	vc	2	2	1	3	3	2	3	3	3	3	3	3													
Shrub	*Rhodomyrtus tomentosa*	vc	2	2	2	2	2	2	2	2	2	3	3	3													
Shrub	*Ricinus communis*	rest																1	1		1	1				1	
Shrub	*Sarcandra glabra*	vc				2	2	1	1	1																	
Shrub	*Scaevola taccada*	vc							2	2	1	2	2	1	2	2	2										
Shrub	*Senna occidentalis*	vc																1	1	1	1	1	1			1	1
Shrub	*Sesbania cannabina*	c																2	2	2	3	3	3				
Shrub	*Sida acuta*	c																1	1	1	3	3	3			3	3
Shrub	*side rhombifolia*	c																1	1	1	3	3	3			3	3
Shrub	*Sinosideroxylon wightianum*	c							2	2		1	1	2													
Shrub	*Solanum torvum*	c																1			1	1				1	1
Shrub	*Suaeda maritima*	c													3	3											
Shrub	*Syzygium buxifolium*	c																									
Shrub	*Tarenna attenuata*	c							2	2																	
Shrub	*Triumfetta bartramia*	vc			1							2	2					2	2	2	2	2				1	1
Shrub	*Urena lobata*	c						1				2	2	2				2	2	2	2	2	2			2	2
Shrub	*Vitex rotundifolia*	c													3	2											
Shrub	*Wikstromeia indica*	c							2	2		2	2	2								1					
Shrub	*Wikstromeia nutans*	c				2	2		1						1												
Herb	*Acampe rigida*	c +										1															
Herb	*Acorus tatarinowii*	c				1	1																				
Herb	*Acrostichum aureum*	rest													2	2								1			
Herb	*Adenosma glutinosum*	vc										1	1	2							1	1	1				
Herb	*Adiantum flabellulatum*	c	2			2	2	2	1	1		1	1														
Herb	*Agave vivipara*	p																		1							
Herb	*Ageratum conyzoides*	c										1	2	2				2	2	2	2	2	2			1	1
Herb	*Alocasia cucullata*	c																			1	1		3	3		
Herb	*Alocasia macrorrhiza*	vc	1	1	1	1	1	1										1	1		2	2		2	2	2	2
Herb	*Alopecurus aequalis*	c																			2	2	1				
Herb	*Alpinia stachyodes*	c				2	2		1																		
Herb	*Alpinia zerumbet*	vc		2		2	2		2																		
Herb	*Alpinia zerumbet*	vc					1																				
Herb	*Alternanthera philoxeroides*	c																			2	2		2	2	2	2
Herb	*Amaranthus viridis*	vc																1	1		2	2				1	
Herb	*Anisomeles indica*	c																			2			3	3	2	2
Herb	*Anisopappus chinensis*	c												2													
Herb	*Apluda mutica*	c																2	1		3	3		3	3	3	
Herb	*Aristida chinensis*	vc										2	2	2	1												
Herb	*Arundina chinensis*	c +										1	1														
Herb	*Arundinella setosa*	vc										3	3	3	1	1											
Herb	*Asplenium neolaserpitiifoloium*	rest				2	2		1																		
Herb	*Aster baccharoides*	vc							2	2		3	3	3													
Herb	*Avicennia marina*	c													3	3											
Herb	*Bacopa monnieri*	vc													2	2											
Herb	*Bidens bipinnata*	vc					1							1	1			2	2	2	2	2	2			2	2
Herb	*Blechnum orientale*	c	2	2	2	2	2	2	2	2	1							1	1	1							
Herb	*Bothriochloa bladhii*	vc					1					2	2	2				2	2	2	2	2	2				

Hong Kong - Zhuhai - Macao Bridge
Hong Kong Section and North Lantau Highway Connection
Ecological Baseline Survey

Vegetation

Date of survey: September 2003 to May 2004

	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Herb	*Carex tristachya*	vr							1																		
Herb	*Caryopteris incana*	c										2	2		1					2							
Herb	*Celosia argentea*	vc																2	2	2	2	2	2	3	3	2	
Herb	*Cenchrus echinatus*	vc																			2	2	2			2	2
Herb	*Centella asiatica*	vc																2	2		2	2		2	2	2	2
Herb	*Centipeda minima*	c																			2	2					
Herb	*Chamaecrista mimosoides*	c																		2	2	2				2	2
Herb	*Chamaesyce hirta*	vc																			2	2	2			2	2
Herb	*Chamaesyce thymifolia*	vc																			2	2	2			2	2
Herb	*Cibotium barometz*	c				2	2																				
Herb	*Cirsium japonicum*	c													1	1											
Herb	*Cleisostoma simondii*	c +										1															
Herb	*Clinopodium gracile*	c																2			2						
Herb	*Coix lachryma-jobi*	c																						2	2	1	
Herb	*Colocasia esculenta*	c																1						3	3		
Herb	*Commelina nudiflora*	c																1	1					3	3	1	1
Herb	*Corchorus aestuans*	c																			2	2				2	
Herb	*Crassocephalum crepidioides*	c																2	2		2	2				1	1
Herb	*Crinum asiaticum*	rest										1	1														
Herb	*Cyanotis vaga*	rest													2												
Herb	*Cyclosorus acuminatus*	vc																						2	2		
Herb	*Cyclosorus interruptus*	c																						2	2		
Herb	*Cyclosorus parasiticus*	vc	2	2		2	2																				
Herb	*Cymbopogon* spp.	n/a	1	2					2	2		3	3	3	2	2				2							
Herb	*Cynodon dactylon*	vc																2	2	2	3	3	3			2	2
Herb	*Cyperus haspan*	c																2	2								
Herb	*Cyperus imbricatus*	c																						2	2		
Herb	*Cyperus malaccensis*	c													2	2								2		2	
Herb	*Cyperus pilosus*	c																2	2	2	2	2					
Herb	*Cyperus rotundus*	vc													1	1		2	2	3	2	2	2			2	2
Herb	*Cyrtococcum patens*	vc				2	2														2						
Herb	*Dianella ensifolia*	vc	1	1		1	1		1	1	1	2	2	2													
Herb	*Dicranopteris pedata*	vc	2	2	2	2	2	2	2	2	2	2	3	3													
Herb	*Digitaria ciliaris*	vc																			2	2		2		1	
Herb	*Diplacrum caricinum*	rest										1	1														
Herb	*Drosera indica*	vr													1												
Herb	*Drosera spathulata var louriri*	c										1	1														
Herb	*Dryopteris varia*	c				1			1																		
Herb	*Echinochloa crusgalli*	vc																			1	1	1	2	2	1	1
Herb	*Eclipta prostrata*	c													2	2		1	1		2	2		2		2	2
Herb	*Elephantopus scaber*	c										2	2					2	2	2	2	2	2			2	2
Herb	*Elephantopus tomemtosa*	c																			2	2	2			1	1
Herb	*Eleusine indica*	vc																2	2	2	3	3	3			2	2
Herb	*Emilia sonchifolia*	vc																2		2	2	2	2			2	2
Herb	*Eragrostis* sp.	n/a										2	2	2	1												
Herb	*Eremochloa ciliaris*	vc										3	3	3													
Herb	*Ericaulon merrillii*	c										2	2					2	2								
Herb	*Eriocaulon sexangulare*	vc										2	2					2	2								
Herb	*Eriocaulon* sp.	vc										2	2		2												
Herb	*Eulalia* spp.	c										3	3	3													
Herb	*Eulophia graminea*	rest +							1																		
Herb	*Fimbristylis cymosa*	vc													1	1											
Herb	*Fimbristylis subbispicata*	c																	2	2				2			
Herb	*Fimbristylis thomsonii*	vc							2	2	2							2	2	2	2	2	2				
Herb	*Floscopa scandens*	c					1																				
Herb	*Fuinera umbellata*	c											1											2	1	3	3
Herb	*Gahnia tristis*	vc										3	3	3													
Herb	*Gnaphalium affine*	c																1	2		2	2				2	2

Vegetation

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	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Herb	*Grewia biloba*	c										1			1												
Herb	*Gynura divaricata*	vc										1	1								1	1	1				
Herb	*Halophila beccarii*	r															1										
Herb	*Halophila ovata*	r													1												
Herb	*Hedyotis acutangular*	c							1	1		2	2	3													
Herb	*Hedyotis auricularia*	c	2	2		3	3	1	2	2																	
Herb	*Hedyotis consanguinea*	c	2	2		3	3	1	2	2																	
Herb	*Hedyotis corymbosa*	vc																2	2		2	2	2			2	
Herb	*Hedyotis diffusa*	c																1			1	1					
Herb	*Heteropogon contortus*	vc										2	2	2	2	2											
Herb	*Hypericum japonicum*	vc																1	1					2	2	2	2
Herb	*Imperata cylindrica*	vc																2	2	2	2	2	2			3	3
Herb	*Indigofera spicata*	rest																			1						
Herb	*Indocalamus longiauritus*	vc						2	2	2	2	2	2														
Herb	*Innula cappa*	vc								2		3	3	3													
Herb	*Ipomoea aquatica*	c																1						2	2		
Herb	*Ipomoea cairica*	vc	2	2	2										2			2	2	3	3	3	3	3	3	3	3
Herb	*Ipomoea purpurea*	rest																			2	2				2	
Herb	*Isachne globosa*	vc																						3	3	2	
Herb	*Ischaemum aristotum*	c										2	2	2							2			2			
Herb	*Ischaemum ciliare*	vc										3	3	3													
Herb	*Ischaemum indicum*	c										3	3	3	2	1						2		2	3	2	
Herb	*Ischaemum rugosum*	c										3	3	3													
Herb	*Juncus prismatocarpus*	c																			1						
Herb	*Kyllinga breviflora*	c													1			2	2					2	2	2	2
Herb	*Kyllinga nemoralis*	vc																2	2								
Herb	*Lactuca repens*	c										2	2														
Herb	*Leersia hexandra*	c																						2	2		
Herb	*Lepidosperma chinense*	c										2	2														
Herb	*Limnophila aromatica*	rest																						1	1		
Herb	*Limonium sinense*	c													2	2											
Herb	*Lindernia anagallis*	c																			1	1		1			
Herb	*Lindernia crustaceae*	rest																			1	1					
Herb	*Lindsaea ensifolia*	c				2	2																				
Herb	*Lindsaea heterophylla*	c				2	2																				
Herb	*Liriope spicata*	c	2	2		3	3	1	2	2	1																
Herb	*Lobelia chinensis*	c																1	1					1	1		
Herb	*Lophatherum gracile*	c	2	2	2	2	2	2	2	2								1	1		2	2	2				
Herb	*Ludwigia ascendens*	c																						2	2		
Herb	*Ludwigia octovalvis*	c																						2	2		
Herb	*Melinis repens*	vc													1			2	2	2	3	3	3			2	2
Herb	*Microstegium ciliatum*	vc																			2	2	2			2	2
Herb	*Mimosa pudica*	vc																2	2	3	2	2	2			2	2
Herb	*Miscanthus sinensis*	vc							1	1		2	2	1						2	2	2				2	2
Herb	*Musa* sp.	c																1	1		2	2				3	3
Herb	*Neyraudia reyraudiana*	vc										2	2	3							2	2	2			2	2
Herb	*Oplismenus compositus*	vc				2	2		2																		
Herb	*Opunita dillenii*	c													1												
Herb	*Ottochloa nodosa var micrantha*	vc					2																	2		2	
Herb	*Oxalis corniculata*	vc				1												2	2		2	2	2			2	2
Herb	*Oxalis corymbosa*	vc				1												2	2		2	2	2			2	2
Herb	*Panicum maximum*	vc																1	1	2	3	3	3			3	3
Herb	*Panicum repens*	vc																						2		2	
Herb	*Paspalum conjugatum*	c																			2	2		3	3	2	
Herb	*Paspalum distichum*	c																						3	3		
Herb	*Pennisetum alopecuroides*	c																1	1		2	2	2			2	
Herb	*Pennisetum polystachyon*	c																		2	2	2	2			2	
Herb	*Pennisetum purpureum*	vc																1	1		2	2	2	1		2	2

Vegetation

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	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Herb	*Pericampylus glaucus*	rest				1																					
Herb	*Philydrum lanuginosum*	rest																						1			
Herb	*Phragmites australis*	vc													2						2	2		2			
Herb	*Phragmites vallatoria*	vc													2						2	2		2			
Herb	*Phyla nodiflora*	c													2												
Herb	*Phyllodium pulchellum*	vc										2	2	2							2	2					
Herb	*Plantago major*	vc																2	2		2	2					
Herb	*Plumbago zeylanica*	rest																1			1					1	'1
Herb	*Polygonum barbatum*	c																						2	2		
Herb	*Polygonum chinense*	vc																2			2	2		2	2		2
Herb	*Polygonum lapthifolium*	c																			1	1		1	1		
Herb	*Polygonum plebeium*	rest																			1	1		1	1		
Herb	*Pongamia pinnata*	c													1												
Herb	*Portulaca oleracea*	vc													2	2											
Herb	*Pteridium aquilinum*	c										2	2	2													
Herb	*Pteris dispar*	c				2	2		2	2																	
Herb	*Pteris multifida*	vc																2	2		1	1					
Herb	*Pycreus polystachyos*	c																2			2						
Herb	*Ranunculus sceleratus*	vc																			1			2	1	2	
Herb	*Rhynoscopa rubra*	vc										2	2	2	1	1					2	2					
Herb	*Rhynoscopa rugosa*	rest																						2			
Herb	*Rostellularia procumbens*	c																2	2								
Herb	*Schizachyrium sanguineum*	vc										2	2	3													
Herb	*Scleria ciliarus*	c							2	2			2	2													
Herb	*Scleria levis*	c										2	2	2	1												
Herb	*Scleria terrestris*	c				2	2		2	2																	
Herb	*Scoparia dulcis*	c																			2	2				1	
Herb	*Setaria pumila*	vc										2	2	2	2	2					2	2		2	2	2	2
Herb	*Sigesbeckia orientalis*	c																2	2		2	2					
Herb	*Siplanthes paniculata*	c																			1	1	1			1	
Herb	*Solanum americanum*	vc																2	2	2	2	2	2				
Herb	*Sonchus arvensis*	vc																			1	1	1			1	
Herb	*Spinifex littoreus*	c													2												
Herb	*Sporobolus indicus*	vc																2	2	2	2	2	2				
Herb	*Sporobolus virginicus*	vc										3	3														
Herb	*Stenoloma biflorum*	rest													1												
Herb	*Synedrella nodiflora*	vc													1			2	2	2	2	2	2			2	2
Herb	*Tadehagi triquetrum*	vc										2	2	2							1	1					
Herb	*Teuricum quadrifarium*	rest				1	1														1	1					
Herb	*Thysanolaena latifolia*	c										1	1	1													
Herb	*Tridax procumbens*	vc																2	2		2						
Herb	*Urochloa subquadripara*	c	2		2	2	2	2																			
Herb	*Utricularia bifida*	c										1	1					1									
Herb	*Utricularia caerulea*	rest										1	1														
Herb	*Utricularia striatula*	rest										1	1														
Herb	*Wedelia biflora*	c													2	2					2	2		2	2	2	2
Herb	*Wedelia chinensis*	c													2			2	2	2	3	3	2	2	2	2	2
Herb	*Wedelia prostrata*	c													2			2	2	2	3	3	2	2	2	2	2
Herb	*Xanthium strumarium*	c																2	2	2	2	2	2				
Herb	*Xyris pauciflora*	rest											1														
Herb	*Youngia japonica*	vc																			1	1					
Herb	*Zostera japonica*	r													1												
Herb	*Zoysia sinica*	c													3	3											
Climber	*Abrus mollis*	rest	1	1		2	2																				
Climber	*Alysicarpus vaginalis*	vc										2	2	2							2	2	2			2	
Climber	*Alyxia sinensis*	c				3	3	1	3	3	3	3	3	3	1												
Climber	*Asparagus cochinchinensis*	c							3	2	2	2	2	2												2	2
Climber	*Bauhinia championii*	c	2	2		3	3	2	3	3	2	2	2	2													

Vegetation

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			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Climber	*Bauhinia galuca*	vc				2	2		3	3																	
Climber	*Berchemia racecmosa*	c							2	2																	
Climber	*Bowringia callicarpa*	vc				2																					
Climber	*Byettnera aspera*	vc	2	2		3	3	2																			
Climber	*Caesaplinia bondou*	rest				2	2		2	2		2	2		2	2											
Climber	*Caesaplinia crista*	vc				2	2		2	2		2	2														
Climber	*Cajanus scarabaeoides*	c													2	2											
Climber	*Calamus tetradactylus*	c				2	2		2																		
Climber	*Calamus tetradactylus*	c				1	1																				
Climber	*Canavalia lineata*	c													2	2											
Climber	*Cansjera rheedii*	rest				2	2	2	2	2	2	2	2	2													
Climber	*Cassytha filiformis*	vc							3	3	3	3	3	3	2	1					2	2	2	2	2	2	2
Climber	*Cayratia corniculata*	vc				2																					
Climber	*Celastrus hindsii*	c	2	2		2	2	2	2	2	2																
Climber	*Cocculus orbiculatus*	c				2	2		2	2		2	2														
Climber	*Cuscuta* sp.	c																2	2		2	2		2			
Climber	*Cyclea hypoglauca*	c				2	2		2	2																	
Climber	*Dalbergia hancei*	c	2	2	1	3	3	2	3	3				2													
Climber	*Dalbergia milletti*	vc				2	2	1	2	2																	
Climber	*Dendrotrophe frutescens*	vc							2	2	2	2	2	2													
Climber	*Derris trifoliata*	c							2	2					2	2											
Climber	*Desmos chinensis*	c	2	2	1	3	3	2	2																		
Climber	*Desomdium heterocarpon*	vc												3								2					
Climber	*Dioscorea benthamii*	c					2		2	2																	
Climber	*Diploclisia glaucescens*	c	2	2	2	2	2	2	2	2																	
Climber	*Embelia laeta*	vc	3	3		2	2	2	2	2	2	3	3	3													
Climber	*Embelia ribes*	c				2	2		2	2																	
Climber	*Ficus pumila*	vc	2	1	2	3	3	1	2	2	1																
Climber	*Gnetum luofuense*	vc	2	2		2	2	2	2	2	1																
Climber	*Gymnema sylvestre*	vc				2	2	2	2	2	2	2	2	2												2	
Climber	*Hedyotis hedyotidea*	vc	2	2		3	3	2	2	2																	
Climber	*Heterosmilax japonica var. gaudichaudiana*	vc				3	3	2	2	2	2			2							2	2				2	
Climber	*Hypserpa nitida*	vc				2	2	2	2	2	2							2									
Climber	*Ipomoea batatas*	p																			2	2				2	2
Climber	*Ipomoea carica*	vc	2	2	2										2						3	3	3	3	3	2	2
Climber	*Ipomoea imperati*	rest													2												
Climber	*Ipomoea nil*	c														2		2	2		2	2	2				
Climber	*Ipomoea obscura*	c														1		2	2		2	2	2				
Climber	*Ipomoea pes-caprae*	c													2	2											
Climber	*Jasmanium lanceolata*	c				1	1		2	2																	
Climber	*Lonicera japonica*	c				1				2																	
Climber	*Lygodium flexuosum*	vc			2	2	2	2	2																		
Climber	*Lygodium japonicum*	vc	3	3	3	3	3	3	3	3	3	3	3	3							3	3	3	3	3	3	3
Climber	*Lygodium scandens*	c	2	2	2	2	2	2	2	2	2	1	1	1							2	2	2	2	2	2	2
Climber	*Macroptilium leucocephala*	c																					3				
Climber	*Melodinus suaveolens*	c				2	2	2	2	2																	
Climber	*Merremia hederacea*	rest																			2	2	2	2	2	2	2
Climber	*Merremia umbellata*	c	2	2	2	1	1		2	2																	
Climber	*Mikania micrantha*	vc	2	2	2	2	2	1													3	3	3	3	3	3	3
Climber	*Milletia dielsiana*	vc				1																					
Climber	*Milletia reticulata*	c				1	1																				
Climber	*Milletia speciosa*	c				1	1		1	1	1	1	1	1													
Climber	*Millettia nitida*	vc				2	2	2	2	2	2	3	3	3													
Climber	*Morinda umbellata*	c				1	1		2	2	2	3	3	3													
Climber	*Mussendanea pubescens*	vc							2	2																	
Climber	*Paederia scandens*	vc	2	2	3	1	1	3	2	2	2							2	2								
Climber	*Psychotria serpens*	vc	2	2	2	3	3	1	2	2	2	1	1	1													
Climber	*Pueraria lobata*	vc	1	1	1	1	1	1	2	2	2	2	2	2				3	3	3	3	3	3	2	2	3	3

Vegetation

Date of survey: September 2003 to May 2004

	Species list	Status	Plantation Woodland			Secondary Woodland			Tall Shurbland			Shrubby Grassland			Coastal			Developed Area			Wasteland			Salt Marsh		Cultivated Field/Orchard	
			A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	B
Climber	*Pueraria phaseoloides*	vc																3	3	3	2	2	2	1	1	2	2
Climber	*Pyrrosia lingua*	c				3	3	3	2	2					2	2											
Climber	*Rosa laveigata*	c						1																			
Climber	*Rourea microphylla*	c						3	3	1	2	2	2	1													
Climber	*Rourea minor*	c							3	2		2	2														
Climber	*Rubus parvifolius*	c				1	2																				
Climber	*Rubus reflexus*	vc	2	2	2	2	2	2	1	1											1	1	1	1	1	1	1
Climber	*Sageretia thea*	vc				2	2	2	2	2																	
Climber	*Senecio scandens*	c	1			1	1		2	1																1	
Climber	*Smilax china*	vc	2				2	2	2	2	2	2	2														
Climber	*Smilax corbularia*	c				2			2																		
Climber	*Smilax glabra*	vc	1	2		2	2	1	2	2	2	2	2	2													
Climber	*Stephania longa*	c					2	2	1	2																	
Climber	*Strophanthus divaricatus*	c	2	2		2	2		2	2	2	2	2	2													
Climber	*Strychnos angustifolia*	c	3		1	2	2	2	3	3	2	2	2	2													
Climber	*Strychnos umbellata*	c			2	2	2	2	3	3	2	2	2	2													
Climber	*Tetracera asiatica*	vc	2	2	2	3	3	3	3	3	3	2	2	3												2	2
Climber	*Thunbergia grandiflora*	c																2									
Climber	*Toddalia asiatica*	rest				2	2		2	2																2	2
Climber	*Toxocarpus wightianus*	c				2	2		2	2	2																
Climber	*Tylophora ovata*	c				1	1	1	1	1		1	1	1													
Climber	*Uraria crinita*	c											1		1						1	1	1			1	
Climber	*Urceola rosea*	c					2	2				2	1	1							1	1	1			1	
Climber	*Uvaria grandiflora*	rest				2	2		2	2	2																
Climber	*Uvaria mic-ocarpa*	c	2	2		3	3	2	2	2	2																
Climber	*Vitis bala isana*	rest								2																	
Climber	*Zanthoxylum nitidum*	vc	2	2	1	2	2	2	2	2	2	2	2								2	2					
Climber	*Zanthoxylum scandens*	c	2			2	2		2	2	2																

Total No. of Species : 475

Status (Based on Siu (2000), Wu and Lee (2000), Xing et al. (2000))

c: Common
vc: Very common
rest: Restricted
n/a: Not applicable
p: Planted
r: Rare
vr: Very rare

* Although the wild population of the species is catagorized as restricted in terms of abundance and distribution, it is widely planted in Hong Kong.

Regionally Protected

+ Locally Protected

Volume 2

Marine Fisheries Review

1. Introduction

Construction of the proposed Hong Kong – Zhuhai - Macao Bridge (HZMB) will not be approved unless it can be demonstrated that no unacceptable environmental impacts will result to the ecological and fisheries resources present within the study area. As many of the marine fish species are known to undergo seasonal migration it is conceivable that any impact from the project could affect both fisheries resources and dolphins. The criteria described in the TM Annexes 9 (Criteria for Evaluating Fisheries Impact) and 17 (Guidelines for Fisheries Impact Assessment) have been followed when establishing the baseline.

2. Literature Review

The HZMB is located in the Northwestern waters that is considered to be a reasonably valuable fishing ground in terms of fisheries production and owing to the prevailing hydrological conditions, is also an important spawning and nursery ground for many species of fish and penaeid shrimps (Mouchel, 2001, 2002). An assessment of potential impacts to marine fisheries resources is, therefore, required. The most recent information on the capture fisheries is summarised in the AFCD Port Survey of 2001/2002 and the ongoing EM&A at East of Sha Chau (Mouchel, 2001, ongoing). There have been several recent fisheries assessments conducted in the wider study area and these include:

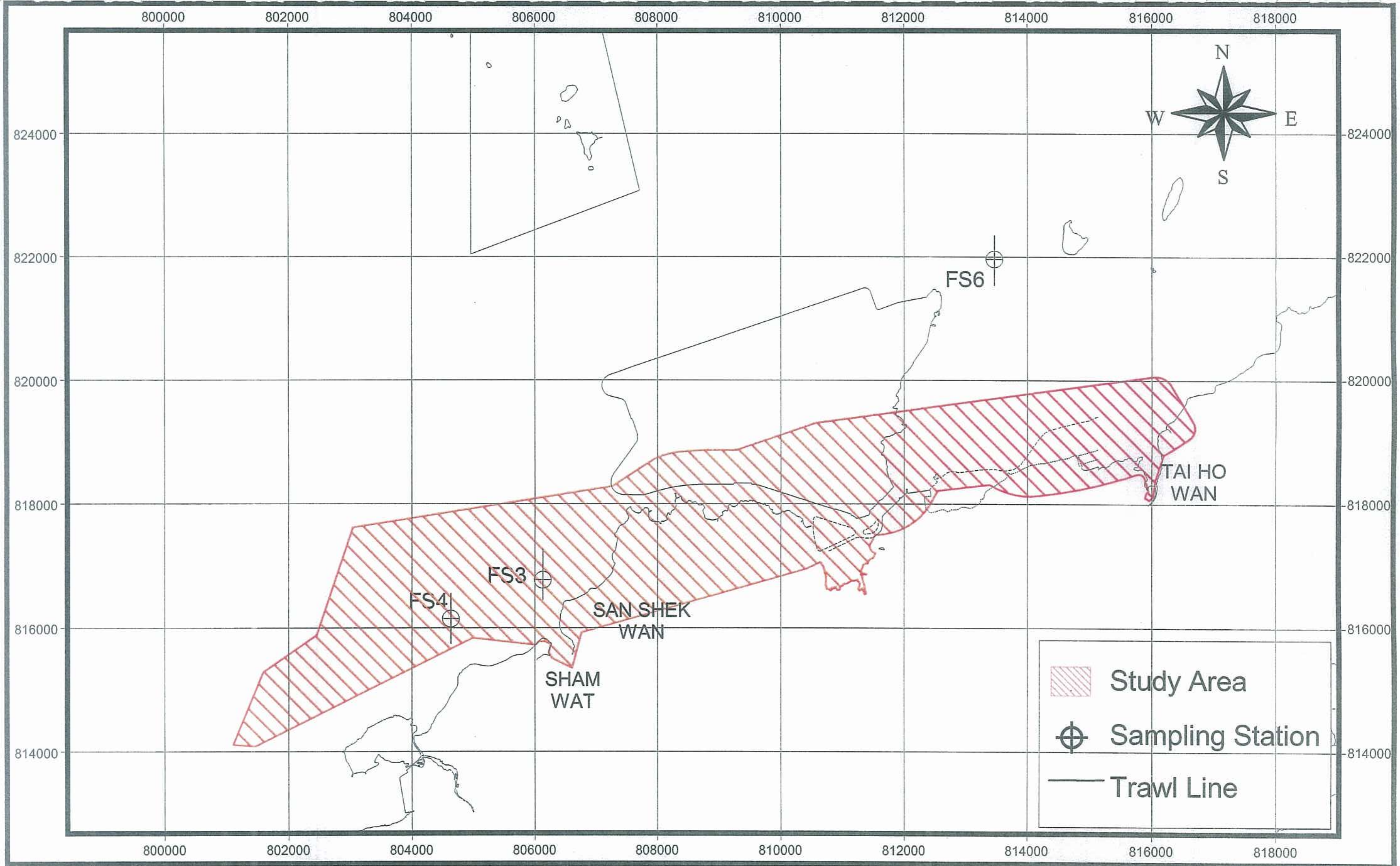
- EIA for the Proposed Sand Extraction from The Brothers' Marine Borrow Area (Hyder Consulting, 1998);
- Route 10 North Lantau to Yuen Long Highway Investigation and Preliminary Design EIA (Mott Connell, 1999);
- EIA for Permanent Aviation Fuel Facility (Mouchel, 2002);
- Hong Kong-Pearl River West Link Preliminary Environmental Review (Scott Wilson, 2002); and
- Environmental Monitoring and Audit for Contaminated Mud Pit IV at East of Sha Chau Mouchel, 2001, ongoing).

Reports from the ongoing environmental monitoring and audit at the contaminated mud pits at East of Sha Chau (Mouchel, 2001, ongoing), however, provide a large amount of relevant fisheries data and have been reviewed. The fisheries data provided in the aforementioned EM&A study provides the most up to date information on the fisheries resources of the study area.

3. Survey Methodology

3.1 Introduction

Trawling is conducted as part of the ongoing EM&A programme for the contaminated mud pits in locations (North of Tai Ho Wan, off San Shek Wan and Sham Wat) adjacent to the HZMB study area (Mouchel, 2001, 2004a,b; *Figure A1*). A local shrimp trawler and a minimum of 6 standard beam trawl nets was used for the demersal trawling. Six standard beam trawl nets were deployed in the daytime from the shrimp trawler equipped with dGPS for a tow of 10 minutes (5 tows per station). The tows at each station were shifted slightly to avoid repetitive harvesting along a single track. Further tows only began at a station after the elapse of at least two hours from the completion of the previous series of tows. On board the trawler, the contents from each of the six nets were pooled to form one sample, sorted and packed separately in labelled Ziploc plastic bags. The existing fisheries data covering both the wet (July-August 2003) and dry (January-February 2004) seasons from the Northwestern waters off Sham Wat, San Shek Wan and approximately 4km North of Tai Ho Wan have been used to establish the marine fisheries baseline.



Demersal Trawling Stations

Meinhardt Mouchel
Figure A1

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4. Baseline Conditions

4.1 Description of Physical Habitat

The HZMB is located within the Northwestern waters of Hong Kong that are highly influenced by the variable estuarine conditions of the Pearl River estuary. Owing to relatively slow tidal currents the hydrography is depositional and much of the seabed is predominantly made up of soft muds although where currents are stronger, scouring is evident and some seabed habitat is comprised of a muddy shell sand matrix (Mouchel, 2002, 2004a,b). The benthos is, therefore, highly sediment laden and the resident fauna are dominated by representatives that tolerate high ambient suspended solid loads (Mouchel, 2002). In terms of water quality, there are significant pollution inputs from the Pearl River catchment resulting in significant nutrient loading and generally eutrophic conditions (Mouchel, 2002, 2004a,b; Huang *et al.*, 2003). The predominantly estuarine fish inhabiting the study area are, therefore, naturally subjected to certain environmental stresses notably high suspended solid concentrations. Although many estuarine fish are tolerant of elevated suspended solid concentrations (e.g., CPCC, 2001) they may suffer sublethal stress (often associated with damage to the gills) when held in such conditions over prolonged periods (O'Connor *et al.*, 1977).

4.2 Capture Fisheries

Recent information on the capture fisheries is summarised in the Port Survey of 1996/97 and 2001/2002 (AFCD, 1998, 2003) and in the Report on Fisheries Resources and Fishing Operations in Hong Kong Waters (ERM, 1998). The HZMB passes through five fishing areas, namely, Shum Wat, Sha Lo Wan, Tung Chung, Chek Lap Kok and Pak Mong, as identified in the Port Survey Report (AFCD, 1998).

The total value and ranking of the fisheries resources in each of these fishing areas that lie within the study area are presented below in *Table 4.2a*. The Shum Wat and Chek Lap Kok fishing areas are of reasonably high value and rank quite highly in terms of adult fish biomass and overall value per hectare. The fishing area at Tung Chung is less productive and ranked 106 (of 189 fishing areas) in terms of adult fish production.

Table 4.2a Fisheries Production in Each Fishing Area (all fishing vessels)

AFCD Fishing Area (ha)	Total Production			Production (ha^{-1})			Rank Production (ha^{-1})		
	Adult Fish (kg)	Fry (tails)	Value (HK$)	Adult Fish (kg)	Fry (tails)	Value (HK$)	Adult Fish	Fry	Value
Shum Wat 528.41	135,069.68	-	3,410,552.23	255.61	-	6,454.33	34	-	34
Sha Lo Wan 961.00	132,449.64	-	3,335,986.19	137.82	-	3,471.35	75	-	77
Tung Chung 363.42	28,662.43	-	994,607.30	78.87	-	2,736.80	106	-	91
Chek Lap Kok 591.60	168,240.94	-	3,308,991.13	284.38	-	5,593.26	29	-	47
Pak Mong 533.22	66,410.08	-	1,210,254.17	124.55	-	2,269.72	78	-	100

Note: Based on the 189 fishing areas in Hong Kong waters (AFCD, 1998).

The five fishing areas are subunits of a wider sector (SE02) that occupies the sea around North Lantau (AFCD, 1998). It is conceivable that any impacts from the project could affect the wider regional areas and a summary of the fishery for the region is included below. In terms of adult production per hectare, the North Lantau region ranks quite highly (4th out of 12 sectors) and is relatively valuable, however, the fry fishery is not as productive (ranked 9 out of 12).

The AFCD Port Survey identified the highest species in terms of adult fish weight caught in the North Lantau sector as mixed fish, scad (*Caranx kalla*), gizzard shad (*Clupanodon punctatus*), sardine (*Sardinella jussieu*) and croaker (*Argyrosomus* spp.). These fish catches reflect the operations in the area, which are dominated by larger fishing vessels and notably hang trawlers fishing pelagic species (AFCD, 1998; Mouchel, 2002).

The recent Port Survey of commercial fisheries (AFCD, 2003) showed that maximum adult fish production (determined for all fishing vessels) ranged from 100-200 kg ha^{-1} for all fishing areas (Shum Wat, Sha Lo Wan, Tung Chung, Chek Lap Kok and Pak Mong). The fishing areas are of reasonably high value and the majority are valued at between HK$2000-5000 ha^{-1} for adult fish and fry. In terms of fisheries production, the major fisheries resources (expressed in terms of production >10-20 kg ha^{-1}) present include rabbitfish (siganidae), sardine (clupeidae), croaker (sciaenidae), shrimp and crab (AFCD, 2003).

<u>Wet Season Trawls (July-August 2003)</u>

The demersal trawl surveys conducted in locations near the study area at sites around Sham Wat, San Shek Wan and off Tai Ho Wan as part of the ongoing EM&A for the contaminated mud pits at East Sha Chau (Mouchel, 2004a,b) recorded a total of 159 different species. Of these faunal groups, crabs, fish, bivalves, gastropods, shrimps (including mantis shrimp) and prawns were the most abundant. The crabs were numerically dominant and 6320 individuals were trawled in July and August 2003, although not all these crabs are commercial species.

Fish were also abundant and 5067 individuals were recorded in July-August 2003 and were represented by 69 different species. In terms of numerical dominance, the most common fish recorded were the Shortnose pony fish *Leiognathus brevirostris* (common locally; Sadovy and Cornish, 2000); Asiatic glassfish *Ambassis gymnocephalus* (widely distributed and common in estuaries throughout the Indo-Pacific; Sadovy and Cornish, 2000; Lam, 2002); the croaker *Johnius macrorhynus* (distributed throughout the Indo-Pacific and South China Sea; Fishbase); Saddleback silver-biddy *Gerres lucidus* (=*limbatus*) which is distributed in tidal areas throughout the Indo-Pacific and South China Sea (Fishbase); and the flathead *Platycephalus indicus* which is common throughout the Indo-West Pacific and Hong Kong coastal waters (Fishbase; Ni and Kwok, 1999). The commercially important mantis shrimps (mostly *Oratosquilla interrupta*) and prawns (*Metapenaeus* spp. and *Penaeus* spp.) were also numerically abundant components of the trawls.

<u>Dry Season Trawls (January-February 2004)</u>

In the dry season trawls recently conducted during January and February 2004, a total of 129 different species were recorded. Of these faunal groups the gastropods and fish were the most abundant. The gastropods were numerically dominant and 1610 individuals were trawled in January and February 2004, although not all these gastropods are commercial species.

Fish were also abundant and 1292 individuals were recorded comprising 44 different species. In terms of numerical dominance, the most common fish recorded were the croakers *Johnius macrorhynus* and *Dendrophysa russelii* (widespread in coastal waters and estuaries throughout the Indo-Pacific; Fishbase) and the Shortnose pony fish *Leiognathus brevirostris*.

The species trawled from locations near to Sham Wat, San Shek Wan and Tai Ho Wan are presented below in *Table 4.2b*.

Table 4.2b Species Composition and Abundance (Total Counts) in the Wet (July-August 2003) and Dry (January-February 2004) Seasons (Mouchel, 2004a,b)

Group	Species	Wet season				Dry Season			
		FS3	FS4	FS6	Total	FS3	FS4	FS6	Total
Bivalve	*Anomia chinensis*			2	**2**				
	Chione calophylla	30	32	3	**65**	7	4		**11**
	Chlamys pica	3		31	**34**				
	Isognomon legumen		3		**3**			1	**1**
	Laternula sp.		12		**12**				
	Paphia undulata	94	11	309	**414**	51	133	39	**223**
	Perna viridis	2		86	**88**	1	1	10	**12**
	Pinctada chemnitzi					3			**3**
	Pinna pectinata	4		1	**5**	1			**1**
	Potiarca pilula	29	30	7	**66**	6	5		**11**
	Scapharca subcrenata	124	69	27	**220**		6	1	**7**
	Tapes philippinarum	2	577	1322	**1901**	3	1		**4**
Bivalve Total		**288**	**734**	**1788**	**2810**	**72**	**150**	**51**	**273**
Cephalopod	*Loligo* sp.	1	2	6	**9**	2	5	2	**9**
	Octopus sp.					1	1	3	**5**
	Sepia aculeata	2	2		**4**				
	Sepiella japonica	1		5	**6**		1		**1**
	Sepiella sp.			1	**1**				
Cephalopod Total		**4**	**4**	**12**	**20**	**3**	**7**	**5**	**15**
Coelenterata	*Guaiagorgia* sp.			8	**8**	2		6	**8**
	Jelly fish	2	3		**5**				
	Sea anemone	16	19	3	**38**	7	4	7	**18**
	Sea pen 1	3	8	131	**142**	1	7	242	**250**
	Sea pen 2	25	41	260	**326**	14	31	502	**547**
	Sea pen 3	7	5	19	**31**	1	3	9	**13**
Coelenterata Total		**53**	**76**	**421**	**550**	**25**	**45**	**766**	**836**
Crab	*Calappa philargius*			8	**8**				
	Charybdis acuta	98	12	71	**181**	2	4	29	**35**
	Charybdis affinis					1	3	8	**12**
	Charybdis anisodon	3	8	1	**12**				
	Charybdis callianassa			4	**4**				
	Charybdis cruciata	2		8	**10**	18	10	5	**33**
	Charybdis japonica	2165	1841	701	**4707**	81	65	125	**271**
	Charybdis truncata	2		8	**10**			6	**6**
	Charybdis variegata	2			**2**	1		1	**2**
	Clibanarius sp.	59	63	38	**160**	18	11	4	**33**
	Diogenes sp.	31	3	3	**37**	1	1	1	**3**
	Doclea gracilipes			2	**2**		3		**3**
	Dorippe polita					1		1	**2**
	Eriochier rectus		8		**8**			1	**1**
	Ethusa indica	7	9	352	**368**		3	5	**8**
	Eucrate costata	38	20	80	**138**	2	5	12	**19**
	Eucrate crenata		136	16	**152**	3	1	4	**8**
	Eucrate solaris	2	22	12	**36**		1		**1**
	Galene bispinosa	25	15	9	**49**	1	4	2	**7**
	Goniohellenus vadorum	7	4	8	**19**	45	21	58	**124**
	Leucosia vittata	24	17	27	**68**	2	1	1	**4**
	Macrophthalmus japonicus	11	4	3	**18**	1	2	2	**5**
	Petrolisthes sp.						2		**2**
	Platylambrus validus	6	8	22	**36**	5	2	7	**14**
	Portunus hastatoides	6	16	15	**37**	10	34	66	**110**
	Portunus pelagicus	9	8	17	**34**			6	**6**
	Portunus		2		**2**			1	**1**

Group	Species	Wet season				Dry Season			
		FS3	FS4	FS6	Total	FS3	FS4	FS6	Total
	sanguinolentus								
	Porcelain crab							16	16
	Scylla serrata			2	2		1		1
	Thalamita sima	18		6	24			12	12
	Typhlocarcinus nudus	29	91	76	196	2		3	5
Crab Total		**2544**	**2287**	**1489**	**6320**	**194**	**174**	**376**	**744**
Echinoderm	*Acaudina molpadioides*	162	190	61	413			7	7
	Salamacis sphaeroides variegata			13	13				
	Sea urchin			4	4				
	unidentified sea cucumber					1	5	1	7
Echinoderm Total		**162**	**190**	**78**	**430**	**1**	**5**	**8**	**14**
Fish	*Acanthopagrus latus*		2		2				
	Acentrogobius caninus	52	16	23	91	23	26	15	64
	Ambassis gymnocephalus	5	984		989				
	Amblychaeturichthys hexanema					11	15	1	27
	Apogon kiensis	22	8	37	67	1	1	4	6
	Apogon lineatus		2	1	3				
	Arius maculatus			1	1				
	Arnoglossus tenuis							1	1
	Brachyamblyopus anotus	2	1	2	5				
	Brachyamblyopus brachysoma	1			1				
	Butis butis			2	2				
	Chaeturichthys stigmatias	1	6	4	11				
	Chrysochir aureus	2	1	2	5				
	Coilia grayii			6	6				
	Coilia nasus					1	2		3
	Collichthys lucidus	5	13	20	38			1	1
	Cryptocentrus filifer	1			1				
	Ctenotrypauchen microcephalus	1			1				
	Cynoglossus arel	19	25	77	121	5	3	44	52
	Cynoglossus itinus							1	1
	Cynoglossus joyneri	47	25	26	98	14	13	8	35
	Cynoglossus semilaevis	1			1	9	4	2	15
	Dasyatis zugei			1	1				
	Dendrophysa russelii	75	21	46	142	18	148	37	203
	Drepane punctata		1	28	29				
	Epinephelus morrhua		1		1				
	Gazza minuta							1	1
	Gerres lucidus	80	181	40	301	1	3	33	37
	Grammoplites scaber		1	20	21		4	1	5
	Gymnothorax reevesii			1	1				
	Harpadon microchir		1	25	26				
	Ilisha elongata		2	3	5				
	Inegocia japonica	2	3	14	19				
	Inimicus japonicus			1	1			1	1
	Johnius belangerii	12	9	115	136		27	4	31
	Johnius macrorhynus	103	76	141	320	131	184	39	354
	Lagocephalus gloveri	29	12	3	44				
	Lateolabrax japonicus						1	2	3
	Leiognathus	398	589	138	1125			75	75

Group	Species	Wet season				Dry Season			
		FS3	FS4	FS6	Total	FS3	FS4	FS6	Total
	brevirostris								
	Lutjanus russellii							1	1
	Muraenesox cinereus	1	1	1	3			1	1
	Nematalosa come						28		28
	Nematalosa japonica	12	6	1	19			1	1
	Nemipterus japonicus	102	74	29	205			5	5
	Nibea soldado			1	1				
	Otolithes ruber	2	5	1	8		14	1	15
	Oxyurichthys tentacularis	48	120	53	·221	12	53	3	68
	Pagrus major			1	1				
	Pampus chinensis			1	1				
	Parachaeturichthys polynema	10	7	42	59	1	8	11	20
	Pennahia argentata	33	28	27	88			3	3
	Platycephalus indicus	49	147	97	293	13	18	14	45
	Plotosus lineatus							1	1
	Polydactylus sextarius	26	13	4	43	4	9	1	14
	Prionobutis koilomatodon							1	1
	Pseudorhombus arsius		7	7	14				
	Repomucenus richardsonii		2	1	3				
	Saurida elongata	10	11	6	27		3		3
	Sebastiscus marmoratus		1	8	9			5	5
	Secutor ruconius		2	9	11				
	Setipinna taty			1	1				
	Siganus canaliculatus			19	19				
	Sillago sihama	4	19	14	37		2	9	11
	Solea ovata	7	6	26	39	3	2	19	24
	Stolephorus indicus	2			2				
	Syngnathus acus	1	4	1	6	5	2	3	10
	Takifugu alboplumbeus			2	2		1		1
	Takifugu bimaculatus	1	1		2				
	Takifugu oblongus	1	6		7				
	Terapon jarbua	3	30	2	35				
	Terapon theraps		2		2				
	Thryssa chefuensis		1	5	6	1		1	2
	Thryssa hamiltonii					4		2	6
	Trachycephalus uranoscopa	4	7	21	32	1	3.	18	22
	Trichiurus lepturus			2	2				
	Trypauchen vagina	51	25	137	213	14	20	26	60
	Uroconger lepturus		2		2				
	Valamugil formosae		26	1	27	16	8	2	26
	Vespicula trachinoides	2	3	6	11				
	Zebrias zebra			1	1		4		4
Fish Total		1227	2536	1304	5067	288	606	398	1292
Gastropod	*Architectonica* sp.						1		1
	Babylonia areolata		6	1	7				
	Brachytoma sp.	9	6	1	16	7	2	1	10
	Bufonaria rana	36	35		71	52	28	10	90
	Bullacta exarata	4		14	18	10	2	2	14
	Calyptraea sp.		2		2	14			14
	Cheilea sp.			6	6				
	Epitonium scalare			1	1				
	Gyrineum natator						1		1
	Hemifusus tube	6	6		12				
	Lataxiena sp.			3	3	1			1

Group	Species	Wet season				Dry Season			
		FS3	FS4	FS6	Total	FS3	FS4	FS6	Total
	Lophiotoma leucotropis	19	5		**24**	13	3		**16**
	Murex trapa	444	364	106	**914**	47	45	59	**151**
	Nassarius crematus	108	89	2	**199**	137	80	5	**222**
	Nassarius sp.	3		1	**4**				
	Natica lineata		8	1	**9**				
	Natica sp.		2		**2**				
	Natica sp. 1	6		1	**7**				
	Pleurobranchus sp.							4	**4**
	Polynices sp.	2		1	**3**		1		**1**
	Rapana bezoar	4		9	**13**	1			**1**
	Sea slug							2	**2**
	Tonna sp.			3	**3**				
	Turricula javana	12	9		**21**	5	4	3	**12**
	Turritella terebra	728	564	42	**1334**	662	402	6	**1070**
Gastropod Total		**1381**	**1096**	**192**	**2669**	**949**	**569**	**92**	**1610**
Mantis shrimp	*Clorida decorator*	3	4	1	**8**	1			**1**
	Dictyosquilla foveolata		7	3	**10**	1	1	3	**5**
	Harpiosquilla harpax	16	2	14	**32**	5	2	15	**22**
	Miyakea nepa					2			**2**
	Oratosquilla interrupta	238	192	215	**645**	50	38	13	**101**
	Oratosquilla oratoria	3	2	23	**28**	7	10	6	**23**
Mantis shrimp Total		**260**	**207**	**256**	**723**	**66**	**51**	**37**	**154**
Polychaete	Polychaete							1	**1**
Polychaete Total								**1**	**1**
Prawn or Shrimp	*Alpheus brevicristatus*			4	**4**	1			**1**
	Alpheus distinguendus			2	**2**	2			**2**
	Alpheus hoplocheles	1	2		**3**				
	Metapenaeopsis barbata							4	**4**
	Metapenaeus affinis	27	109	286	**422**	2	15	17	**34**
	Metapenaeus burkenroadi			1	**1**	4	11		**15**
	Metapenaeus ensis	63	80	61	**204**		3	6	**9**
	Metapenaeus joyneri	15	130	171	**316**	6	5	6	**17**
	Parapenaeopsis hardwickii	161	118	57	**336**	5	2	5	**12**
	Parapenaeopsis hungerfordi	191	238	59	**488**	14	9	22	**45**
	Parapenaeopsis tenella					33	2		**35**
	Penaeus monodon	2	1	1	**4**				
	Penaeus orientalis					6	14	45	**65**
	Penaeus penicillatus	118	238	347	**703**		1		**1**
	Scyllarus martensii							1	**1**
	Solenocera crassicornis			18	**18**	7	11	4	**22**
	Trachypenaeus fulvus					4		8	**12**
Prawn or Shrimp Total		**578**	**916**	**1007**	**2501**	**84**	**73**	**118**	**275**
Grand Total		**6497**	**8046**	**6547**	**21090**	**1682**	**1680**	**1852**	**5214**

5. Discussion

5.1 *Fisheries Resources*

The Report on Fisheries Resources and Fishing Operations in Hong Kong Waters (ERM, 1998) generally supports the information provided in both the Port Survey data and detailed above. In terms of seasonality, the data above support the conclusion that the wet summer months tend to record the highest abundance of fisheries resources when recruitment is higher (e.g., Mouchel, 2004c).

5.2 *Culture Fisheries*

The nearest culture fishery is the mariculture zone at Ma Wan located approximately 10km to the east of Tai Ho Wan (this represents the nearest point between the project and the FCZ). The Ma Wan FCZ consists of 138 licensed floating rafts and the main species cultured are spotted grouper (*Epinephelus chlorostigma*), goldlined seabream (*Rhabdosargus sarba*), mangrove snapper (*Lutjanus argentimaculatus*) and pompano (*Trachinotus blochii*) (Mott Connell, 1999; Mouchel, 2002).

5.3 *Sensitive Receivers*

The major sensitive receiver present is the mariculture zone at Ma Wan. The operators of capture fisheries and the spawning grounds may, however, also be affected by the project and will require assessment.

6. References

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APPENDIX 10B

Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Verification Survey for Ecologcial Baseline Final Report, May 2009

1.0 BACKGROUND

1.1 The Verification Survey (hereafter known as the "current study") was designed to cover wet and dry seasons between the end of August 2008 and January 2009. Within this 5 month period, ecological surveys focused on the areas of sub-tidal, intertidal and terrestrial habitat that lie within a 500m distance of the Hong Kong Link Road (HKLR) alignment as well as sites/habitats of concern in the vicinity. Desktop studies have been employed in order to describe important habitats in the wider area.

1.2 The Assignment includes the following:

(a) undertake a desktop study of available data;
(b) undertake field surveys and investigations covering both the wet and dry seasons;
(c) investigate and describe the existing wildlife uses of various habitats;
(d) review and verify the validity of the ecological baseline information produced under Agreement No. MW 01/2003; and,
(e) establish the updated ecological profile of the Survey Area and description of the characteristics of each habitat found.

1.3 This Final Report on Verification Survey includes the results of the surveys carried in the wet and dry seasons and the dive survey.

2.0 LITERATURE REVIEW

2.0.1 Headings follow those in the previous study Final 9 Month Ecological Baseline Survey Report (hereafter known as the "Previous Study') produced by Meinhardt Mouchel in August 2004 for the Highways Department (HyD). The Brief for the Current Study differs slightly from that in 2004; the Study Area for the Current Study is much smaller than the Previous Study and specific surveys for some species groups were not required. However, it must be noted that whilst specific surveys were not directly required in the Current Brief (e.g. Freshwater and estuarine fish, Freshwater macroinvertebrates, Coral) these groups were surveyed under other survey headings (i.e. Stream Surveys, Intertidal Surveys, Dive Surveys). No surveys for Cetaceans were required in the Current Brief, though references to this group have been made by way of literature review. The following headings are those from the Previous Study. Those headings marked with an asterisk (*) are those which differ slightly from the requirements or headings in the Current Study Brief.

2.0.2 However, this section is intended to summarize findings from the Previous Study and to highlight those species or habitats of conservation interest of the species groups which were identified within the boundaries of the smaller, Current Study Area. The Current Study Area occupies a much smaller area terrestrial habitats than the Previous Study Area due to a change in the alignment of the proposed HKLR.

2.1 Freshwater and Estuarine Fish*

2.1.1 Streams in North Lantau have long been considered as important habitats for local freshwater fishes, for example Tung Chung Stream was once been considered to hold the second most diverse freshwater fish habitat in Hong Kong (Chong & Dudgeon 1992) and Tai Ho Stream is thought to be the only habitat for the Ayu *Plecoglossus altivelis* in Hong Kong (Lee *et al.* 2002). The Previous Study (HyD 2004) conducted a detailed freshwater and estuarine fish study in North Lantau during 2003 and 2004 and found that, in addition to the aforementioned streams, the fish diversity in Sham Wat Stream was also high. A species of conservation concern, *Takifugu ocellatus*, was also recorded at a stream in San Tau. It should be noted that Tung Chung Stream and Tai Ho Stream are outside of the limits of the current Study Area.

2.2 Freshwater macroinvertebrates*

2.2.1 Aquatic macroinvertebrate surveys were conducted at five streams during the Previous Study (HyD 2004); three of these streams are not within the current Study Area. No species of conservation interest or importance were recorded during the Previous Study, though these streams were considered to provide nurseries for uncommon odonate and water beetle species (HyD 2004).

2.2.2 Aquatic invertebrates of high conservation concern (for example *Somanniathelphusa zanklon*) have been recorded in these North Lantau streams during other studies (DSD 2002). North Lantau streams are generally unpolluted and receive less human impact than most other local streams (HyD 2004), and these streams would be expected to support a greater diversity of invertebrates than disturbed freshwater habitats.

2.3 Marine Benthic Macrofauna

2.3.1 The marine benthic macrofauna exhibited distinct seasonal patterns during the Previous Study. In the wet season, species abundance and diversity was higher outside (32.6 individuals and 4.2 taxa grab^{-1}) than inside Tung Chung Channel (9.2 individuals and 2.4 taxa grab^{-1}; HyD 2004). In the dry season, conversely, species abundance and diversity was higher inside (46.2 individuals and 9.8 taxa grab^{-1}) than outside (23 individuals and 5.6 taxa grab^{-1}) Tung Chung Channel (HyD 2004).

2.3.2 The marine benthic macrofauna was comprised of a high diversity of polychaete species, in which *Sigambra hanaokai* was the dominant species in the wet season, while *Eunice indica* and *Prionospio* sp. dominated in the dry season (HyD 2004). Species diversity of other taxa (mainly crustaceans, echinoderms and molluscs) and the overall biomass were, however, low, which is typical in the northwestern waters of Hong Kong (ERM 2000; Shin 2002; Mouchel 2002). All the species recorded occur frequently in Hong Kong and no rare species were observed (Shin 2002). The biotic index of ~ 2 – 3 and the dominant species recorded implies the community is slightly disturbed (HyD 2004).

2.4 Intertidal Flora and Fauna (Hard and Soft Shores)

Soft Shore

2.4.1 Soft shore habitats (mudflats and sandflats) along the coast of northern Lantau are well-studied (Morton & Morton 1983), a result of their diversity of fauna and flora combined with the heavy development pressure on these habitats. Some of these soft shores have been identified as nursery habitats for horseshoe crabs (Chiu & Morton 1999, Shin *et al.* 2007), and San Tau, one of the soft shore sites surveyed in the Current Study, is known to be an important site for seagrass (Kwok *et al.* 2005a). Mangroves are common in some of these areas (Tam & Wong 2000). The shallow soft shores are considered to be nursery habitats for fishes in Hong Kong (Nip 2005). The Previous Study recorded low numbers of typical soft shore intertidal fauna, with species abundance similar during the wet and dry seasons (HyD 2004).

Soft Shore Flora

2.4.2 The mangrove stands along northern Lantau are dominated by *Aegiceras corniculatum, Kandelia obovata* and *Bruguiera gymnorrhiza*, with considerable patches of *Avicennia marina* and *Acanthus ilicifolitus*. Similar backshore vegetation was recorded in the Previous Study (HyD 2004), with some locally restricted species (such as *Celtis biondii*, *Ipomoea imperati*, *Stenoloma biflorum* and *Thespesia populnea*) also identified. Coastal vegetation between Tung Chung and Sham Wat is quite rich and four rare/protected species, including the herb *Drosera indica*, the seagrasses *Halophila ovalis* (reported as *Halophila ovata* in HyD 2004) and *Zostera japonica*, and the tree *Dodonaea viscosa*, were identified near Hau Hok Wan, at San Tau SSSI and Sha Lo Wan Beach respectively. Fong (1999, 2000) previously reported a complete disappearance of *Zostera japonica* and *Halophila ovalis* (Fong reported as *Halophila ovata* but Yip & Lai (2006) clarified that the reported *Halophila ovata* should be based on misidentification of *Halophila ovalis*) during the construction and reclamation works of the Chek Lap Kok new airport in early 1990s; the seagrass populations have gradually recovered following the completion of the airport.

San Tau SSSI

2.4.3 Part of San Tau SSSI occurs within the current study area and this area has been designated as a SSSI on account of the seagrass beds that occur. Seagrasses, flowering plants which are mostly distributed in shallow, sheltered soft-bottom marine coastlines or in estuarine waters, are uncommon in Hong Kong. This habitat is of conservation importance because it plays a crucial role in stabilizing coastlines and provides shelter and feeding grounds for a number of coastal fauna, including fishes, gastropods, crabs and horseshoe crabs (Kwok *et al.* 2005). Hence, the stability and size of seagrass beds are important to maintain the balance of the coastal ecosystem. According to TM-EIAO, established seagrass beds of any size are considered to be a valuable habitat in Hong Kong. The seagrass species recorded at San Tau SSSI are considered to be rare in Hong Kong (South China Institute of Botany & AFCD 2003, Kwok *et al.* 2005b).

2.4.4 San Tau was designated as SSSI in 1994 due to the presence of an extensive seagrass bed dominated by two seagrass species *Halophila ovalis* and *Zostera japonica*. According to the routine biodiversity survey of seagrass beds conducted by AFCD since 2002, a maximum extent of 3820 m^2 of *H. ovalis* and 20 m^2 of *Z. japonica* has been recorded in San Tau SSSI (Kwok *et al.* 2005).

2.4.5 According to Fong (2000), *Halophila ovalis* (reported as known as *Halophila minor* or *Halophila ovata* in Fong (2000) but Yip & Lai (2006) clarified that such *Halophila* spp. should be due to misidentification of *Halophila ovalis*), is a short-lived pioneer annual plant which can colonize suitable substratum in a short period of time, but rapidly disappears when abiotic factors become unfavorable. The degree of recovery each year shows considerable annual variation. Areas of extensive coverage of this species have been reported to disappear completely within a short period at San Tau. This unusual life cycle leads to seasonal variation in abundance of *Halophila ovalis* with regular annual cycles (Fong 2000). Although the sheltered flat at San Tau SSSI provides suitable substratum for *Halophila ovalis* and *Zostera japonica*, the specific growth requirements of these two seagrass species are easily influenced by abiotic factors (including temperature and turbidity of water), biotic factors (including macro-algal blooms during winter) and anthropogenic effects (Fong 2000, Huang *et al.* 2006). Temperature influences the growth, flowering period and seed germination of both species (Fong 2000); *Z. japonica* is favored by slightly warm temperature during the flowering period (from March to July, with a peak in May), whereas *Halophila ovalis* is favored by hot summer temperatures. Anthropogenic factors could further hasten the disappearance of seagrass bed. Urban development and reclamation around Tung Chung Bay may increase the sedimentation rate and change the hydrology of the bay, which may directly or indirectly change the substratum of the seagrass bed in San Tau SSSI (Fong 2000). Seagrass beds at Hepu in Guangxi and Liusha in Guangdong have been affected by digging activity for shellfish collection (Huang *et al.* 2006). Similarly, regular digging for shellfish by local residents around the mudflat and low shores at San Tau SSSI could influence the roots of seagrasses and loosen the sand and mud of the shore, affecting the establishment and normal growth of seagrasses.

Hard Shores

2.4.6 The local hard-bottom intertidal habitats (i.e. boulder shore and rocky shore) usually contain fewer species of conservation concern. In Hong Kong, hard shore habitats are more common than soft shore habitats, and most species in the former habitats usually appear to be common and widespread (Morton & Morton 1983). Hard shore intertidal fauna recorded in the Previous Study were common in Hong Kong with low species diversity (HyD 2004).

2.5 Coral*

2.5.1 Around the proposed survey area, only one survey has been conducted previously on the subtidal community structure (The Oceanway Corporation Ltd 2003) as part of the Previous Study (HyD 2004). The survey involved spot dives at twenty-seven sites within the area potentially impacted.

2.5.2 No reef-building or hermatypic corals were observed in the east or west of the Chek Lap Kok Channel. An ahermatypic cup coral species, *Balanophyllia* sp., and a gorgonian soft coral species, *Echinomuricea* sp., were observed on the hard substrate. The abundance of both species was low (cover <5%), however, and high levels of partial mortality of the *Echinomuricea* colonies were observed. Both are commonly found in western Hong Kong waters but with a patchy distribution. Generally, hard substrate ended at ~3m depth, beyond which the substrate was sand and mud (HyD 2004).

2.6 Horseshoe Crabs

2.6.1 Territory-wide Horseshoe Crab surveys have been conducted by Chiu and Morton (1999) and Shin *et al.* (2007), with results indicating that the soft shores along the North Lantau coast provide suitable nursery habitats for Horseshoe Crabs. In addition, surveys conducted along the North Lantau coast as part of environmental impact assessment reports (e.g. MTRC 2003, HyD 2004) have identified the presence of Horseshoe Crabs in soft shore areas within the Current Study area.

2.6.2 The conservation importance of Horseshoe Crabs is well recognized and local populations are declining (Shin *et al.* 2007). The territory–wide surveys conducted between 2004 and 2006 (*ibid.*) found that local Horseshoe Crab populations declined dramatically compared to an earlier study in 2002 (Morton & Lee 2003).

2.6.3 The Previous Study for this Project (HyD 2004) recorded more than 50 individuals of two species (*Carcinoscorpius rotundicauda* and *Tachypleus tridentatus*) over a nine-month study period. Of the six soft shore sites for the 2008-09 study, Horseshoe Crabs were found at four during the 2003-04 studies (Tung Chung Bay, Sham Wat, San Tau and Hoi Hok Wan).

2.7 Cetaceans*

2.7.1 Whilst no specific surveys were conducted in the previous report, Impact Index analysis was conducted for Chinese White Dolphins *Sousa chinensis* for the proposed alignment in Hong Kong waters. It was concluded that the western section of the bridge (4.8km) passes through known areas of high dolphin density, whilst the section in eastern waters (4.1km) passes through an area of low dolphin density. No sightings of dolphins have been documented in the Airport Channel, between Airport Island and the northern coast of Lantau (HyD 2004).

2.8 Avifauna

2.8.1 Across the 9-month survey period, a total of 118 bird species, including 32 of conservation interest, was recorded during the Previous Study (HyD 2004). Fourteen species of conservation interest were recorded in the current Study Area, ten of which are considered to be wetland or wetland-associated species.

2.8.2 In September 2003, high numbers of both Cattle Egrets *Bubulcus ibis* and Little Egrets *Egretta garzetta* were recorded from Tung Chung Bay (over 700 individuals of each species) indicating this area is an important foraging site for these species (HyD 2004), although these numbers may also suggest that these birds are migratory in this area.

2.9 Terrestrial Mammals

2.9.1 Two species of mammal, Indian Muntjac *Muntiacus muntjac* and Brown Musk Shrew *Suncus murinus*, were recorded during the Previous Study (HyD 2004). Whilst listed as being of Potential Regional Concern (Fellowes *et al.* 2002), Indian Muntjac (as Red Muntjac) is listed as having a wide distribution in Hong Kong (Shek 2004) and several records occur along the north coast of Lantau. Brown Musk Shrew (as Musk Shrew) is described as having a wide distribution occupying a wide variety of habitats in Hong Kong (*ibid.*).

2.9.2 Several unidentified bat species were observed during the nocturnal surveys in 2003-04, though the report does not speculate the species observed. All bat species are protected in Hong Kong under the Wild Animals Protection Ordinance (Cap. 170).

2.10 Insects (Dragonflies and butterflies)

Dragonflies

2.10.1 Twenty-four species of dragonfly species were recorded in the Previous Study. This included three species of conservation interest, all of which were recorded outside of the current Study Area.

Butterflies

2.10.2 A total of 90 butterfly species was recorded during the Previous Study; including six species of conservation interest (HyD 2004). Two of these species, Common Albatross *Appias albina* and Danaid Eggfly *Hypolimnas misippus*, were recorded in the current Study Area.

2.10.3 The areas around San Tau and Sha Lo Wan are recognized as being important locations for rare and uncommon butterfly species (Young & Yiu 2002), including the protected Golden Birdwing Butterfly *Troides helena* (Young & Reels 1998, Young & Yiu 2004).

2.11 Herpetofauna

2.11.1 During the 2003-04 study, a total of 14 species of reptile was recorded. Only one of these is recognized as being of conservation interest: Tokay Gecko *Gekko gecko*, which occurs within the limits of the current Study Area. This species was seen on rocky outcrops and within villages in the vicinity of Sham Wat, San Shek Wan and San Tau (HyD 2004).

2.11.2 Of the amphibians surveyed in 2003-04, a total of seven species was recorded, including one species of conservation interest, the Lesser Spiny Frog *Paa exilispinosa (ibid.).* Lesser Spiny Frog was observed as tadpoles within several streams within the current Study Area.

2.11.3 The most significant herpetofauna record in the current Study Area is that of the endemic Romer's Tree Frog *Philautus romeri*, which is known to be extant on the northern side of Scenic Hill (HyD 2004, AFCD pers. comm.). This species has restricted local distribution (Karsen *et al.* 1998) and the remnant population on Chek Lap Kok is a fragment of a larger population that was present prior to the extensive construction work required for the current airport. Whilst a large number of adult and tadpoles was translocated, a small population remains within the abandoned village area at Scenic Hill, with breeding occurring within small water bodies amongst the ruins (AFCD 2005).

2.12 Habitats and vegetation (terrestrial)

2.12.1 A comprehensive botanical survey was conducted by the Previous Study (HyD 2004). A total of eleven habitats, including secondary woodland, plantation woodland, tall shrubland, shrubby grassland, mangrove, seagrass, coastal habitat and salt marsh, cultivated land/orchard, developed area, wasteland and stream/riparian habitats, were identified in the study. A total of 475 plant species were recorded in the botanical surveys, including five locally protected species (orchids *Cleisostoma simondii*, *Arundina chinensis*, *Acampe rigida*, *Eulophia graminea* and shrub *Pavetta hongkongensis*) and five rare species (herb *Drosera indica* found along the shoreline from Hau Hok Wan to Kau Liu, seagrass *Halophila ovalis* (reported as *Halophila ovata* in HyD 2004) and *Zostera japonica* in San Tau SSSI, sedge *Carex tristachya* along the footpath near a tall shrubland near Hau Hok Wan and tree *Dodonaea viscosa* along the back of the beach near Sha Lo Wan). With the exception of the sedge *Carex tristachya*, approximately 70 individuals of which were recorded, these protected and rare species were generally recorded in small patches within the Study Area. In addition, nine trees, four shrubs, 20 herbs and eight climber species are identified as restricted species by Xing *et al.* (2000). Of these species, the trees *Dimocarpus longan* and *Litchi chinensis* are widely cultivated as fruit trees in villages and orchards (Xing *et al.* 2000), the mangrove *Bruguiera gymnorrhiza* is quite widespread in the local mangrove stands (27 out of 43 mangrove stands surveyed in Tam *et al.* (1997)), and the shrubs *Boehmeria nivea* and *Ricinus communis* are often recorded in wastelands and shrubby grassland.

2.12.2 The Previous Study recorded a total of eleven habitats, dominated by developed area (on account of the large area occupied by the Airport Island). Of the remaining ten habitat types, three were considered to be of High Ecological value (Mangrove and Seagrass, Streams and Riparian (high base flow) and Secondary Woodland), with Tall Shrubland considered to be of Moderate to High ecological value.

3.0 FIELD SURVEY METHODOLOGIES FOR VERIFICATION OF ECOLOGICAL BASELINE STUDY

Marine Surveys

3.1 Marine Grab Survey

3.1.1 Marine grab samplings for benthic communities in soft substrate seabed were conducted at 9 stations along the most recent proposed HKLR alignment during both wet season and dry seasons (September 2008 and December 2008). The HKLR alignment and the sampling locations are shown in Appendix 1. Three grab sample replicates of $0.1m^2$ were collected at each of the sampling stations by van Veen-type Grab and collected samples were sieved using a 0.5mm mesh-size sieve and then preserved in 70% ethanol. Organisms inside the samples were sorted from the sediments by staining with Rose Bengal and then identified to the lowest practicable taxonomic level. Species composition, abundance and biomass were reported and statistical analyses (Diversity index, evenness index and Abundance/Biomass Comparison (ABC) plots), were provided for evaluation and ranking of ecological values.

3.2 Dive Survey

3.2.1 Dive surveys for corals and other hard-substrate marine organisms were conducted at seven locations in the shallow coastal waters that will potentially be subject to direct loss (including the landing points of HKLR at both natural and artificial coastlines along Airport Channel and on Airport Island) or to indirect impacts due to changes in water quality and hydrodynamic condition (including the coastlines to the east and to the west of Airport Channel). The locations for dive survey are shown in Appendix 1.

3.2.2 A semi-quantitative Rapid Ecological Assessment (REA) survey was conducted at each survey location. The REA survey was performed along a 100m underwater transect parallel to the coastline. Transects of 50m to 100m (subject to the underwater visibility) perpendicular to the coastline were also performed. The depth and substrate along the perpendicular transects were recorded at 3m intervals, or at smaller intervals if the gradient significantly changed along the transect. The benthic cover, taxon abundance, and ecological attributes of the transects were recorded in a 2m wide strip, 1m either side of the transects (subject to the underwater visibility), following the Rapid Ecological Assessment (REA) technique. The exact locations and routes of the REA transects were recorded on site by GPS and map.

3.2.3 Video footage and photos of the transects and the surveyed areas were taken during the dive surveys.

3.2.4 The purpose of the REA survey was to quantitatively record the habitat types and ecological values of the area by SCUBA diving. The REA approach (see Appendix 3 for further detailed methodology) aimed to collect data on the type of substrate and the abundance of marine organisms, in particular the occurrence of corals and the extent of the coral distribution from the coastline, for ranking the ecological values. Other parameters recorded during the surveys included site condition (e.g. observations regarding the degree of exposure of the sites to wave action), species list of corals and other marine organisms, coral sizes, coral health status and translocation feasibility of corals.

3.3 Intertidal Survey

3.3.1 Intertidal surveys for epifaunal communities were conducted on both hard (including natural and artificial coastlines) and soft shores along the Airport Channel and on Airport Island, during both the wet season and dry season. All intertidal surveys were conducted during suitable tides. For both hard and soft shores, a detailed active search along the shore was also conducted to supplement the transect surveys with details of any other species present and their occurrence in the survey locations, so as to produce a comprehensive species list for each of the survey areas.

Hard shores

3.3.2 Horizontal transects (at least 50m in length) at three tidal levels (High, Middle and Low) were established on each of the landing points of HKLR, covering natural and artificial coastlines; each transect comprised ten 0.5m x 0.5m quadrats. The locations of the hard shore survey areas are shown in Figure 1. The epifauna in each quadrat were identified and their numbers/coverage percentages recorded. Species and abundance of biota in quadrats were reported and diversity index, evenness index and other statistical analyses were provided for evaluating and ranking the ecological values.

Soft shores

3.3.3 The embayments along and in the vicinity of Airport Channel, namely Sham Wat, San Shek Wan, Sha Lo Wan, Hau Hok Wan, San Tau and Tung Chung Bay, were surveyed. The locations of the embayments are shown in Appendix 1.

3.3.4 At each site, horizontal transects (at least 50m in length) at three tidal levels (High, Middle and Low) were established, with ten 0.5m x 0.5m quadrats along each transect. The epifauna and infauna (within the top 5cm sediment) in each quadrat were identified and their numbers/coverage percentages recorded. One core of 10cm diameter x 20cm depth was also collected within each quadrat, the sediments sieved using 2mm mesh-size sieve and the biota inside identified and counted. Species and abundance of biota in both cores and quadrats were reported and statistical analyses (diversity index and evenness index) were provided for evaluating and ranking the ecological values.

3.3.5 Seagrass surveys and horseshoe crab surveys were also conducted at the above soft shore sites. The sites were thoroughly searched for seagrasses and horseshoe crabs during suitable tides. The species, number and size of horseshoe crabs and the species, area and coverage percentages of seagrass beds were recorded, and the locations of horseshoe crabs and the locations and extents of seagrasses were mapped.

Terrestrial survey

3.4 Habitat & Vegetation

3.4.1 Habitat and vegetation surveys were conducted in the terrestrial areas within 500m from the HKLR alignment (see Appendix 1) on North Lantau and Airport Island, during both wet season and dry season. The walk-over survey locations were selected prior to the field survey through aerial photographs and data from the baseline surveys. During the surveys, locations of any rare or protected plant species were recorded and the number of individuals present counted.

3.5 Mammals

3.5.1 Traces, tracks and scats of mammals were searched and recorded, with specific night surveys conducted for this group in the land areas within 500m from the HKLR alignment (see Appendix 1) on North Lantau and Airport Island, during both wet season and dry season. All mammals were identified to species level (wherever possible) and abundance was recorded.

3.6 Birds

3.6.1 Transect count were used to survey the avifauna present within 500m of the HKLR alignment. In addition, night surveys, with binoculars and powerful search lights, were conducted in order to assess the activity of nocturnal species, (e.g. owls, nightjars). All birds were identified to species level and the abundance was recorded.

3.7 Herpetofauna

3.7.1 Reptiles and amphibian surveys within 500m of the HKLR alignment were conducted by active searching in all habitats, with particular attention given to potential shelter sites and microhabitats such as leaf-litter, rubble piles, streams and watercourses. Special attention was paid to Scenic Hill on Airport Island, where Romer's Tree Frogs have been recorded. Anurans were surveyed by auditory as well as visual detection. As most of the amphibian species are more active during the night time, nocturnal surveys were also conducted during the wet season. All herpetofauna were identified to species level and the abundance was recorded.

3.8 Dragonfly

3.8.1 Dragonflies were surveyed following the same transects used for bird surveys. Dragonflies were identified with the aid of binoculars, and a telescopic hand net was used to capture specimens for identification in the hand when necessary (all species thus trapped were released back to the wild following identification). All dragonflies were identified to species level and the abundance was recorded.

3.9 Butterfly

3.9.1 Butterfly surveys were conducted in tandem with the dragonfly surveys, using similar methodology. Potential microhabitats, (especially ground and canopy of woodland) were searched and swept with a long-handled butterfly net where appropriate. All butterflies were identified to species level and the abundance recorded.

3.10 Stream Fauna

3.10.1 Fish and invertebrates present in streams within 500m of the HKLR alignment were identified and recorded by direct observation, dip-netting and active sampling. All aquatic fauna were identified to species level as far as possible and abundance recorded.

3.11 General

3.11.1 Lists of all species recorded in wet and dry seasons in each habitat have been produced, with details of abundance and conservation status (including local, regional and international such as China Redlist and IUCN Redlist). Photos of any protected species were taken when possible.

4.0 RESULTS FROM VERIFICATION OF ECOLOGICAL BASELINE STUDY

4.1 Marine Grab Survey

4.1.1 A total of 985 macro-faunal specimens, comprising 90 species from 59 families in 9 phyla (Annelida, Arthropoda, Branchiopoda, Chordata, Cnidaria, Echinodermata, Mollusca, Nemertea and Platyhelminthes), were recorded in the wet season (Table 1). In the dry season, a total of 383 macro-faunal specimens comprising 58 species from 44 families in 6 phyla (Annelida, Arthropoda, Coelenterata, Echinodermata, Mollusca and Nemertea) were recorded (Table 1). Only 28 species were found in both seasons (Appendix 2). Polychaetes (Annelida) were collected at all stations and represented the highest species richness and abundance in both seasons (Appendix 2).

Table 1. *Summary of the macrofauna collected in wet season (September) and dry season (December) 2008.*

Phylum	Wet Season (September 2008)			Dry Season (December 2008)		
	Number of families	Total number of individuals	Total biomass (g)	Number of families	Total number of individuals	Total biomass (g)
Annelida	26	457	2.71	15	201	1.24
Arthropoda	10	90	5.47	9	71	20.77
Branchiopoda	1	1	0.03	0	0	0
Chordata	3	4	1.87	0	0	0
Cnidaria	1	4	0.01	0	0	0
Coelenterata	0	0	0	1	1	0.70
Echinodermata	3	72	0.31	3	34	40.77
Mollusca	19	285	22.07	15	53	67.92
Nemertea	10	70	0.14	1	23	0.08
Platyhelminthes	1	2	0.03	0	0	0
Total	**59**	**985**	**30.94**	**44**	**383**	**131.53**

4.1.2 The bivalves *Donax* sp. and *Theora lata* and the brittle star *Macrophiothrix longipeda* were the commonest species recorded in the wet season, whilst the polychaetes *Notomastus latericens* and *Euclymene* sp. and the pea crab *Xenophthalmus* sp. were the most abundant species recorded in the dry season (Appendix 2). Detailed data are presented in Appendix 2.

4.1.3 Species abundance and richness were higher in the wet season than in the dry season (using two-way ANOVA, $p < 0.001$; see Appendix 2), except in Station 7 where the species abundance and richness remained constant (Figures 1 & 2). The overall patterns were, however, similar in both seasons: higher in open waters (Stations 1-3, 8 & 9) and declining gradually towards the Airport Channel. In the wet season, Stations 2 and 3 possessed the highest species abundance and Station 1 had the highest species richness. The lowest species richness and abundance occurred in Station 7. In the dry season, the species abundance and richness were highest in Stations 2 and 3 and were lowest in Stations 5 and 6.

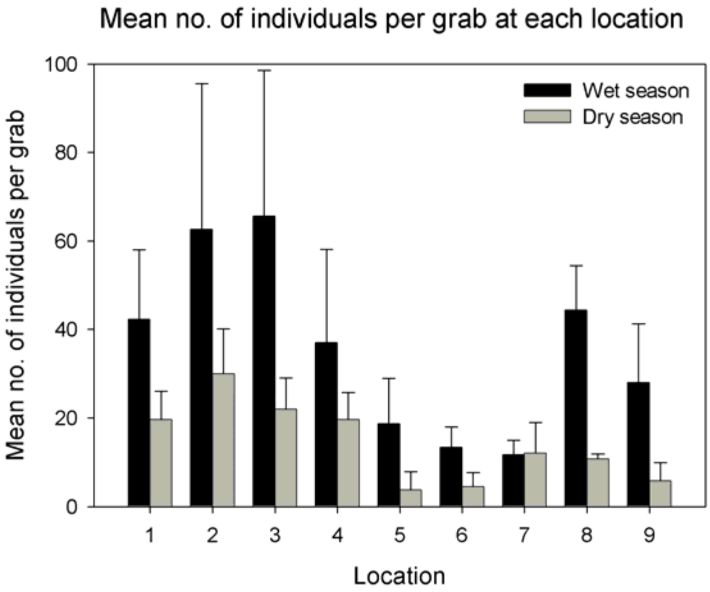

Figure 1. *Mean number of individuals per grab at each sampling location (wet and dry season)*

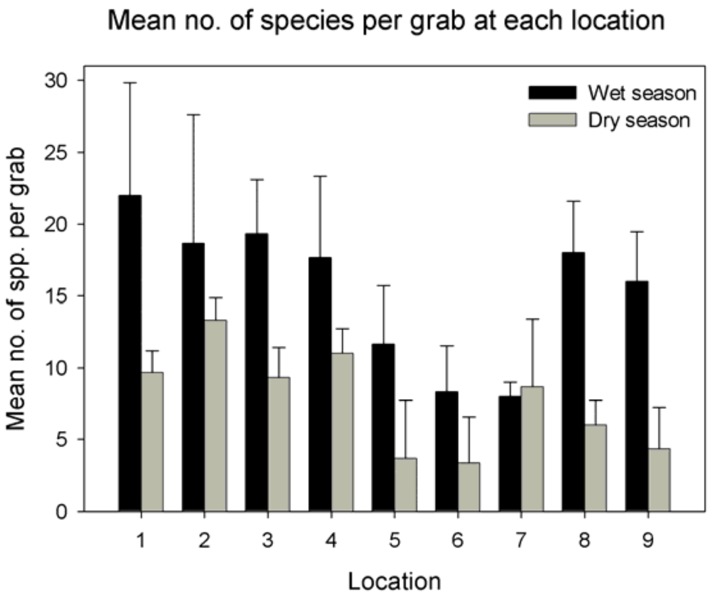

Figure 2. *Mean number of species per grab at each sampling location (wet and dry season)*

4.1.4 The Pielou's Index was similar between seasons and stations (wet season: 0.75 – 0.93, dry season: 0.79 – 0.99; Table 1). The Shannon-Wiener Diversity Index was slightly higher in the wet season than in the dry season, but the variation between stations is slight (wet season 2.68 – 3.37, dry season: 1.84 – 2.57).

4.1.5 The overall biomass was higher in the dry season than in the wet season (using two-way ANOVA, $p < 0.05$; see Appendix 2). The values in both seasons were, however, variable between stations and no general patterns could be deduced (Figure 3). Total biomass in the wet season was 30.94 g and was mainly due to the relatively high mass of molluscs (22.1 g) and arthropods (5.5 g; Table 1). Juveniles (~1 – 5 mm length) of bivalves and gastropods were recorded. Total biomass in the dry season was 131.53 g and was mainly due to the relatively high mass of molluscs (67.92 g), echinoderms (40.77 g) and arthropods (20.77 g). The biomass of other taxa in both seasons was low because of their small sizes and/or low abundance. Detailed biomass data are presented in Appendix 2.

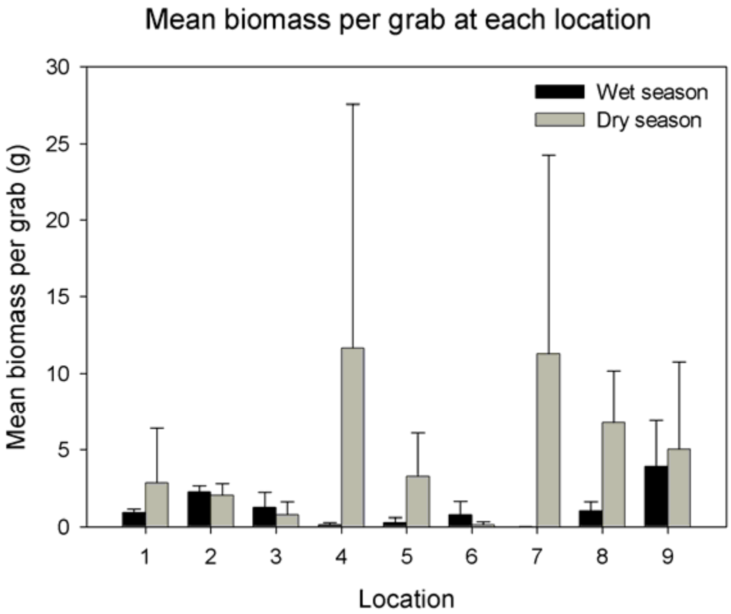

Figure 3. *Mean biomass per grab at each sampling location (wet and dry season)*

4.1.6 The W statistics for the 9 stations during the wet season were all positive and generally similar (0.225 – 0.411), although Station 7 possessed the lowest value of 0.11 and Station 9 had the highest value of 0.556 (Appendix 2). The W-statistics for the 9 stations during the dry season were also positive and the values were higher than those recorded in the wet season (0.264 – 0.739).

4.1.7 In both wet and dry seasons, none of the species are mentioned in the IUCN Red List (IUCN 2008). One species is listed in the China Species Red List (CSIS 2008): the Greasyback Shrimp *Metapenaeus ensis* is listed as Vulnerable. The conservation status of most annelids recorded in the Current Study is unclear, however, due to their poorly-known ecology.

4.1.8 The marine benthic macrofauna in North Lantau was composed of a high diversity of polychaete species and a low diversity of other taxa, which is characteristic in the northwestern waters of Hong Kong (ERM 2000; Shin, 2002; Mouchel, 2002; HyD, 2004). There was, however, a distinct spatial and temporal pattern, suggesting the benthic macrofauna are sensitive as a biological indicator to reflect changes in environmental conditions (Shin, 2002).

4.1.9 Spatially, species abundance and richness were higher outside than inside the Tung Chung Channel. The large error bars indicate that species abundance and richness varied considerably within sites.

4.1.10 Temporally, species abundance, richness and diversity (Shannon-Wiener Diversity Index) were higher in the wet season than in the dry season. The small individual sizes observed and the low biomass recorded in the wet season may suggest that the majority of the benthic macrofauna recruit during this time period. The decrease in species abundance and richness in the dry season is possibly an indication of post-recruitment mortality of the benthic macrofauna. The similarity in the Pielou's Evenness between seasons and stations indicates the species evenness was constant over time alike among the 9 stations.

4.1.11 Infauna diversity in the Study Area is relatively low when compared to other areas in Hong Kong (Hyd 2004). The impoverished assemblages present is likely due to the proximity of the Pearl River Estuary, leading to low salinity and possibly due to the predominantly silt-clay composition of the seabed which does not lend itself to supporting high diversity (HyD 2004). The wet and dry seasons results for species diversity ranged between 2.68-3.37 and 1.84-2.70 respectively from the nine sampling stations (See Appendix 2, Table A2.5). These are comparable to other soft-bottom benthic communities in Hong Kong, which are characteristsed by an extensive homogeneous assemblage dominated by polychaete annelids, where species diversity was calculated to be 2.87 in the summer (wet season) and 2.82 in the winter (dry season); these data are averaged from 97 sampling stations from across Hong Kong. (Shin *et al.* 2004). Most species recorded occur frequently in Hong Kong and no species of conservation concern were observed.

4.2 Dive Survey

4.2.1 Dive surveys conducted at the seven dive survey sites between 18th and 26th October 2008 revealed that the diversity and abundance of hard and soft corals within and outside the Airport channel were low. Most hard substrates were dominated by barnacles, mussels and rock oysters. Dive survey locations can be seen in Appendix 3.

4.2.2 Only one genus of ahermatypic cup coral *Balanophyllia* (Dendrophylliidae) and one genus of octocoral, *Echinomuricea* sp. (Plexauridae) were recorded from two (DS1 and DS2) and four (DS1, DS2, DS6 and DS7) of the seven survey sites, respectively. Both the hard and soft corals were only present outside the Airport Channel. No coral was found within the Channel (i.e. DS3, DS4 and DS5).

4.2.3 No other taxa of high conservation interest were recorded in the seven survey sites. Full details of substrate type and fauna recorded are shown in Appendix 3.

4.2.4 Compared with the previous survey conducted in 2003 (Oceanway 2003), the spot dive in 2003 generated similar qualitative data as the present survey. In the previous survey, the ahermatypic cup coral *Balanophyllia* sp. was only recorded outside the Airport Channel at site SD5 (DS1 in present survey), SD9 (DS2) and SD22 (DS6). In the present survey, this cup coral was also recorded in DS1 and DS2 but not in DS6, which is probably due to the very low abundance and patchy distribution of the coral within same area. For the octocoral *Echinomuricea* sp., the results in this survey agree with the finding in the previous quantitative survey.

4.2.5 In Hong Kong context, the low salinity and murky water at the western Hong Kong limit the development of hard coral to few thriving species such as ahermatypic cup corals, *Oulastrea crispata, Plesiastrea versipora* and selected *Favia* species. At north and northwest Lantau, only *Oulastrea crispata* and ahermatypic cup corals have been reported. The low diversity and low abundance of corals in the present survey is typical for the western Hong Kong waters.

4.3 Intertidal Survey

Soft Shores

4.3.1 In the Current Study, six soft shore locations (Sham Wat (SW), Sha Lo Wan (SLW), Hau Hok Wan (HHW), Tung Chung Bay (TCB), San Tau (ST) and San Shek Wan (SSW)) along the northern coast of Lantau were surveyed in September and December 2008 to cover wet and dry seasons. The locations of these soft shore locations can be seen in Appendix 1.

4.3.2 A total of 155 species were recorded from several faunal groups, including ichthyofauna (fish), echinoderms (sea cucumber), arthropods (shrimp, crab and horseshoe crab), molluscs (bivalve, gastropod and tusk shell), annelids (segmented worm), sipunculids (peanut worm), nemerteans (ribbon worm), cnidarians (sea anemone) and poriferans (sponge). Detailed data are presented in Appendix 4. Of these six sites, the highest species number was recorded at ST and TCB (76), and the lowest number was recorded at SW (57). Species numbers recorded at SSW, SLW and HHW were 69, 72 and 75, respectively.

4.3.3 During the transect and quadrat surveys, a total of 26,627 individuals belonging to 104 species were recorded (Appendix 4), including a single horseshoe crab individual. A total of 1,019 individuals belonging to 56 fauna species were found in the core samples (Appendix 4). Findings of quantitative surveys are summarized in the table below.

Table 2. *Species number, numerical abundance, Pielou's evenness index (J') and Shannon diversity index (H', Log $_e$) recorded at each soft shore site.*

	SW	SSW	SLW	HHW	ST	TCB
Epifauna						
Number of Species	29	42	44	49	55	50
Abundance	1259	4147	5079	3899	4222	8021
J'	0.46	0.49	0.47	0.53	0.55	0.43
H' (Log $_e$)	1.56	1.82	1.79	2.07	2.20	1.67
Infauna						
Number of Species	12	20	17	18	19	24
Abundance	164	265	83	56	115	336
J'	0.45	0.52	0.74	0.86	0.81	0.48
H' (Log $_e$)	1.11	1.56	2.10	2.47	2.38	1.51

4.3.4 Most species found during these surveys are common and widespread in Hong Kong. Six species of conservation concern were recorded (Table 3), details of which are given in the following paragraphs.

Table 3. *Species of conservation interest or potential conservation interest*

Species	SW	SSW	SLW	HHW	ST	TCB
Indo-Pacific Tropical Sand Goby *Favonigobius reichei*	+	+	+	+	+	+
Snowy Puffer *Takifugu niphobles*				+	+	
Predaceous Chub *Parazacco spilurus*		+				
Sea Cucumber *Holothuria leucospilota*	+					
Horseshoe Crab *Tachypleus tridentatus*	+				+	+
Greasyback Shrimp *Metapenaeus ensis*	+		+	+	+	

Key: SW=Sham Wat; SSW=San Shek Wan; SLW=Sha Lo Wan; HHW=Hau Hok Wan; ST=San Tau; TCB=Tung Chung Bay.

Fish

4.3.5 The Indo-Pacific Tropical Sand Goby *Favonigobius reichei*, which has been regarded as "Lower Risk/Near Threatened" by IUCN (2009), was found to be very common at all the study sites. Although it is regarded globally as Lower Risk/Near Threatened, this species is common and widespread in intertidal areas in Hong Kong (Lee *et al.* 2004, Nip 2005).

4.3.7 Another fish species observed, Snowy Puffer *Takifugu niphobles*, is regarded as "Data Deficient" by IUCN (2008). This fish is, however, considered to be common in Hong Kong (Nip 2005, AFCD 2008).

4.3.8 Two Predaceous Chub *Parazacco spilurus* were observed in a freshwater creek running across the shore in SSW. This species is considered to be Vulnerable in Mainland China (Yue & Chen 1998, CSIS 2008). This is primarily a freshwater species, however, and is not known to tolerate saline conditions; its presence on the surveys probably resulted from upstream populations having been washed into the lower reaches of the stream.

Horseshoe Crab

4.3.9 The Horseshoe Crab *Tachypleus tridentatus* was recorded at two of the soft shore sites, TCB and ST. Two records from TCB included a juvenile (max. width of prosoma = 40mm) and one dead subadult (max. width of prosoma = 150mm). The single crab at ST was one tiny juvenile (max. width of prosoma = 5mm). Horseshoe Crab tracks were observed at SW. Anecdotal evidence of a mating pair in the intertidal area just outside SW village in August 2008 was also gained from local residents. This Horseshoe Crab species is regarded as Vulnerable by CSIS (2008).

4.3.10 Two Horseshoe Crabs (of unknown species) were also recorded by AFCD staff at San Tau on 29th September 2008. (AFCD pers. comm.).

Other Invertebrates of Conservation Interest

4.3.11 The Sea Cucumber *Holothuria leucospilota* was found on the shore of SW. This species is usually found in the low tide/subtidal zone of boulder shores (Morton & Morton 1983) and the soft shore at SW is not optimal habitat for this species. It is the most common holothuroid in Hong Kong (Lai *et al.* 2006) but is regarded as Endangered in Mainland China due to over-exploitation (CSIS 2008).

4.3.12 Although *Metapenaeus* spp. are common in mangrove and estuarine areas in Hong Kong (Leung 1999, Vance 1999), all four species found in Hong Kong (including *M. ensis*) are considered to be Vulnerable in Mainland China due to over-exploitation (CSIS 2009). In the Current Study, individuals of *M. ensis* were found in SW, SLW, HHW and ST.

Artificial and Natural Rocky Shore

4.3.13 Five rocky shores, including those on the western and eastern sides of San Shek Wan headland (SSWW and SSWE), near Sha Lo Wan Pier (SLWP) and to the south and east of the Airport (AS and AE), were surveyed during September and December 2008 and January 2009. The former three sites are natural hard shores and the later two are artificial rocky shore.

4.3.14 A total of 54 species was recorded in the hard shore habitats (Appendix 4). None of these species are listed as being of conservation concern (IUCN 2008, CSIS 2009). During the quantitative survey, a total of 118,043 individuals belonging to 45 species were recorded (Appendix 4). The number of species and the diversity and evenness indices of natural rocky shores were in general slightly higher than those of the two artificial hard shores (Table 4). Sessile organisms such as Purplish Bifurcate Mussel, Rock Oyster and Striped Barnacle were the dominant species of all these sites. Other abundant species observed were Bearded Ark Shell, Limpets, *Nerita yoldii* and Periwinkles. Mobile crustaceans such as Sea Slater and Sesarmine Crabs were commonly observed at these sites during the wet season surveys but were almost absent in the dry season; this accounts for the lower diversities recorded in winter (Appendix 4).

Table 4. *Species number, numerical abundance, Pielou's evenness index (J') and Shannon diversity index (H', Log $_e$) recorded at each rocky shore site during quantitative surveys.*

	SSWW	SSWE	SLWP	AS	AE
Species Number	30	28	24	21	26
Abundance	23764	31477	24847	14234	23721
J'	0.37	0.37	0.26	0.26	0.33
H' (Log $_e$)	1.25	1.25	0.82	0.79	1.09

Key: SSWW=San Shek Wan Headland West; SSWE=San Shek Wan Headland East; SLWP=Sha Lo Wan Pier; AS=Airport South; AE=Airport East.

4.3.15 In the Current Study, the dominant species found, such as Bearded Ark Shell, Periwinkles, Purplish Bifurcate Mussel, Rock Oyster and Striped Barnacle, are common and widespread in Hong Kong rocky shores (Williams 2003, Lai *et al.* 2006). None of the species recorded are considered to be rare or of conservation concern.

4.4 Mammals

4.4.1 Only three species of mammal were recorded during both the wet and dry season surveys. A Red Muntjac *Muntiacus muntjac* was seen in the village section of San Tau stream on the evening of the 29th August 2008. In addition, footprints of Muntjac deer, presumably Red Muntjac, were observed in the soft sand at the beach close to the mouth of the Stream ST9 at San Tau. Red Muntjac (as Indian Muntjac) is listed as being of Potential Regional Concern following Fellowes *et al.* (2002) and is protected under the Wild Animals Protection Ordinance (WAPO). This small deer is widespread in Hong Kong (Shek 2006).

4.4.2 No other direct observations or field signs (e.g. scats, burrows) of terrestrial mammals were observed during the survey period.

4.4.3 The skull of a Eurasian Wild Pig *Sus scrofa* was found on the beach at Sha Lo Wan during surveys on 15th January 2009. This species has a widespread distribution in Hong Kong (Shek 2006).

4.4.4 A brief glimpse of a rat *Rattus* sp. was seen on the 29th August 2008 on the footpath leading to San Tau from Tung Chung, just outside of the 500m Study Area. In the Hau Hok Wan area, another rat species (possibly Indochinese Forest Rat *R. andamanensis*) was also observed during dry season botanical surveys.

4.5 Birds

4.5.1 A total of 61 bird species was recorded during wet (35 species) and dry (44 species) season surveys. These records come from both walked transects and incidental recordings during other surveys between 27th August and 16th September 2008 and between 5th and 7th January 2009. Specific bird surveys covered diurnal and nocturnal periods.

4.5.2 Of these 61 species, 14 are listed by Fellowes *et al.* (2002) as species of conservation concern; nine of the 14 species of conservation concern are also wetland dependant species, and were observed on the shoreline of northern Lantau and the artificial seawall of Chek Lap Kok. These species are listed in Appendix 6, with those of Conservation Importance, shown in Table 5.

4.5.3 In addition, eight species also appear on various China Red Lists. Six species are Class II protected species in China (www.sepa.gov.cn 2008); these are Pacific Reef Egret *Egretta sacra*, Black Kite *Milvus migrans* Crested Goshawk *Accipiter trivirgatus*, Common Buzzard *Buteo buteo*, Common Kestrel *Falco tinnunculus* and Collared Scops Owl *Otus bakkamoena.* Emerald Dove *Chalcophaps indica* and Hwamei *Garrulax canorus* are both listed as Near Threatened (CSIS 2008). Pacific Reef Egret and Emerald Dove are listed as Rare and Vulnerable respectively in the China Red Data Book (Zheng & Wang 1998).

4.5.4 Shrubland habitats produced the highest number of bird species, with a total of 18 species recorded during the wet season. None of these species are listed as being of conservation concern (Fellowes *et al.* 2002), although three species are listed in China Red Lists: Emerald Dove, Collared Scops Owl and Hwamei (CSIS 2008). Within the shrubland habitat, Chinese Bulbuls *Pycnonotus sinensis* were the most numerous species, and small parties of birds were frequently observed foraging in fruiting bushes.

4.5.5 Surveys of soft shore habitats revealed a total of nine species, including eight wetland-dependant species and two that are closely associated with wetlands. Overall bird abundance in this habitat was relatively low, however. The highest species count was of 11 Little Ringed Plovers *Charadrius dubius* at Sha Lo Wan on the 16th September. Migrant waders such as Whimbrel *Numenius phaeopus* and Grey-tailed Tattler *Heteroscelus brevipes* were also observed on soft shore habitats within the Study Area. These waders appeared to be utilizing the soft shore habitat for foraging.

4.5.6 Hard Shore Habitats included rocky headlands and artificial shorelines of the Airport Island and the north Lantau coast. A total of seven species were recorded in this habitat, the most numerous species being Little Egret *Egretta garzetta*, which was most abundant along the artificial shoreline of the Airport Island. These ardeids appeared to be utilizing the hard shore habitat as feeding areas. Common Sandpiper *Actitis hypoleucos* were frequently observed foraging along the hard shores.

Table 5. *Bird species of conservation interest recorded within the study area during wet and dry season surveys.*

Species	*Species of Conservation Interest*	China Red List	Habitats recorded
Grey Heron *Ardea cinerea* [w]	*PRC*		Soft Shore; Hard shore
Great Egret *Egretta alba* [w]	*PRC (RC)*		Soft Shore; Hard shore
Little Egret *Egretta garzetta* [w]	*PRC (RC)*		Soft Shore; Hard shore
Pacific Reef Egret *Egretta sacra* [w]	*(LC)*	Class II Protected* Rare***	Hard Shore
Striated Heron *Butorides striatus* [w]	*(LC)*		Intertidal Streams
Black-crowned Night Heron *Nycticorax nycticorax* [w]	*(LC)*		Intertidal Streams
Black Kite *Milvus migrans*	*(RC)*	Class II Protected*	Overhead
Crested Goshawk *Accipiter trivirgatus*		Class II Protected*	Overhead
Common Buzzard *Buteo buteo*		Class II Protected*	Overhead
Common Kestrel *Falco tinnunculus*		Class II Protected*	Overhead
Little Ringed Plover	*(LC)*		Soft Shore

Species	Species of Conservation Interest	China Red List	Habitats recorded
Charadrius dubius w			
Whimbrel *Numenius phaeopus* w	LC		Soft Shore
Grey-tailed Tattler *Heteroscelus brevipes* w	LC		Soft Shore
Collared Scops Owl *Otus bakkamoena*		Class II Protected*	Shrubland
Emerald Dove *Chalcophaps indica*		Near Threatened**; Vulnerable***	Shrubland
Hwamei *Garrulax canorus*		Near Threatened**	Shrubland
Blyth's Leaf Warbler *Phylloscopus reguloides*	LC		Shrubland
Common Rosefinch *Carpodacus erythrinus*	LC		Village/farmland
White-shouldered Starling *Sturnus sinensis*	(LC)		Village/farmland
Black-naped Oriole *Oriolus chinensis*	LC		Plantation

w= denotes wetland dependent bird species
PRC= Potential Regional Concern; RC=Regional Concern; LC = Local Concern, as of Fellowes *et al.* (2002). Those in parenthesis indicate that the assessment is on the basis of restrictedness in breeding and/or roosting rather than general occurrence.
*CSIS 2008; **www.sepa.giv.cn 2008; ***Zeng & Wang 1998.

4.6 Reptiles

4.6.1 Seven species of reptile, all common and widespread in Hong Kong, were seen across wet and dry season surveys. Six species of lizard were observed and one exotic species of terrapin, Red-eared Slider *Trachemys scripta*. No snakes were seen during any of the surveys. Two diurnal and two nocturnal surveys were conducted between 29th August and 16th September 2008 for the wet season, and between 5th and 7th January 2009 for dry season surveys.

4.6.2 Two species of gecko, Chinese Gecko *Gekko chinensis* and Bowring's Gecko *Hemidactylus bowringii*, were regularly encountered in village habitats, particularly the abandoned village houses on Scenic Hill. Three species of skink were seen (Chinese Skink *Eumeces chinensis*, Long-tailed Skink *Mabuya longicaudata* and Reeves' Smooth Skink *Scincella reevesii)* primarily on woodland/shrubland edges along footpaths, although juvenile Long-tailed Skinks were common amongst the leaf-litter of the abandoned village on Scenic Hill. Changeable Lizard *Calotes versicolor* was seen in waste ground on the edge of Sha Lo Wan. None of these lizards are of conservation concern and all are common and widespread in Hong Kong (Karsen *et al.* 1998).

4.7 Amphibians

4.7.1 Diurnal and nocturnal surveys were conducted between 29th August and 16th September 2008 for wet season surveys and between 5th and 7th January for dry season surveys. A total of four species of amphibian were recorded during the all surveys. Two of these are listed as species of conservation concern, these being the Chinese Bullfrog *Hoplobatrachus chinensis* and Lesser Spiny Frog *Paa exilispinosa*.

4.7.2 Chinese Bullfrog is a Class II Protected Animal in China and is considered to be of Potential Regional Concern in Hong Kong owing to depletion of wild populations for the food trade (Fellowes *et al.* 2002, Chan *et al.* 2005). An adult Chinese Bullfrog was seen in a drain at Scenic Hill. The origins of this species are unknown, and there is some confusion between wild populations and animals originating from religious releases that occur in some areas of the territory. The species has previously been recorded on Chek Lap Kok (Chan *et al.* 2005).

4.7.3 Lesser Spiny Frog is regarded as Vulnerable by IUCN (2008) and is considered to be of Global Concern (Fellowes *et al.* 2002), although it is widely distributed and common in suitable habitat in Hong Kong (Chan *et al.* 2005). Tadpoles of this species were observed in the streams between San Tau and Hau Hok Wan (c.f. Stream Section 4.12).

4.7.4 Other amphibians seen included Asian Common Toad *Bufo melanostictus* and Asian Painted Frog *Kaloula pulchra*, which were common throughout the terrestrial habitats of northern Lantau. Both species are common and widespread in Hong Kong (Karsen *et al.* 1998, Chan *et al.* 2005).

4.7.5 Romer's Tree Frog *Philautus romeri* is known to occur on Chek Lap Kok (Karsen *et al.* 1998, Chan *et al.* 2005) though no evidence of adults or larvae were seen during the wet season surveys. Tadpoles of this species were seen earlier in 2008 as part of the on-going monitoring by AFCD (AFCD pers. comm.).

4.8 Dragonfly

4.8.1 Only seven dragonfly species were recorded in the Study Area, none of which are considered to be of conservation concern. These records come from both walked transects and incidental recordings during other surveys between 27th August and 16th September 2008 for the wet season, and on 6th and 8th January 2009 during the dry season survey. Species lists are given in Appendix 7.

4.8.2 By far the most numerous and widespread species recorded was the Wandering Glider *Pantala flavescens*, with many hundreds seen across the site over all habitats. This is the most common species in Hong Kong (Wilson 2004). Other than Wandering Glider, all other species were recorded only outside the proposed road alignment, within the limits of stream and/or irrigation ditches across the Study Area.

4.9 Butterfly

4.9.1 A total of 58 butterfly species was recorded during both seasonal surveys within the study area; one is considered to be species of conservation concern. These records come from both walked transects and incidental recordings during other surveys between 27th August and 16th September 2008 for the wet season, and on 6th and 8th January 2009 during the dry season survey. A full species list can be seen in Appendix 8. Most species occur in shrubland (32) with 24 species recorded in woodland and 15 species recorded from village habitats.

4.9.2 White Dragontail *Lamproptera curius* was recorded during soft shore surveys in December 2008 at a San Tau stream (ST9). This species is considered to be of Local Concern (Fellowes *et al.* 2002)

4.9.3 Few records of butterflies were made from the intertidal habitats (i.e. soft shore, hard shore and mangrove), as would be expected from the paucity of suitable food plants in this habitat. Common Mormon *Papilio polytes* was the most widespread species, occurring in five different habitat types; this species is very common and widespread in Hong Kong (Lo & Hui 2005).

4.10 Stream Fauna

4.10.1 Six streams were located within the Study Area and were surveyed on 25th and 30th September for wet season surveys and on 2nd and 3rd December 2008 for dry season surveys. Of the 10 streams surveyed, four (SL8, ST13, ST14 and HH1) were found to be dry during both wet and dry season surveys, and no fauna was observed in any of these dry stream beds. Several species of conservation interest were recorded and are listed below.

Table 6. *Species of conservation interest found in streams*

Species Name	ST9	ST12	HH2	HH3	HH5	SL3
Lesser Spiny Frog *Paa exilispinosa*			+	+		
Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis*	+					
Indo-Pacific Tropical Sand Goby *Favonigobius reichei*	+				+	+
Dark-margined Flagtail *Kuhlia marginata*	+					
Rice Fish *Oryzias curvinotus*	+			+	+	
Predaceous Chub *Parazacco spilurus*	+					+
Sesarmine Crab *Chiromantes sereni*				+		+
Greasyback Shrimp *Metapenaeus ensis*	+					+
Freshwater Crab *Somanniathelphusa zanklon*		+				

Amphibians

4.10.2 Lesser Spiny Frogs tadpoles were observed in HH2 and HH3 during wet season surveys. This species is of conservation importance (see Section 4.9.3).

Fish

4.10.3 In Hong Kong, Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis* is a rare species and only appears in several streams (Lee *et al.* 2004) and it is also considered to be of Global Concern (Fellowes *et al.* 2002). One individual was observed in the midstream section of ST9 in December 2008.

4.10.4 The Indo-Pacific Tropical Sand Goby *Favonigobius reichei*, which is regarded as "Lower Risk/ Near Threatened" by IUCN (2009), was found in the lower sections of several streams surveyed. Whilst it is regarded globally as Near Threatened, this species is common and widespread in the intertidal area in Hong Kong (Lee *et al.* 2004, Nip 2005).

4.10.5 Dark-margined Flagtail *Kuhlia marginata* was observed at ST9 in December 2008. This species is considered to be very rare in Hong Kong (AEC Staff pers. obs.) and was regarded as locally endangered in a recent EIA Study Report (DSD 2005). It is regarded to be of Regional Concern by Fellowes *et al.* (2002), but its status was not evaluated by Lee *et al.* (2004) or AFCD (2009). Since freshwater streams are important nursery habitats for this catadromous species (Oka & Tachihara 2008), ST9 is considered to have potential to be a nursery habitat for this species.

4.10.6 Rice Fish *Oryzias curvinotus* was found at three stream sites (see Table 6 and Appendix 9) and is a species considered to be of Global Concern (Fellowes et al.

2002) which is uncommon in the wild in Hong Kong (Lee *et al.* 2004). Although it is generally considered to be a freshwater species, it can inhabit brackish environments (Froses & Pauly 2008) and a large population can be found in the mangrove area of Tung Chung Bay (AEC Staff pers. obs.). In the lower reaches of ST9, a small population of Rice Fish was observed, and although not as numerous as that of Tung Chung Bay, it is considered to be self-sustaining. Only single individuals of this species were seen in the lower sections of the other two stream sites (HH3 and HH5).

4.10.7 Predaceous Chub *Parazacco spilurus* is common and widespread in Hong Kong (Lee *et al.* 2004), but is regarded as a vulnerable species in Mainland China (Yue & Chan 1998, CSIS 2008). Populations of over 100 individuals of this species were seen in the middle sections of ST9 and SL3.

Crustaceans

4.10.8 The Sesarmine Crab species *Chiromantes sereni* was found in the lower sections of HH3 and SL3. This species was first recorded in Hong Kong by Soh (1978) and is reported to be endemic (Kwok & Tang 2005). Although its conservation status is not fully understood, it was only found at four sites in a recent territory-wide Sesarmine Crab survey (Kwok & Tang 2005).

4.10.9 *Somanniathelphusa zanklon*, another endemic crab species, was also found in the Current Study. Although this species has been found to be quite abundant in Lantau and other places in Hong Kong (DSD 2002, EPD 2007), it is regarded as an endangered species by IUCN due to its restricted distribution (IUCN 2008). Two juveniles of this species were recorded in ST12. This small stream has potential to provide a nursery habitat for this endangered species.

4.10.10 Greasyback Shrimp *Metapenaeus ensis* juveniles were recorded in the lower section of the streams ST9 and SL3. Shrimps belonging to the genus *Metapenaeus* are commercially important and were extensively cultured in the *Gei Wai* of Mai Po in the past. They are common in mangrove and estuarine areas in Hong Kong (Leung 1999, Vance 1999). Due to over-exploitation, all four *Metapenaeus* species found in Hong Kong (including *M. ensis*) are considered to be Vulnerable in China (CSIS 2008). Shallow estuarine areas in Hong Kong have the potential to provide nursery habitats for these species.

Insects

4.10.11 Only two common insect species (Backswimmer *Enithares* sp. and the nymph of Green Skimmer *Orthetrum sabina*) were recorded in any of the streams.

4.11 Habitats and vegetation

4.11.1 Habitats within the Study Area were identified and mapped based on the recent aerial photographs and detailed ground-truthing survey. The aerial photographs aid in mapping the hilly terrestrial habitats that are inaccessible during the ground-truthing survey. Botanical survey of this verification study was conducted on 19th, 22nd September, 22nd October 2008 and 15th January 2009. Due to the potential impacts/disturbances on the seagrass bed located at San Tau SSSI, two additional surveys were carried out during low tides on 22nd October 2008 and 15th January 2009 to verify the current status and extent of the seagrass beds. Due to the limited survey period and the inaccessibility of most hilly terrestrial habitats, the survey was only conducted along the accessible footpath within the Study Area.

4.11.2 Fourteen habitat types were identified within the Study Area, shown in the Habitat Map (Appendix 5). Table 7 summarizes the areas of the fourteen habitats present. A total of 308 plant species were identified within the Study Area. Tall shrubland, secondary woodland, shrubby grassland and developed area support higher plant species diversities, with 123, 90, 96 and 111 plant species respectively, than other coastal and riparian habitats.

4.11.3 The terrestrial botanical survey focused on three terrestrial areas, namely Scenic Hill in Chek Lap Kok, North Lantau from San Tau to Sha Lo Wan and San Tau SSSI. All these regions comprise a number of typical habitat types which are dominated by different plant species. A general description of these habitats and their dominant plant species are presented in Section 6.0..

Table 7. *Overview of habitats within study area (excludes open water of the sea and shorelines – see text in section 4.11.4)*

Habitat	Area (ha)	% Cover
Active Dry Agriculture	0.05	0.02
Associated Mangrove	0.80	0.24
Developed Area	225.86	67.47
Grassland	0.40	0.12
Grassland/ Shrubland	15.22	4.55
Mangrove	0.14	0.04
Plantation	15.37	4.59
Mudflat	0.14	0.04
Seasonally Wet Grassland	0.64	0.19
Secondary Woodland	17.73	5.30
Shrubland	10.50	3.14
Stream	1.35	0.40
Tall Shrubland	42.70	12.76
Young Woodland	3.84	1.15
Total	**334.74**	**100.00**

4.11.4 Intertidal and marine habitats occupy a significant section of the current Study Area, with a total length of coastline of 12.71 km on Lantau and the Airport Island. Whilst difficult to quantify total areas due to the dynamic nature and interaction with the sea and tides, it can be further categorized as natural hard coastline (*c.* 5.527 km), artificial hard coastline (*c.* 4.705 km) and natural soft coastline (*c.* 2.478 km).

Scenic Hill

4.11.5 Scenic Hill is located at the south-eastern part of Chek Lap Kok and comprises five habitat types (grassland, plantation, grassland/shrubland, tall shrubland and secondary woodland). The latter three habitat types are the dominant areas identified and the vegetation of all three habitats are represented by common and widespread species typically found in similar habitats throughout the territory in Hong Kong.

4.11.6 The grassland and plantation habitats contain a composition and structural complexity typical of these habitats throughout the territory. The plantation area is dominated by species commonly found in parks for ornamental and visual greening purposes.

Airport landside area in Chek Lap Kok

4.11.7 All landside areas within the Chek Lap Kok Airport are regarded as developed area. Vegetation in this habitat is heavily managed by the Landscape Team of the Airport Authority so as to ensure that the plants do not attract large flocks of birds which may cause high risk of bird strike.

North Lantau from San Tau to Sha Lo Wan (Terrestrial)

4.11.8 This surveyed region contained a higher number of habitat types, ranging from human-dominated agricultural land and developed area to semi-natural habitats such as seasonally wet grassland, shrubland, tall shrubland, young woodland and secondary woodland. Apart from the human-dominated habitats which are similar to similar habitats throughout Hong Kong, these habitats (described further in Section 6.0) display higher floristic diversities and structural complexities.

Botanical Species of Conservation Interest

4.11.9 Eight species of conservation importance, either restricted range species or protected species, are discussed and their locations were marked on the habitat map.

4.11.10 Low numbers (3-5 individuals) of the tree *Pavetta hongkongensis* were identified in tall shrubland close to Hau Hok Wan. This species is protected under the Forestry Regulations (Cap. 96A) but it is a common tree species found in tall shrubland and young woodland in Hong Kong (Xing *et al.* 2000).

4.11.11 The insectivorous herb *Drosera indica* was identified on the rock surface of a stream at Hau Hok Wan. Approximately 40 individuals of *D. indica* were identified in both dry and wet season surveys. This herbaceous plant is identified as a very rare plant only found in Tung Chung (Xing *et al*. 2000) but receives no protection by law in Hong Kong (South China Institute of Botany & AFCD 2003). It has been listed as “Least Concern” in China.

4.11.12 Around six individuals of orchid *Eulophia graminea* were identified within the stone crevices along a stream at Hau Hok Wan. The orchids were flowering during the botanical survey conducted in September 2008 but the specimens disappeared during the following survey conducted in October 2008. This orchid species is a restricted terrestrial herb found in the grassland and highly disturbed areas (Siu 2000, Xing *et al.* 2000). However, the rapid disappearance of the *E. graminea* specimens within the survey period implies the high disturbance impacts and illegal collection by people. All wild native orchid species are protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and the Forestry Regulations (Cap. 96A) in Hong Kong. It is also classified as a restricted species by Siu (2000).

4.11.13 Several tree specimens and seedlings of *Aquilaria sinensis* were identified along the footpath near the tall shrubland from Hau Hok Wan to Sha Lo Wan and within the secondary woodland of the Scenic Hill in Chek Lap Kok Island. Due to potential threats of habitat destruction and over-exploitation in China, this tree species is regarded as “Near Threatened” in the China Plant Red Data Book and the Illustrations of Rare & Endangered Plants in Guangdong Province. It is listed as a Category II nationally protected species in China (South China Institute of Botany & AFCD 2003). This species is, however, common in lowland forest and *Feng Shui* woodlands (Xing *et al.* 2000) and currently is protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).

4.11.14 Numerous individuals of tree *Thespesia populnea* were identified along the coastal and associated mangrove habitats of the Study Area. This is a tree species restricted to coastal habitats (Xing *et al.* 2000) and is regarded as a rare associate mangrove species (present in only nine of 43 mangrove stands) in a terrestrial-wide mangrove study by Tam *et al.* (1997). However, *T. populnea* has no protection by law in Hong Kong.

4.11.15 An individual of shrub/small tree *Drosera viscosa* was recorded near the tall shrubland close to the coastline at Sha Lo Wan. This is regarded as a rare species only found in Ham Tin and Tung Chung (Xing *et al.* 2000), but it is not protected by law in Hong Kong.

Seagrass

4.11.16 Two seagrass species, *Halophila minor* (identification based on the taxonomic key in Yip & Lai (2006)) and *Zostera japonica* were recorded along the mangrove fringe within the San Tau SSSI. Small patches of seagrass *Z. japonica* were recorded in both seagrass surveys conducted in October 2008 and January 2009. Approximately seven patches of *Z. japonica* were identified, with sizes ranging from 0.1 m^2 to 16 m^2; the number of patches and patch sizes increased during the survey period. Three small patches of *Halophila minor*, with sizes of 0.2 m^2 to 1.5 m^2, were identified in surveys conducted in January 2009; all were found in association with the *Z. japonica* patches. Both seagrasses are rare species with restricted locations in San Tau and Tung Chung (Xing *et al.* 2000). The seagrass bed at San Tau mudflat and mangrove stands is regarded to be of high conservation value and its locality is designated as San Tau SSSI for better protection by law (South China Institute of Botany & AFCD 2003). In addition, all established seagrass beds are considered to be an importance habitat under the Environmental Impact Assessment Ordinances and any potential developmental disturbances and/or impacts should be avoided or minimized (Kwok *et al.* 2005).

4.11.17 Despite being recorded during the Previous Study (HyD 2004), no *Halophila ovalis* (reported as *Halophila ovata* in HyD (2004)) was identified on the mudflat and intertidal area at San Tau SSSI during the botanical survey conducted in low tide. This corresponds to a massive disappearance of seagrass bed after heavy rainfall in May 2008 (Fong pers. com. in RTHK TV Programme aired on 14th Feb 2009). Additionally, the same Programme indicated that further investigations into the substratum of the mudflat, revealed that the mud was black in colour (indicating a lack of oxygen) and degraded seagrass was also observed possibly due to increased sedimentation in substratum after the heavy rainfall. These factors may restrict the development of seagrass bed. Finally the Programme also mentioned that the growth of the seagrass bed is very variable (e.g. ~ 10,000 m^2 was recorded in 2003, but had completely disappeared in 2005), depending on the natural environments and human disturbance.

5.0 Current Ecological Profile – Species of Conservation Interest

5.1 Details of the species of Conservation Interest identified from both studies (HyD 2004 and the Current Study) and literature review where relevant are listed below in Table 8. This Table relates to species recorded within the Current Study Area. The findings of the Previous Study have been reviewed in light of the findings of the Current Study. As can be seen from Table 8 results of the two studies largely correspond and there were no new significant findings from the Current Study. As such it is concluded that the ecological baseline information produced from the Previous Study remain valid.

Table 8. *Flora and Fauna Species of Conservation Interest recorded within the Study Area during the Previous Study (HyD 2004) and the current wet and dry season surveys*

Species/Group	Species of Conservation Interest (Fellowes *et al.* 2002)	Protection/ China Red Data Book	Locations/ Habitats Recorded in Study Area	Study species recorded from	Rarity/HK Status
Marine Mammals					
Indo-pacific Humpback Dolphin *Sousa chinensis*	-	WAPO, AP, UN Biodiversity treaty	Mostly in waters north and west of Lantau, Seasonally in waters south and east of Lantau	Previous Study (literature review)	Approximately 100 individuals inhabiting northwestern waters of Hong Kong (Jefferson 2000)
Mammals					
Red Muntjac *Muntiacus muntjac*	PRC	WAPO	Scrubland, Streams	Both Studies	Widespread (Shek 2004)
Birds (all birds protected under WAPO)					(as of Carey *et al.* 2001)
Little Grebe *Tachybaptus ruficollis*	LC	-	Open water	Previous Study	Locally common
Grey Heron *Ardea cinerea* w	PRC	-	Soft Shore; Hard shore	Current Study	Abundant winter visitor
Great Egret *Egretta alba* w	PRC (RC)	-	Soft Shore; Hard shore	Current Study	Common to abundant resident
Little Egret *Egretta garzetta* w	PRC (RC)	-	Soft Shore; Hard shore	Current Study	Abundant resident
Pacific Reef Egret *Egretta sacra* w	(LC)	Class II Protected* Rare***	Hard Shore	Current Study	Locally uncommon resident
Cattle Egret *Bubulcus ibis*	(LC)	-	Soft Shore	Previous Study	Uncommon to common resident
Chinese Pond Heron *Ardeola bacchus*	(LC)	-	Hard Shore	Previous Study	Common resident
Striated Heron *Butorides striatus* w	(LC)	-	Intertidal Streams	Both Studies	Uncommon in summer, scare in winter
Black-crowned Night Heron *Nycticorax nycticorax* w	(LC)	-	Intertidal Streams	Both Studies	Common to abundant resident
Black Kite *Milvus migrans*	(RC)	Class II Protected*	Overhead	Both Studies	Abundant winter visitor and resident
Peregrine Falcon *Falco peregrinus*	LC	-	Overhead	Previous Study	Scare resident and winter visitor
Black-winged Stilt *Himantopus himantopus*	RC	-	Soft Shore	Previous Study	Common to uncommon winter visitor
Little Ringed Plover *Charadrius dubius* w	(LC)	-	Soft Shore	Current Study	Locally common winter visitor, scarce breeding.
Whimbrel *Numenius phaeopus* w	LC	-	Soft Shore	Current Study	Common passage migrant
Grey-tailed Tattler *Heteroscelus brevipes* w	LC	-	Soft Shore	Current Study	Passage migrant
Eurasian	LC	-	Secondary	Previous	Scare winter

Species/Group	Species of Conservation Interest (Fellowes *et al.* 2002)	Protection/ China Red Data Book	Locations/ Habitats Recorded in Study Area	Study species recorded from	Rarity/HK Status
Woodcock *Scolopax rusticola*			Woodland	Study	visitor
Collared Scops Owl *Otus bakkamoena*	-	Class II Protected*	Tall Shrubland	Current Study	Common and widespread resident
Pacific Swift *Apus pacificus*	(LC)	-	Overhead	Previous Study	Common spring migrant, localized summer visitor, scarce and irregular in autumn and winter
White-throated Kingfisher *Halcyon smyrnensis*	(LC)	-	Soft Shore, Hard Shore	Previous Study	Resident, locally common in autumn and winter
Emerald Dove *Chalcophaps indica*	-	Near Threatened**; Vulnerable***	Tall Shrubland	Current Study	Scarce but widespread resident
Hwamei *Garrulax canorus*	-	Near Threatened**	Shrubland	Current Study	Common and widespread resident
Blyth's Leaf Warbler *Phylloscopus reguloides*	LC	-	Shrubland	Current Study	Scarce winter visitor
Common Rosefinch *Carpodacus erythrinus*	LC	-	Village/farml and	Current Study	Rare winter visitor
Red-billed Starling *Sturnus sericeus*	GC	-	Coastal habitat, secondary woodland	Both Studies	Abundant but localized winter visitor
White-shouldered Starling *Sturnus sinensis*	(LC)	-	Village/farml and	Both Studies	Common passage migrant, scare and localized breeding summer visitor and winter visitor
Black-naped Oriole *Oriolus chinensis*	LC	-	Plantation	Current Study	Scarce autumn migrant and irregular breeder
Reptiles					
Tokay Gecko *Gekko gecko*	RC	-	San Tau Village	Previous Study	Rare (Karsen *et al.* 1998)
Amphibians					
Chinese Bullfrog *Hoplobatrachus chinensis*	PRC	IUCN Least Concern Class II Protected*	Scenic Hill – concrete drainage system	Current Study	Fairly common and widespread in NT and Lantau (Chan *et al.* 2005)
Lesser Spiny Frog *Paa exilispinosa*	GC	IUCN Vulnerable	Streams	Both Studies	Common & Widespread in protected areas (Chan *et al.* 2005).
Romer's Tree Frog *Philautus romeri*	PGC	IUCN Endangered	Literature review and	Not recorded during either	Endemic to Hong Kong.

Species/Group	Species of Conservation Interest (Fellowes *et al.* 2002)	Protection/ China Red Data Book	Locations/ Habitats Recorded in Study Area	Study species recorded from	Rarity/HK Status
			AFCD (Pers. comm.)	Study	Locally Common in protected areas (Chan *et al.* 2005)
Fish					
Beijiang Thick-lipped Barb *Acrossocheilus beijiangensis*	GC	-	Stream (ST9)	Current Study	Rare (Lee *et al.* 2004)
Indo-Pacific Tropical Sand Goby *Favonigobius reichei*	-	IUCN Lower Risk/Near Threatened	Stream (ST9, HH5, SL3)	Current Study	Common and widespread (Lee *et al.* 2004, Nip 2005)
Dark-margined Flagtail *Kuhlia marginata*	RC	-	Stream (ST9)	Current Study	Status unknown (Lee *et al.* 2004)
Rice Fish *Oryzias curvinotus*	GC	-	Stream (ST9, HH3, HH5)	Current Study	Uncommon (Lee *et al.* 2004)
Predaceous Chub *Parazacco spilurus*	-	Vulnerable***	Stream (ST9, SL3)	Current Study	Common and widespread (Lee *et al.* 2004)
Snowy Puffer *Takifugu niphobles*	-	IUCN "Data Deficient"	Soft Shore (ST)	Current Study	Considered to be common in Hong Kong (AFCD 2008).
Takifugu ocellatus	LC	-	Stream (ST9)	Previous Study	-
Butterflies					
White Dragontail *Lamproptera curius*	LC	-	Stream At San Tau (ST9)	Current Study	Limited Distribution (Lo 2005)
Common Albatross *Appias albina*	LC	-	Cultivated field at San Tau	Previous Study	Rare (Lo 2005)
Danaid Eggfly *Hypolimnas misippus*	LC	-	Shrubland at Scenic Hill	Previous Study	Uncommon (Lo 2005)
Crustaceans					
Sesarmine Crab *Chiromantes sereni*	-	-	Stream (HH3, SL3)	Current Study	Endemic. Only known from four sites(Kwok & Tang 2005)
Greasyback Shrimp *Metapenaeus ensis*	-	Vulnerable***	Stream (ST9, SL3)	Current Study	Found on sandy-mud or muddy bottoms. Major species cultivated at Mai Po Marshes Nature Reserve (AFCD 2004)
Freshwater Crab *Somanniathelphusa zanklon*	-	IUCN Endangered	Stream (SL12)	Current Study	Locally abundant in Lantau (DSD 2002, EPD 2007),
Horseshoe Crabs					
Tachypleus tridentatus	-	Vulnerable***	San Tau, Hau Hok Wan	Both Studies	Declining in range due to water pollution/ loss of nursery grounds (Morton

Species/Group	Species of Conservation Interest (Fellowes *et al.* 2002)	Protection/ China Red Data Book	Locations/ Habitats Recorded in Study Area	Study species recorded from	Rarity/HK Status
					& Lee 2003)
Carcinoscorpius rotundicauda	-	Vulnerable***	San Tau, Hau Hok Wan	Previous Study	Declining in range due to water pollution/ loss of nursery grounds (Morton & Lee 2003)
Coral					
Balanophyllia sp.,	-	AP	Sham Wat to San Shek Wan (2004); east of Chek Lap Kok (HyD 2004); DS1 and DS2 (Current Study)	Both Studies	Common in Hong Kong Waters (AFCD 2004)
Seagrass					
Dwarf Eel Grass *Zostera japonica*	-	-	San Tau SSSI	Both Studies	Locally Rare (Hu *et al.* 2003)
Halophila minor	-	-	San Tau SSSI	Current Study	Not previously recorded at San Tau. Locally Rare (Xing *et al.* 2000, South China Institute of Botany & AFCD 2003)
Oval Halophila *Halophila ovalis* (reported as *Halophila ovata* in HyD (2004))	-	-	San Tau SSSI	Previous Study	Rare (Xing *et al.* 2000)
Terrestrial Plants					
Hong Kong Pavetta *Pavetta hongkongensis*	-	Cap. 96	Tall Shrubland	Both Studies	Common (Xing *et al.* 2000)
Indian Sundew *Drosera indica*	-	-	Stream (HHW)	Both Studies	Rare (Xing *et al.* 2000)
Pale Purple Eulophia *Eulophia graminea*	-	Cap. 586; Cap. 96	Stone crevices in Stream (HHW	Both Studies	Restricted (Siu 2000)
Incense Tree *Aquilaria sinensis*	-	Cap. 586; Cap. 96;Near Threatened**; Class II Protected*	Tall Shrubland, Secondary woodland	Both Studies	Common (Xing *et al.* 2000)
Portia Tree *Thespesia populnea*	-	-	Coastline, Mangrove associate.	Both Studies	Limited range; coastal areas (Xing *et al.* 2000)
Clammy Hop Seed *Dodonaea viscosa*	-	-	Coastal habitat (SLW)	Both Studies	Rare (Xing *et al.* 2000)
Carex tristachya	-	-	Tall Shrubland (HHW)	Previous Study	Very rare (Xing *et al.* 2000)
Bamboo Orchid *Arundina graminifolia*	,	Cap. 586; Cap. 96	Shrubby grassland	Previous Study	Very Common (Siu 2000); Common (AFCD

Species/Group	Species of Conservation Interest (Fellowes *et al.* 2002)	Protection/ China Red Data Book	Locations/ Habitats Recorded in Study Area	Study species recorded from	Rarity/HK Status
					2001)

*CSIS 2008; **www.sepa.giv.cn 2008; ***Zeng & Wang 1998.
w= denotes wetland dependent bird species
PRC= Potential Regional Concern; RC=Regional Concern; LC = Local Concern, as of Fellowes *et al.* (2002). Those in parenthesis indicate that the assessment is on the basis of restrictedness in breeding and/or roosting rather than general occurrence.
WAPO = Wild Animals Protection Ordinance; AP = Animals and Plants (Protection of Endangered Species) Ordinance;

5.2 A total of 34 terrestrial and freshwater faunal species of conservation interest or restricted range have been recorded within the Study Area during literature review , surveys between September 2003 and January 2004 and/or from the Current Study. These include one species of mammal (Red Muntjac), 26 species of bird (listed in Table 8, one species of reptile (Tokay Gecko), three species of amphibian (Chinese Bullfrog, Lesser Spiny frog and Romer's Tree Frog) and three species of butterfly (White Dragontail, Common Albatross and Danaid Eggfly).

5.3 Eleven floral species of conservation interest have been identified through both studies (both terrestrial plants and seagrasses). Eight species identified in this current study were also found in the Previous Study (HyD 2004), while the sedge *Carex tristachya* and orchid *Arundina chinensis* were not recorded in the Current Study, possibly due to the difference in survey areas between both surveys. However, as these two species were recorded in tall shrubland and shrubby grassland in the Previous Study, the proposed development would not cause direct impact on these species.

5.4 Five marine species of conservation interest or have been highlighted through surveys and literature review within the Study Area. These include the Indo-Pacific Humpback Dolphin, the Snowy Puffer, two species of Horseshoe crab *(Tachypleus tridentatus* and *Carcinoscorpius rotundicauda)* and the hard coral *Balanophyllia* sp.

5.5 Nine stream species of conservation interest have been identified within the lower sections of the streams within the Study Area, including six fish species (Beijiang Thick-lipped Barb, Indo-Pacific Tropical Sand Goby, Dark-margined Flagtail, Rice Fish, Predaceous Chub and *Takifugu ocellatu)* and three crustaceans (*Chiromantes serene, Metapenaeus ensis and Somanniathelphusa zanklon*).

5.6 Table 9 attributes the number of species recorded during the current study to particular habitat types.

Table 9. *Number of terrestrial faunal species recorded in different habitat types within the Study Area (Sept 2008-Jan 2009)*

	Soft Shore	Hard Shore	Grassland /Shrubland	Tall Shrubland	Developed Land/Village	Plantation	Young and secondary Woodland	Agricultural land	Mangrove and associated mangrove	Stream
Mammal	1 (1)	-	-	1	-	-	-	-	-	1(1)
Bird	9 (8)	7 (4)		17 (4)	14 (2)	12 (1)	9	7	-	3
Reptile	-	-	-	2	2	-	2	-	-	1
Amphibian	-	-	-	2	2 (1)	-	-	-	-	2 (1)
Dragonfly	-	-	-	5	1	-	1	2	-	5
Butterfly	2	1	3	32	16	6	24	6	4	3 (1)
Flora	2	0	96	123	111	67	90	10	20	50
Total number of fauna species	12	8	3	59	35	18	36	15	4	15
Fauna of Conservation Interest	9	4	0	4	3	1	0	0	0	3
Flora of Conservation Interest	2	0	0	3	0	0	1	0	1	2

Nb. Numbers in parenthesis indicate number of species of conservation interest

5.7 From the details shown in Table 9, tall shrubland habitats contain the greatest number of species recorded, of both flora and fauna, within the Study Area during the current study. Soft shores and streams are also shown to be important habitat types within the Study Area; whilst the total number of terrestrial species are low, a high proportion of these are of conservation interest.

5.8 It must be noted that this table only includes terrestrial species and that the soft shore and stream habitats also provide suitable habitats, breeding, foraging and nursery for several fish and crustacean species which are listed in Table 8 as being of conservation importance.

6.0 Current Ecological Profile - Habitat Quality

Marine Habitats

6.1 Soft bottom benthic habitat

6.1.1 The marine benthic habitats present in north-western waters of Hong Kong are generally characterized by soft-bottom material composed of silts and clay (HyD 2004).

6.2 Marine hard subtidal substrate

6.2.1 The subtidal dive surveys identified the presence of a low abundance of sessile organisms (e.g. rock oysters, mussels and barnacles) at each of the seven Dive Sites, with subtidal substrates a mixture of natural and artificial habitats. One hard coral species *Balanophyllia* sp. and the octocoral *Echinomuricea* sp. were present in the Study Area, in limited numbers at sites outside of the Airport Island Channel.

6.3 Shoreline

6.3.1 Intertidal mudflats larger than one hectare and natural coastal shores longer than 500m are considered as important in Hong Kong. Of the 12.71 km of coastline within the Study Area, approximately 8km is considered to be natural (both hard and soft shores).

Soft shores

6.3.2 A total of approximately 2.48km of shoreline was considered to be soft shore. These sandy beaches and mudflats are often buffered by mangrove and their associates and provide nursery habitats for Horseshoe Crabs and many fishes and invertebrate species, and the mudflats at Tung Chung Bay/San Tau are known to support seagrass beds. The Current Study (HyD 2004) found more than 50 Horseshoe Crab individuals, consisting of two species (*Carcinoscorpius rotundicauda* and *T. tridentatus*) at Tung Chung Bay, San Tau, Hau Hok Wan and Sham Wan. Findings in 2003-04, from this study and from AFCD (*pers. comm.*) have revealed Horseshoe Crabs at Sham Wat, San Tau and Tung Chung Bay, indicating that these areas are still favourable habitat for this species

6.3.3 Local people from Tung Chung were frequently observed collecting clams at Tung Chung Bay and San Tau during the whole survey period; this process can be considered to be very destructive to seagrass beds (Huang *et al.* 2006).

Hard Shores

6.3.5 The intertidal rocky shores surveyed in the Current Study are not considered to be of particular conservation concern. The coastline of Hong Kong is rich in rocky shore habitats (Williams 2003, Lai *et al*. 2006), which are commoner than mangrove, sandy beach and mudflat coastal habitats in Hong Kong. Although at present a large portion of the rocky coastline has been transformed into artificial hard-bottom area (i.e. sea wall), a comparatively uniform habitat which would be less diverse than natural shores, most typical species inhabiting natural rocky shore would readily colonize artificial hard-bottom embankment (Morton and Morton 1983). Thus, natural rocky shore habitats are considered to be re-creatable in general.

6.4 Mangrove and Associates and Seagrass

6.4.1 Mangrove was identified within the San Tau SSSI, while two patches of associated mangrove were found along the coastlines of Tin Sam (just to the north of San Tau) and Hau Hok Wan. The mangrove habitat is dominated by a number of mangrove species, especially *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Kandelia obovata* and *Acanthus ilicifolius*. The associated mangrove habitats are dominated by herb *Limonium sinense*, shrubs *Clerodendrum inerme*, *Suaeda australis*, *Scaevola sericea* and *Pandanus tectorius* and trees *Cerbera manghas*, *Hibiscus tiliaceus* and *Thespesia populnea*.

6.5 Streams

6.5.1 Several of the streams in the Study Area are highly seasonal, and of the ten surveyed, three were dry throughout the study period. Streams are particularly important nursery habitats for a number of fish and invertebrate species.

6.6 Seasonally Wet Grassland

6.6.1 Two small seasonally wet grasslands are located close to Sha Lo Wan Chung Hau and Kau Liu. These were formerly agricultural land which has been abandoned for many years and has been progressively invaded with herbaceous vegetation, including creeping herbs *Commelina diffusa*, *Ipomoea cairica* and *Mikania micrantha*, and herbs *Polygonum chinensis*, *Alocasia odora*, *Colocasia esculenta* and *Coix lacryma-jobi*. Parts of the habitat were overgrown with aggressive climbers such as *Mikania micrantha* and *Rourea microphylla*. Isolated fruit trees such as *Artocarpus macrocarpus* and *Psidium guajava* were recorded around and within the seasonally wet grassland.

6.7 Grassland

6.7.1 Only one very small grassland patch is located close to the Scenic Hill. This grassland patch is a semi-natural habitat developed with low species diversity, including exotic herbs *Bidens alba*, *Conya canadensis* and grasses *Neyraudia reynaudiana* and *Panicum maximum*. This habitat is very common throughout the territory.

6.8 Woodland

Young Woodland

6.8.1 Several patches of young woodland and secondary woodland were identified close to Sha Lo Wan and Hau Hok Wan. Under natural succession, this young woodland has evolved from tall shrubland by developing a denser and more complex canopy coverage and structure. The young woodland is dominated by the trees *Sterculia lanceolata*, *Microcos paniculata*, *Ardisia quinquegona*, *Myrsine seguinii*, *Schefflera heptaphylla* and *Garcinia oblongifolia*, with the understorey containing shrubs such as *Psychotria asiatica*, *Desmos chinensis*, *Ardisia crenata*, *Ilex asprella*, *Ilex pubescens* and seedlings of tree species including *Daphniphyllum calycinum*, *Archidendron clypearia* and *Archidendron lucidum*.

Secondary Woodland

6.8.2 Secondary woodland is a more mature woodland which supports higher floristic diversity and abundance than young woodland. This woodland type is typically developed from plantations which were planted after 1945. The current botanical survey recorded a similar tree composition to that identified in the young woodland, but with trees which form a more complete canopy coverage and are taller in overstorey height. The secondary woodland mainly contains the trees *Pinus massoniana*, *Acronychia pedunculata*, *Celtis sinensis*, *Microcos paniculata* and *Litsea glutinosa* as the overstorey. Its understorey composition and diversity are similar to those of young woodland.

Scenic Hill Woodland

6.8.3 The secondary woodland is typical of other woodlands in Hong Kong. It is dominated by *Sterculia lanceolata*, *Schefflera heptaphylla*, *Celtis sinensis*, *Tetradium glabrifolium* and *Microcos paniculata* as the overstorey (8 – 10 m high). Its understorey is dominated by common and widespread shade-tolerant species including shrubs and small tree species such as *Psychotria asiatica*, *Litsea rotundifolia* var. *oblongifolia*, *Melicope pteleifolia*, *Sarcandra glabra*, *Bredelia tomentosa*, *Zanthoxylum avicennae* and *Uvaria macrophylla*. Seedlings of the trees *Archidendron clypearia* and *Aquilaria sinensis* were found occasionally in the understorey.

6.9 Plantation

6.9.1 Plantation areas are located close to the villages at Tin Sam, Kau Liu and Sha Lo Wan. These areas are either dominated by a mix of cultivated fruit trees and native shrub and tree species or are planted with common roadside plantation species. The plantation identified at Tin Sam and Kau Liu is dominated by common fruit tree species including *Dimocarpus longan*, *Litchi chinensis*, *Artocarpus macrocarpus* and *Mangifera indica* and mix of *Cinnamomum camphora*, *Celtis sinensis*, *Ficus microcarpa* and *Microcos paniculata* as the overstorey. The plantation located along the bay of Sha Lo Wan is mainly planted with tree species *Acacia confusa*, *Hibiscus tiliaceus*, *Delonix regia* and *Sapium sebiferum* as the overstorey, while the area close to the developed area is dominated by several clumps of *Bambusa* spp. and small tree/tree species such as *Sterculia lanceolata*, *Aporusa dioica*, *Microcos paniculata*, *Mallotus paniculatus*, *Bridelia tomentosa* and *Syzygium jambos*.

6.10 Shrubland

Grassland/Shrubland

6.10.1 The grassland/shrubland habitat is typically dominated by grasses *Panicum maximum*, *Imperata koenigii*, *Ischaemum* spp., *Rhynchelytrum repens* and *Neyraudia reynaudiana*, herbs *Bidens alba*, *Eupatorium catarium*, *Mimosa pudica*, *Aster baccharoides*, *Inula cappa*, isolated shrubs *Melastoma candidum*, *Rhaphiolepis indica*, *Rhodomyrtus tomentosa*, *Ilex asprella*, *Osbeckia chinensis*, *Clerodendrum fortunatum*, *Baeckea frutescens*, *Breynia fruticosa* and *Eurya chinensis* and trees *Zanthoxylum avicennae*, *Litsea rotundifolia* var. *oblongifolia*, *Schefflera heptaphylla*, *Aporusa dioica*, *Ficus hirta*, *Ficus variolosa* and *Itea chinensis*. The shrubby coverage of this habitat is generally high, implying that this grassland/shrubland mosaic has undergone some succession to habitat of higher floristic diversity and richness. In time, this habitat would undergo further succession into tall shrubland dominated by taller shrubs and higher number of tree species. The floristic composition and structure of the tall shrubland habitat is similar to that of grassland/shrubland, but with greater canopy height and higher density of shrubs and trees.

Shrubland

6.10.2 The shrubland identified in the Study Area is typical of the habitat in Hong Kong and is dominated by common and widespread shrubby species and isolated tree species. This habitat type supports higher floristic diversity than the grassland and the identified shrubland is largely dominated by climbers such as *Smilax glabra*, *Embelia laeta*, *Embelia ribes*, *Strychnos umbellate*, *Millettia nitida* and *Zanthoxylum nitidum*, shrubs such as *Ilex asprella*, *Melastoma candidum*, *Melastoma sanguineum*, *Diospyros vaccinioides*, *Rhaphiolepis indica*, *Rhodomyrtus tomentosa*, *Baeckea frutescens*, *Breynia fruticosa*, *Helicteres angustifolia* and *Severinia buxifolia* and small trees such as *Alangium chinense*, *Phyllanthus emblica*, *Rhus chinensis*, *Rhus succedanea*, *Aporusa dioica* and *Cratoxylum cochinchinense*. With time, this habitat would develop into tall shrubland due to its close proximity to suitable seed sources. Plant species recorded in the shrubland habitat are presented together with grassland/shrubland habitat in Appendix 5.

Tall shrubland

6.10.3 Tall shrubland is the dominant habitat type along the surveyed North Lantau coast. It supports a higher floristic diversity and complexity than the shrubland, with dense populations of a mixture of native woody climber, shrubs and trees species, including two tree species (*Pavetta hongkongensis* and *Aquilaria sinensis*) protected under the Forestry Regulation Cap. 96. In addition to the shrub species found in the shrubland, tall shrubland contains a higher diversity of taller small tree species, including *Acronychia pedunculata*, *Cratoxylum cochinchinense*, *Schefflera heptaphylla*, *Mallotus paniculatus*, *Cerbera manghas*, *Celtis sinensis*, *Sapium discolor*, *Symplocos glauca*, *Gmelina chinensis* and *Scolopia saeva*. The understorey of the tall shrubland is dominated by wide range of species including climbers *Bauhinia championii*, *Rubus reflexus*, *Rourea microphylla*, *Strophanthus divaricatus* and *Alyxia sinensis*, and shrubs and trees species *Psychotria asiatica*, *Glochidion eriocarpum*, *Breynia fruticosa*, *Ardisia crenata*, *Archidendron clypearia* and *Antirhea chinensis*. Low numbers of the two protected tree species were identified along the hiking trail close to Hau Hok Wan.

6.11 Active Dry Agriculture

6.11.1 Active agriculture was restricted to areas around the villages of San Tau and Sha Lo Wan. A very small area, less than 0.1 ha, was mapped in the Study Area.

6.12 Developed Area

Chek Lap Kok – Airport Island

6.12.1 All landside areas within the Chek Lap Kok Airport are regarded as developed area. Under the regular maintenance and landscape management, the vegetation comprises herbs, shrubs and trees which do not produce fleshy fruits and plants with restricted height to prevent birds roosting. In general, the developed area contains common and widespread ornamental plants (including herbs such as *Wedelia trilobata*, *Panicum maximum*, *Imperata koenigii* and *Rhynchelytrum repens*, shrubs such as *Ixora chinensis*, *Calliandra haematocephala*, *Duranta erecta*, *Nerium oleander*, *Rhododendron* spp., *Bougainvillea glabra*, *Lantana montevidensis* and *Hibiscus rosa-sinensis*, trees such as *Ficus benjamina*, *Ficus microcarpa*, *Casuarina equisetifolia*, *Hibiscus tiliaceus*, *Acacia confusa*, *Melia azedarach*, *Delonix regia* and *Lagerstroemia speciosa* and palms such as *Roystonea regia* and *Phoenix roebelenii*).

Lantau Villages

6.12.2 Other developed areas within the Study Area include San Tau and Sha Lo Wan villages on Lantau. Some vegetation occurs in the low-density village areas, however this is of poor quality and of no particular ecological importance.

7.0 SUMMARY

7.1 The data from the 2003-04 Study was gathered from a larger Study Area over a longer period, incorporating a longer period of wet season surveys, than that of the Current Study. As such, any direct comparison between the species richness between the two studies is impractical. However, the longer wet season survey period for the Previous Study does provide an important ecological baseline, particularly for the vegetation status of the major habitats along northern Lantau which is still considered to be relevant. Given that there has been no notable infrastructural development in the Study Area since the release of Previous Study, the majority of the botanical information and the status of species of conservation interest in the major studied habitats are taken in consideration.

7.2 A result of the larger scale of the Previous Study (in both Study Area and Survey Period) was that several species of conservation interest were recorded that were not observed during the Current Study e.g. Tokay Gecko *Gekko gecko,* Bamboo Orchid *Arundina chinensis* (See Table 8). However it is considered probable that these organisms still occur within the Study Area and the absence of records is more likely to be a combination of survey effort and seasonality. Other groups of conservation importance i.e. Birds, Horseshoe Crabs, Seagrasses, were found in higher numbers and/or greater abundance during the Previous Study, again this is likely to be the result of differences in survey effort and seasonality.

7.4 The Current Study has highlighted a number of additional species of conservation interest to compliment those found in the Previous Study (see Table 8), in particular, surveys have revealed further species of conservation interest at streams and intertidal locations at San Tau, Hau Hok Wan and Sha Lo Wan.

7.5 Overall, it is considered that the results of the Previous Study remain valid and that the combined results of these two studies are adequate for the purposes of impact evaluation.

7.6 Of all the habitats present within the Study Area, the soft shore habitats on the North Lantau coast (Tung Chung Bay, San Tau, Hau Hok Wan, Sha Lo Wan) are of high ecological value, due to the rich diversity of organisms present. Both the Current Study and the Previous Study (HyD 2004) recorded the presence of Horseshoe Crabs (with evidence of these areas also being utilized as nursery habitats by juvenile specimens). In addition, the shorelines are fringed with mangroves and mangrove associates, and two species of seagrass have been recorded at San Tau. The estuarine sections of the streams that enter these bays have been classified as being of Moderate-High ecological value, on account of fish and crustacean species of conservation interest present. These slack waters have potential to be utilized as nursery habitats for several of these species.

7.7 In addition, the secondary woodland at Scenic Hill has been classified as being of high ecological value, on account of the existing population of Romer's Tree Frogs. No evidence of this species, by way of adults, larvae or eggs, was discovered during this survey; largely because the surveys did not commence until late in the wet season when amphibians are less vocal and difficult to survey, particularly when dealing with a very small population. It is recommended that further surveys for this species are conducted in the early wet season 2009 in order to update the status of Romer's Tree Frog in this location.

7.8 It is generally recognized that the terrestrial habitats of North Lantau hold a diverse assemblage of butterfly species. The Current Study revealed 58 species, with the Previous Study recording over 90 species of butterfly (n.b. the Previous Study occupied a larger study area and surveys were conducted over a longer period of time, during more appropriate seasonality timings for observing butterflies on the wing); these results highlight the potential importance of this area for butterflies.

7.9 Both studies have identified the presence of corals along hard shores within the Study Area. It is anticipated that once the exact column locations are determined at the detailed design stage there will be a need to conduct pre-construction dive survey to ensure that no ecological important habitat/species such as corals will be directly impacted.

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APPENDIX 1 – SURVEY LOCATION MAP AND HABITAT MAPS

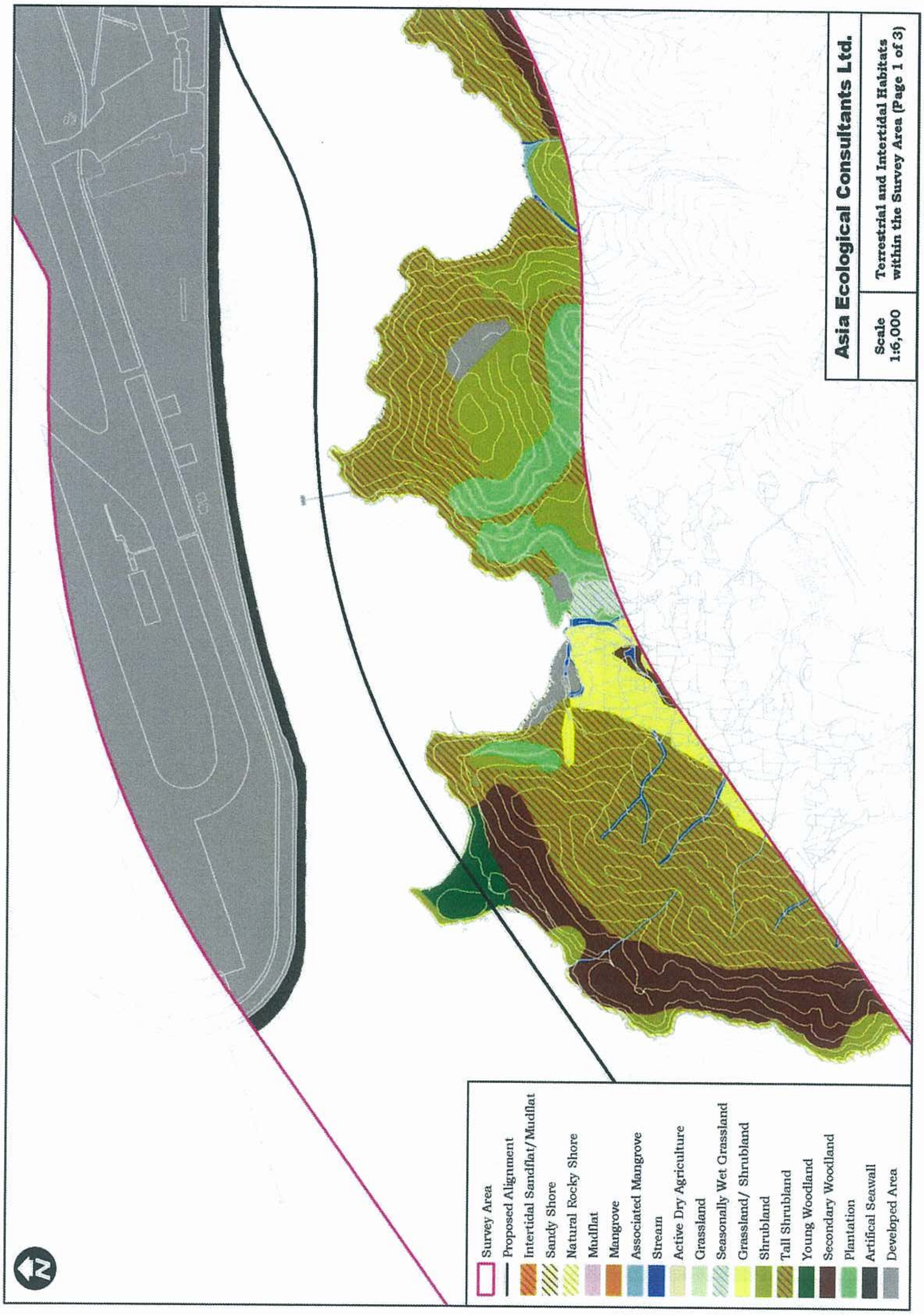


Figure A1.1.1. *Terrestrial and intertidal Habitats within the Survey Area (Page 1 of 3)*

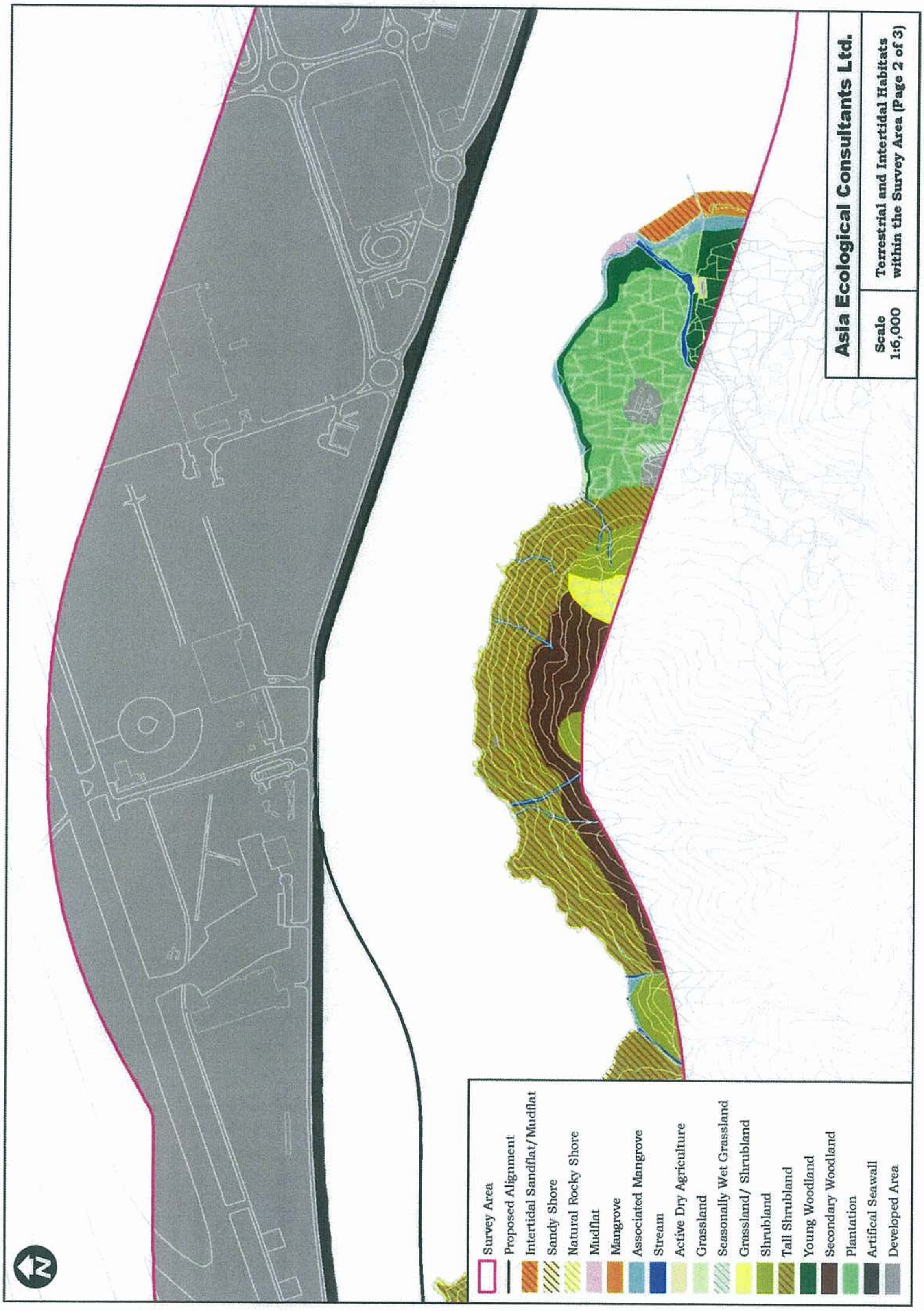


Figure A1.1.2. *Terrestrial and intertidal Habitats within the Survey Area (Page 2 of 3)*

Figure A1.1.3. *Terrestrial and intertidal Habitats within the Survey Area (Page 3 of 3)*

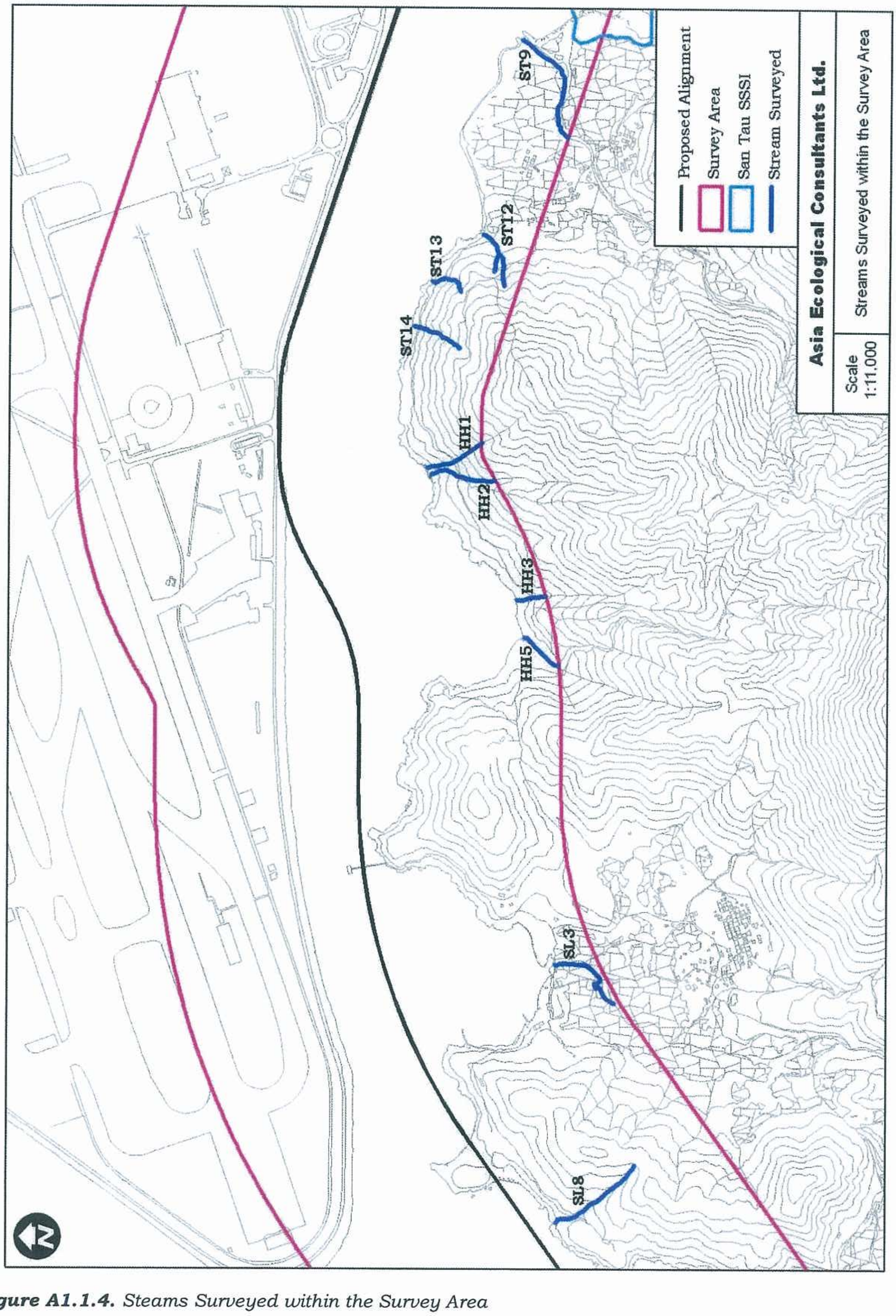


Figure A1.1.4. *Steams Surveyed within the Survey Area*

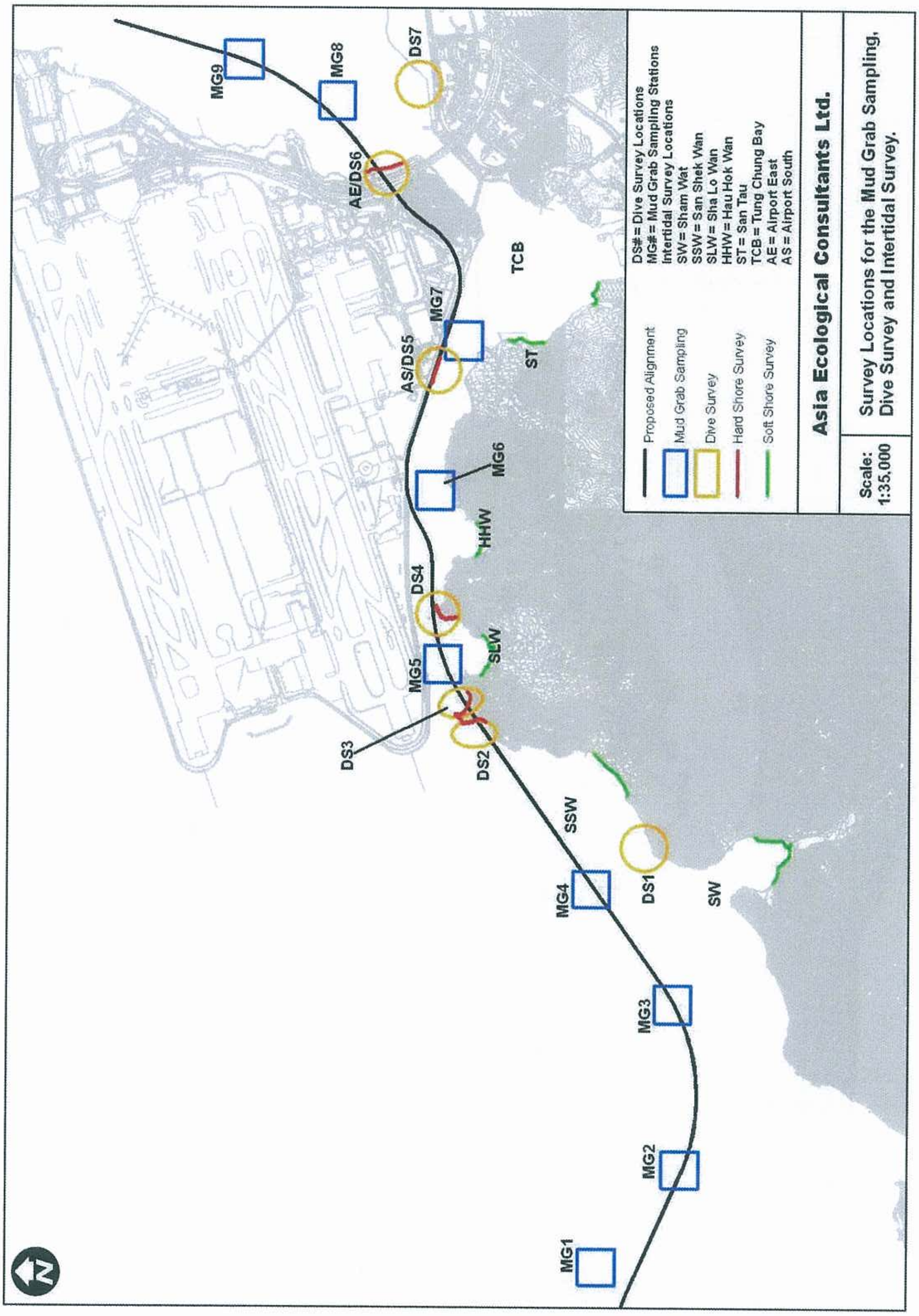


Figure A1.1.5. *Survey locations for the Mud Grab Sampling, Dive Survey and Intertidal Survey*

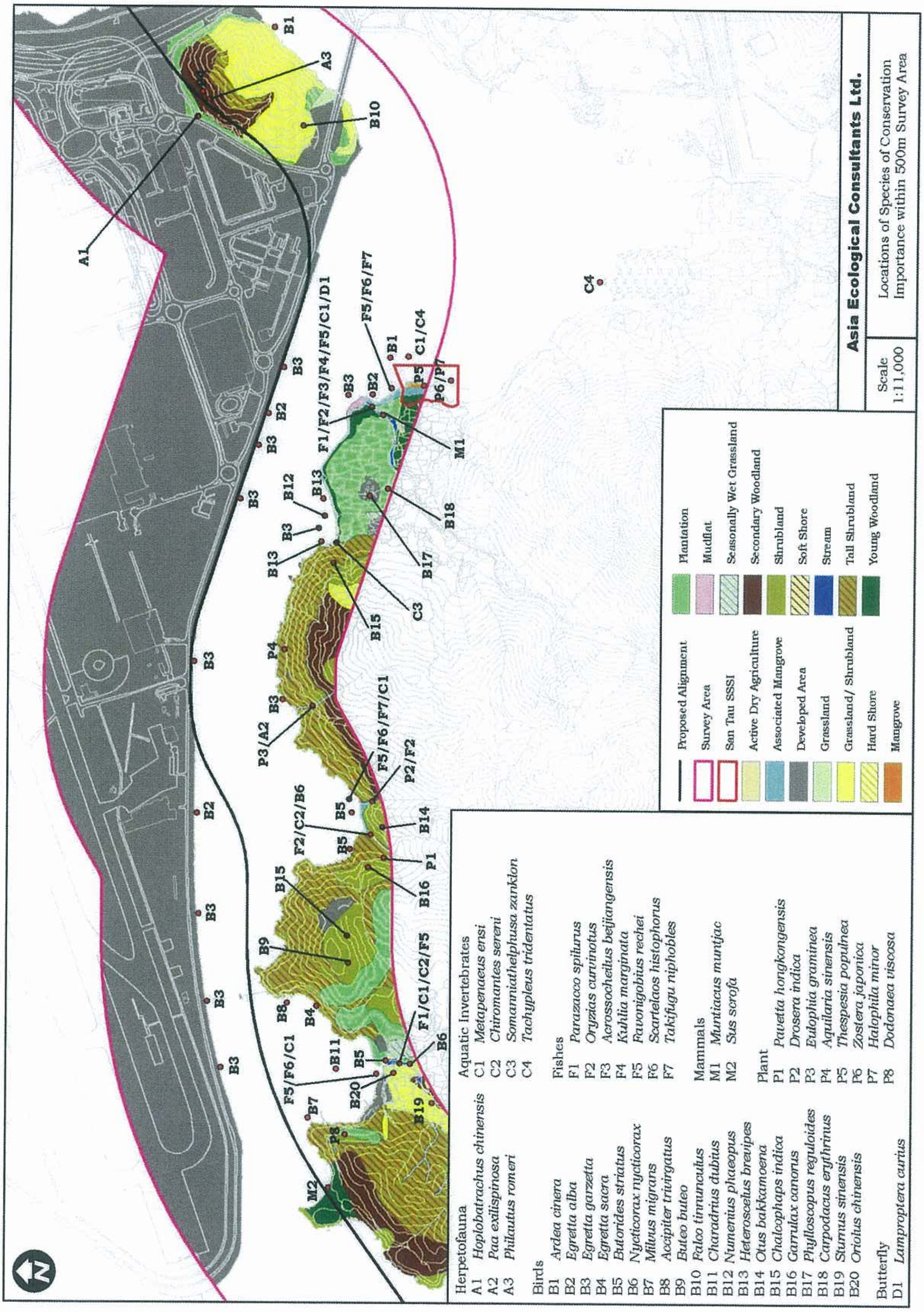


Figure A1.1.6. *Location of Species of Conservation Importance within 500m Survey Area.*

APPENDIX 2 – MARINE GRAB SURVEY RESULTS

Table A2.1. *Summary of the macrofauna families collected in wet season (September) and dry season (December) 2008*

Phylum	Family	Wet Season (September 2008)										Dry Season (December 2008)									
		1	2	3	4	5	6	7	8	9	Total	1	2	3	4	5	6	7	8	9	Total
Annelida	Amphinomidae		1								1										0
	Capitellidae	25	12	26	19	20	3	6	30	21	162	26	27	9	9	2	3	2		1	79
	Chaetopteridae		2								2										0
	Chrysopetalidae										0		1	1							2
	Cirratulidae	4		4	5		1	1	1		16										0
	Cossuridae	1	1		1	2	1	3	2	1	12										0
	Dorvilleidae	1							2	5	8		1								1
	Euphrosinidae	2				2			1	1	6										0
	Flabelligeridae		1		1		2		1	1	6										0
	Glyceridae	1	1	2	1						5	1	1					1			3
	Goniadidae										0		1								1
	Hesionidae			1	2	1			1	2	7										0
	Lumbrineridae	4	3	3	1	4	1		2	1	19	1	2				2				5
	Magelonidae			2							2										0
	Maldanidae	5	5	3	3	4	8		3	2	33	2	6	11	4		5	5	2	2	37
	Nephtyidae			9	5				1		15	8	4	9	4		1		1		27
	Nereididae	1		1		3	1	2		1	9		2							1	3
	Opheliidae			5							5	1	1								2
	Orbiniidae	3									3										0
	Paraonidae					1			1		2										0
	Phyllodocidae									1	1										0
	Pilargiidae	3	1	2	2	1		1	13	5	28		2	12	5			1	1		21
	Poecilochaetidae	2		1				1	1	1	6	1			1						2
	Polygordiidae		1								1										0
	Polynoidae	5	4	5	5		1				20										0
	Spionidae	7	4	12	7	3	4	4	5	3	49	2	1	2			1	5			11
	Sternaspidae	1				1	1				3										0
	Syllidae										0		1								1
	Terebellidae										0				3			1		2	6
Arthropoda	Alpheidae		1			1	1				3							2			2
	Ampeliscidae	1	1	5	4						11			1				1			2
	Bodotriidae	1		3							4		1								1
	Callianassidae		1		1	1					3										0
	Copepod							1			1										0
	Parthenopidae										0		1					5			6
	Penaeidae					1				1	2					1					1
	Pilumnidae	3	1	2			1		1	4	12	1	5	1	2	1		1	1	4	16
	Portunidae										0							1			1
	Squillidae			1							1		1								1
	Stenothoidae		2	3							5										0
	Pinnotherinae	10	12	13	6	1	4		2		48	7	12	6	13			1	1	1	41
Branchiopoda	Lingulidae		1								1										0
Chordata	Bregmacerotidae	1									1										0
	Gobiidae	1		1							2										0
	Syngnathidae			1							1										0
Cnidaria	Actiniidae	1	1			2					4										0
	Clavulariidae										0							1			1
Echinodermata	Amphiuridae		4								4										0
	Chiridotidae			1							1										0

Phylum	Family	Wet Season (September 2008)										Dry Season (December 2008)									
		1	2	3	4	5	6	7	8	9	Total	1	2	3	4	5	6	7	8	9	Total
	Molpadiidae										0				1	1			3		5
	Ophiotrichidae	4	35	21	5		1			1	67	3	16	5	2			2			28
	Phyllophoridae										0					1					1
Mollusca	Arcidae	1			2		1				4	1	1				1		3		6
	Calyptreidae										0							3			3
	Certhiidae		1	2							3										0
	Cylichnidae	1	1	1	2						5			2	2						4
	Dentaliidae	2	5	3	1					1	12				1	2				1	4
	Donacidae	7	32	26	12	1	3	7	12	5	105				1						1
	Ellobiidae				1						1										0
	Littorinidae	1	1								2										0
	Muricidae										0							1			1
	Nassariidae				2	1		2	6	1	12					1					1
	Nuculanidae										0							1			1
	Ostreoidae										0							1			1
	Psammbiidae										0	1			5						6
	Semelidae	9	37	10	12	3	1	1	12	7	92	1	1		1						3
	Solecurtidae				1						1										0
	Solenidae	2	1		1						4										0
	Strombidae									1	1										0
	Tellinidae										0		1	2	2	1			3	2	11
	Trochidae		2		1						3										0
	Unglulinidae					1					1										0
	Veneridae	7	4			1	1	4	7	4	28	3							5	3	11
Nemertea		6	5	14	7	4	3		13	5	57		1	5	3	1		1	12		23
Platyhelminthes					2						2										0

Table A2.2. *Number of individuals per taxa at each station in wet season (September) and dry season (December) 2008*

Taxonomic inventories	Wet Season (September 2008)										Dry Season (December 2008)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Amphipods	1	3	8	4	-	-	-	-	-	16	-	-	1	-	-	-	1	-	-	2
Bivalves	28	79	48	29	6	6	12	31	19	258	6	3	2	10	3	1	2	11	6	44
Brittle star	4	39	21	5	-	1	-	-	1	71	3	16	5	2	-	-	2	-	-	28
Copepod	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	0
Crab	13	13	15	6	1	5	-	3	4	60	8	18	7	15	1	-	8	2	5	64
Cumacea	1	-	3	-	-	-	-	-	-	4	-	1	-	-	-	-	-	-	-	1
Fish	2	-	2	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	0
Gastropods	2	5	3	6	1	-	2	6	2	27	-	-	2	2	1	-	4	-	-	9
Lampshell	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	0
Mantis shrimp	-	-	1	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	1
Mud shrimp	-	1	-	1	1	-	-	-	-	3	-	-	-	-	-	-	-	-	-	0
Nemertea	13	4	20	2	6	3	1	15	7	70	-	1	5	3	1	-	1	12	-	23
Polychaetes	62	41	87	56	39	24	19	78	51	457	42	50	44	26	2	12	15	4	6	201
Sea anemone	1	1	-	-	2	-	-	-	-	4	-	-	-	-	-	-	-	-	-	0
Sea cucumber	-	-	1	-	-	-	-	-	-	1	-	-	-	1	2	-	-	3	-	6
Shrimp	-	1	-	-	2	1	-	-	1	5	-	-	-	-	1	-	2	-	-	3
Soft coral	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	1	-	-	1
Turbellarian	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	0
Total	**127**	**188**	**209**	**111**	**58**	**40**	**34**	**133**	**85**	**985**	**59**	**90**	**66**	**59**	**11**	**13**	**36**	**32**	**17**	**383**

Table A2.3. *Summary of the dominant macrofaunal species (> 30 individuals) collected in wet season (September) and dry season (December) 2008*

Phylum	Class	Order	Family	Species	Abundance
Wet Season (September 2008)					
Mollusca	Bivalvia	Veneroida	Donacidae	*Donax* sp.	114
Mollusca	Bivalvia	Veneroida	Semelidae	*Theora lata*	92
Echinodermata	Ophiuoidea	Ophiurida	Ophiodermatidae	*Macrophiothrix longipeda*	67
Nemertea	-	-	-	-	56
Arthropoda	Crustacea	Decapoda	Pinnotherinae	*Xenophthalmus* sp.	48
Annelida	Polychaeta	Scolecida	Maldanidae	*Euclymene* sp.	43
Annelida	Polychaeta	Spionida	Spionidae	*Paraprionospio pinnata*	40
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus latericens*	38
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus dibranchis*	37
Annelida	Polychaeta	Capitellida	Capitellidae	*Heteromastus* sp.	31
Dry Season (December 2008)					
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus latericens*	49
Arthropoda	Crustacea	Brachyura	Pinnotherinae	*Xenophthalmus* sp.	41
Annelida	Polychaeta	Scolecida	Maldanidae	*Euclymene* sp.	37

Table A2.4. *Two-way ANOVA (n = 3) to compare species abundance, species richness and biomass between wet (September 2008) and dry (December 2008) seasons and Stations (1 – 9). Significant differences are shown in bold*

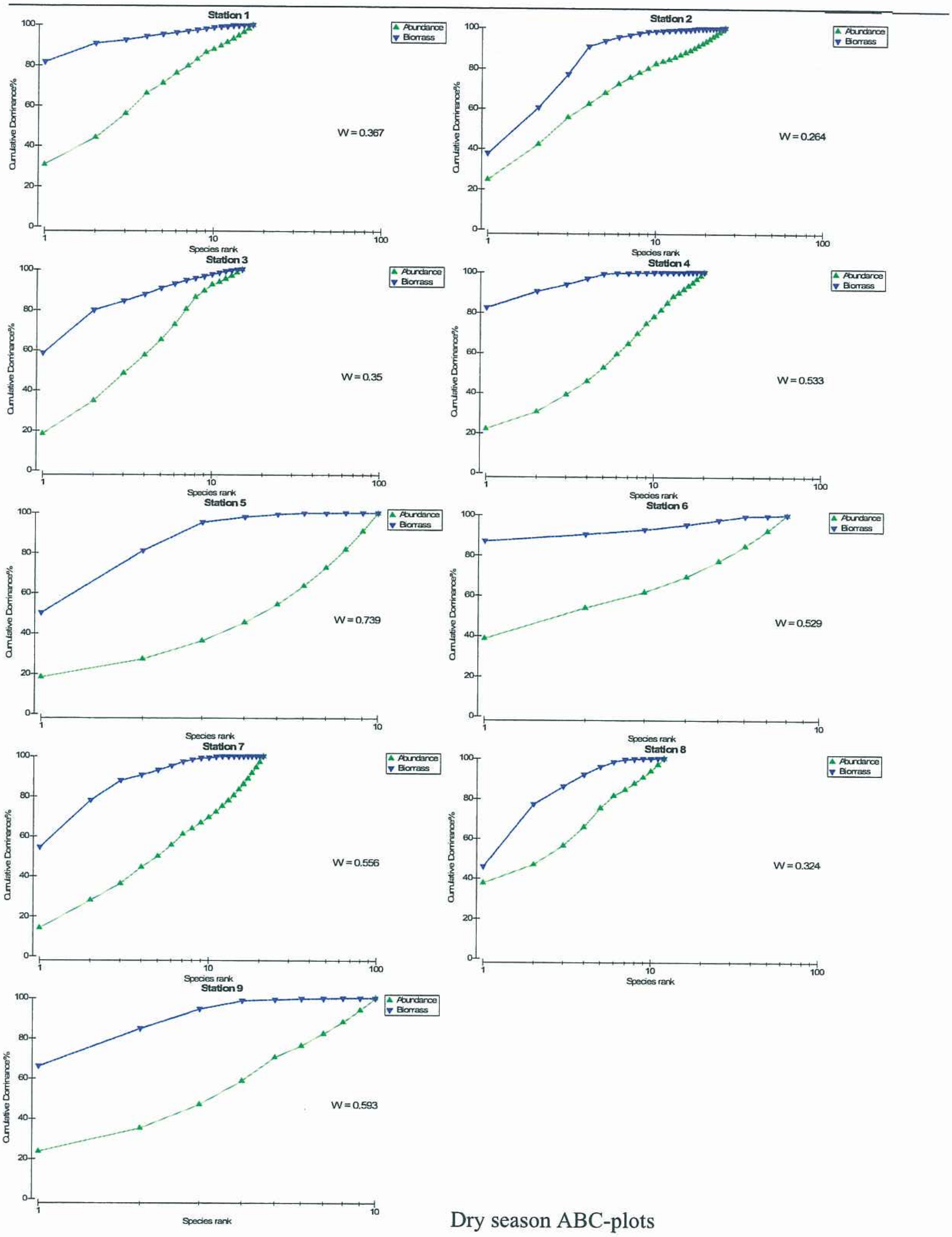
Species abundance				
Source	*df*	MS	F	*p*-value
Season	1	2.41	50.80	**<0.001**
Station	8	0.76	10.03	**<0.001**
Season × Station	8	0.08	2.71	0.13
Error	36	0.05		
Transformation		log (x + 1)		
SNK-test		Station: 5 6 7 9 8 4 1 3 2		

Species richness				
Source	*df*	MS	F	*p*-value
Season	1	93.33	54.64	**<0.001**
Station	8	0.34	6.14	**<0.001**
Season × Station	8	0.04	1.80	0.11
Error	36	0.01		
Transformation		log (x + 10)		
SNK-test		Station: 6 5 7 9 8 3 4 1 2		

Biomass				
Source	*df*	MS	F	*p*-value
Season	1	181.10	6.55	**0.02**
Station	8	25.56	0.92	0.51
Season × Station	8	33.36	1.21	0.32
Error	36	27.66		
Transformation		None		
SNK-test		None		

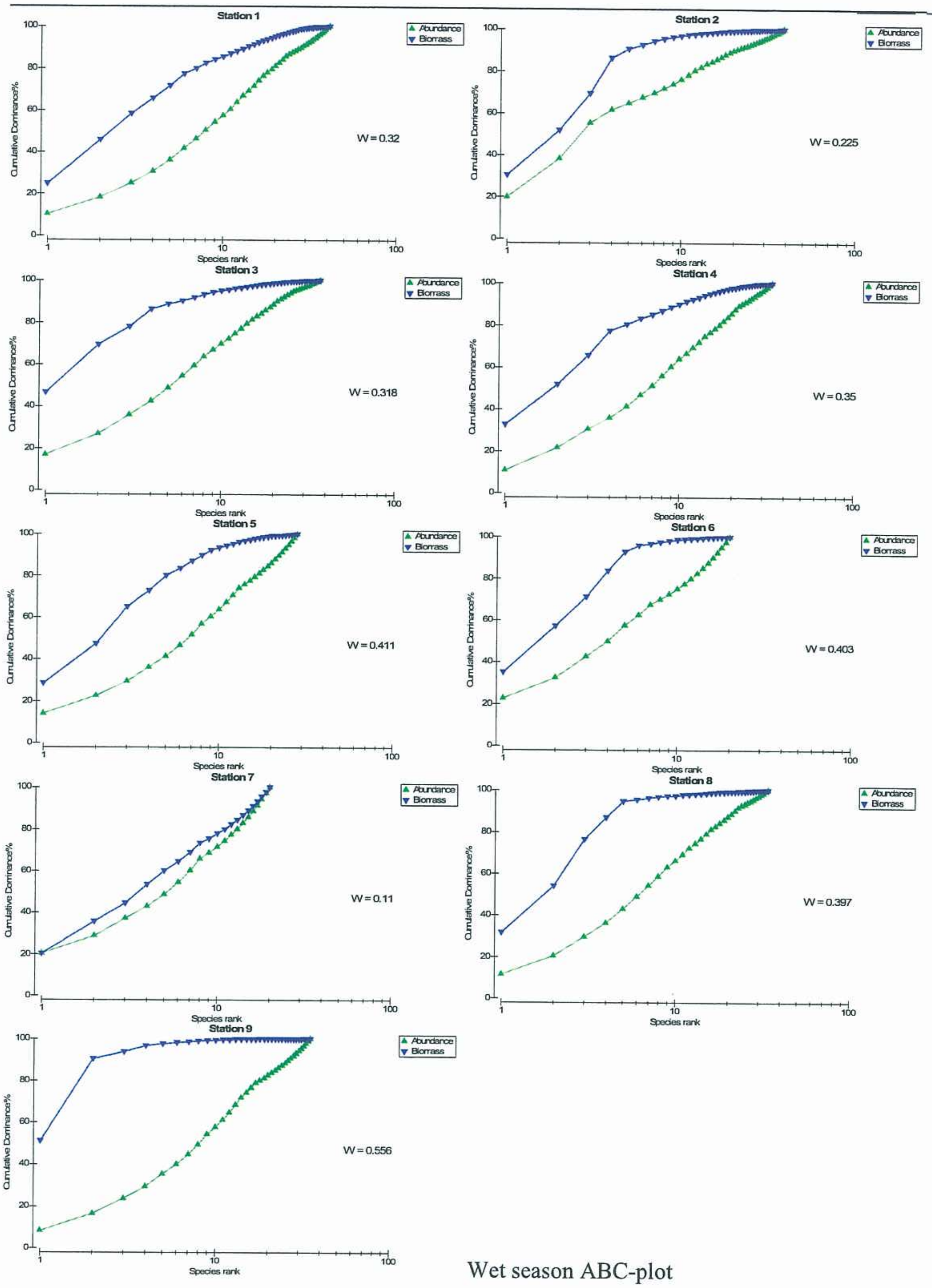
Table A2.5. *Species Richness, Pielou's Evenness and Shannon-Wiener Diversity Index of each location in wet season (September) and dry season (December) 2008*

Station	Wet Season (September 2008)			Dry Season (December 2008)		
	Species Richness	Pielou's Evenness	Shannon-Wiener Diversity Index	Species Richness	Pielou's Evenness	Shannon-Wiener Diversity Index
1	8.26	0.91	3.37	3.92	0.82	2.32
2	7.26	0.75	2.76	5.56	0.79	2.57
3	6.74	0.85	3.07	3.34	0.88	2.38
4	7.01	0.90	3.19	4.66	0.90	2.70
5	6.65	0.93	3.10	3.75	0.99	2.27
6	5.15	0.90	2.68	2.73	0.88	1.84
7	5.34	0.93	2.78	5.58	0.93	1.84
8	6.75	0.89	3.15	3.17	0.84	2.08
9	7.65	0.93	3.30	3.18	0.95	2.18



Dry season ABC-plots

Figure. A2.1. *ABC plots of the benthic macro-fauna from grab samples collected at the 9 stations in September 2008*



Wet season ABC-plot

Figure. A2.2. *ABC plots of the benthic macro-fauna from grab samples collected at the 9 stations in December 2008*

APPENDIX 3 – DIVE SURVEYS

1. METHODOLOGY

1.1 Dive Survey - Rapid Ecological Assessment

1.1.1 Assessment of substrate and ecological attributes using a semi-quantitative, Rapid Ecological Assessment (REA) method was conducted at seven dive survey sites as shown in Fig. 3.1. The field data were collected by marine ecologists using SCUBA dive.

1.1.2 REA surveys provide information on the relative cover of coral and other major benthic groups, as well as inventory of sessile benthic taxa used to define community types. REA has been adopted in many regions to examine baseline information on coral reefs, such as the Great Barrier Reef (DeVantier *et al.* 1998). This method can be applied to a wide range of coral reef and community types and were also used in a coral community study in Hong Kong with some modification (OCL 2003).

1.1.3 At each site, the REA survey was performed along one parallel and one perpendicular transect with respect to the coastline. The length of the parallel transect was 100m, while the perpendicular transect was laid off-shoreward until the visibility was too low for underwater survey. The depth and substrate type along the perpendicular transects for REA were recorded at 2m intervals. The benthic cover, taxon abundance, and ecological attributes of the transects were recorded in a swathe of 2m wide, 1m either side of the transects.

1.1.4 The locations and routes (starting and end points) of the REA transects were recorded on site using GPS (Garmin GPS 60CS). Pictures of representative taxa and video footages along the transects were taken during the surveys.

1.1.5 Two types of information were recorded:

(1) Cover of the major benthic groups;

(2) Inventory of sessile benthic taxa.

These were performed according to Tier I and Tier II levels of information.

1.1.6 Tier I: Categorization of ecological (benthic cover) and environmental variables.

To describe the benthic cover, six substrate and seven ecological attributes (Table 1.1a) were assigned. Each attribute was given a rank, from 0 to 6 (Table 1.1b) based on the overall cover along the survey area.

1.1.7 Tier II: Taxonomic inventories to define types of benthic communities.

An inventory of benthic taxa was compiled during each swim. Taxa were identified either *in situ* or with the aid of photos to confirm identification afterward.

Hard corals (Order Scleractinia) – to genus and species level where possible;
Soft corals (Subclass Octocorallia) – to genus level where possible;
Other benthos (such as sponges zoanthids, bryozoans, macroalgae etc) – to genus level where possible or phylum with growth form;

Each taxon in the inventory was given a rank (0 to 5) on the basis of its abundance in the community at the site (Table 3.1c). These broad categories rank the taxa in terms of the relative abundance of individuals, rather than the contribution to benthic cover, at each site.

Table A3.1. *Categories of a) benthic attributes, b) ordinal ranks of percentage cover of substrate, and (c) ordinal ranks of taxa abundance.*

a) Benthic attributes		b) Percentage Cover		c) Taxon abundance	
Substrate	**Ecological**	**Rank**	**Percentage Cover**	**Rank**	**Abundance**
Bedrock	Hard Corals	0	Not recorded	0	Absent
Boulders (diameter >50cm)	Dead Coral Skeleton	1	1-5%	1	Sparse
Cobbles (diameter < 50cm)	Soft Corals	2	6-10%	2	Uncommon
Rubble (dead corals)	Sea anemone beds	3	11-30%	3	Common
Sand with gravel	Encrusting Algae	4	31-50%	4	Abundant
Mud & Silt	Coralline Algae	5	51-75%	5	Dominant
	Erect Macroalgae	6	76-100%		

2 RESULTS

2.1 Dive Survey - Rapid Ecological Assessment

2.1.1 The dive surveys at the 7 survey sites were conducted on 18th, 19th, 25th and 26th October 2008.

2.1.2 At each site, one parallel and one perpendicular transects were used for the REA survey. The locations of the transects and survey conditions are shown in Fig. 2.1 and Table 2.1. Records of ecological and substrate attributes, as well as the taxonomic inventories are presented in Table 2.2. The depth profile and physical character of the transects are provided in Appendix Ia and Ib. Photographs of the survey sites and benthic organisms are shown in Appendix IIa and IIb.

Site DS1

2.1.3 Site DS1 is a natural shore to the west of the airport channel, with a substrate mainly composed of boulder and sand (Table 2.2). The boulder substrate only extends a short distance (~8m) offshore, then drops to a depth of about 5.5m and is replaced by the sandy substrate (Fig. 3.1; Annex I). The hard substrate was covered with low abundance of rock oysters, mussels (including *Perna viridis*) and sponges. Only one species of hard coral was recorded, an ahermatypic cup-coral *Balanophyllia* sp. (Dendrophyllidae). The recorded colonies showed no sign of suffering from sedimentation, bleaching or partial mortality. The octocoral *Echinomuricea* sp. (Plexauridae) was sparsely distributed on the boulder surface; most of the colonies recorded suffered from high level of partial mortality (Table 2.3; Appendix II). The coverage of both hard and soft corals was low (< 5%). No other flora or fauna of high conservation interest was observed.

Site DS2

2.1.4 Site DS2 is a natural cobble and sandy beach (Table 2.2). The hard substrate was narrow and limited to ~10m from the shore, the sea bed was then covered with sand in a gentle slope from ~10 to ~26m and subsequently replaced by mud and silt at a depth of ~6m (Fig. 3.1; Appendix I). The cobbles and boulders were generally covered by mussels, oysters and barnacles. Similar to DS1, only 1 species of hard coral (*Balanophyllia* sp.) and 1 soft coral species (*Echinomuricea* sp.) were observed, both occurring in low density (< 5%) and patchily distributed. The *Balanophyllia* colonies were generally in normal condition, while the *Echinomuricea* sp. suffered from a high level of partial mortality (Table 2.3; Appendix II).

Site DS3

2.1.5 Site DS3 is a sandy beach scattered with bedrock and cobbles (Table 2.2). The offshore profile was very gentle, extending to ~50m before becoming steeper towards the Airport Channel (Fig. 3.1; Annex I). The rock surface was mainly inhabited by oysters, mussels and barnacles which were common in all sites (Annex II). No hard and soft coral, or other taxa of high conservation interest, were recorded.

Table A3.2. *Location and Condition at the Dive Survey Sites. T1 and T2 are transects parallel and perpendicular to shore, respectively. Note site variation in length of T2 as a result of visibility or substrate type variation.*

Site	Transact (Length,		GPS Coordinates	Depth (m)	Visibility (m)	Weather	Tide	Current (knot)
DS1	T1 (100m)	Start	N 22°16'42.2" E 113°53'12.1"	4.2 – 4.9	0.1 – 0.4	Calm cloudy	Flood	0.5 – 1
		End	N 22°16'42.2" E 113°53'15.7"					
	T2 (20m)	Start	N 22°16'42.2" E 113°53'12.1"	4.5 – 6.7				
		End	N 22°16'42.5" E 113°53'11.4"					
DS2	T1 (100m)	Start	N 22°17'22.5" E 113°53'45.8"	1.8 – 3.6	0.2 – 0.5	Calm cloudy	Ebb	0
		End	N 22°17'28.8" E 113°53'45.9"					
	T2 (30m)	Start	N 22°17'22.5" E 113°53'45.8"	2.4 – 6.1				
		End	N 22°17'25.6" E 113°53'44.7"					
DS3	T1 (100m)	Start	N 22°17'30.7" E 113°53'50.2"	2.7 – 3.0	0.2 – 0.4	Calm; cloudy	Ebb	0 - 0.5
		End	N 22°17'28.6" E 113°53'53.0"					
	T2 (68m)	Start	N 22°17'30.7" E 113°53'50.2"	2.7 – 7.6				
		End	N 22°17'31.8" E 113°53'52.3"					
DS4	T1 (100m)	Start	N 22°17'36.5" E 114°54'16.0"	2.7 – 3.6	0.1 – 0.4	Calm; cloudy	Flood	0 – 0.5
		End	N 22°17'35.2" E 113°54'19.0"					
	T2 (52m)	Start	N 22°17'36.5" E 114°54'16.0"	3.0 – 8.8				
		End	N 22°17'38.1" E 113°54'16.6"					
DS5	T1 (100m)	Start	N 22°17'35.7" E 113°56'14.9"	2.7 – 3.3	0.1 – 0.2	Calm; sun patches	Flood	0.5 - 1
		End	N 22°17'34.7" E 113°55'23.0"					
	T2 (58m)	Start	N 22°17'35.7" E 113°56'14.9"	3.6 – 10.0				
		End	N 22°17'34.1" E 113°55'18.9"					
DS6	T1 (100m)	Start	N 22°17'54.1" E 113°56'14.9"	2.1 – 3.0	0.5 – 1.5	Calm; sun patches	Ebb	0
		End	N 22°17'51.0" E 113°56'15.3"					
	T2 (24m)	Start	N 22°17'54.1" E 113°56'14.9"	2.7 – 3.9				
		End	N 22°17'54.0" E 113°56'16.0"					
DS7	T1 (100m)	Start	N 22°17'43.9" E 113°56'38.6"	3.0 – 4.5	0.5 – 1.5	Calm; sun patches	Ebb	0
		End	N 22°17'46.6" E 113°56'40.6"					
	T2 (50m)	Start	N 22°17'43.9" E 113°56'38.6"	3.0 – 8.8				
		End	N 22°17'44.8" E 113°56'36.9"					

Site DS4

2.1.6 Site DS4 is a natural rocky shore at the southern side of the Airport Channel. The sea bed was covered with cobbles, sand and boulders (Table 2.2). The hard substrate extended to ~20m offshore, and was then replaced by a steady slope of sandy bottom to a depth of 8.8m (Fig. 3.1 and Annex I). As at Site DS3, oysters, mussels and barnacles were the major inhabitants on the rock surface. No hard and soft corals, or other taxa of high conservation interest, were observed.

Site DS5

2.1.7 Site DS5 is an artificial boulder shore at the northern side of the Airport Channel. The substrate was mainly covered by boulders and interspersed with cobbles and sandy substrate (Table 2.2). The offshore sea bed profile was gentle from the shore to ~26m, the sandy substrate dropped steeply to ~9m depth and was replaced by the mud and silt (Fig 3.1; Annex I). The rock surface in DS5 was sparsely inhabited by oysters, mussels and barnacles. No hard and soft corals, or other taxa of high conservation interest were recorded.

Site DS6

2.1.8 Site DS6 is a natural cobble beach at the south-eastern side of the Airport. The cobble substrate was narrow, and replaced by flat, sandy bottom from ~5m onward (Fig 3.1; Annex I). The hard substrate was inhabited by barnacles, mussels, oysters, encrusting algae and bryozoans (Annex II). No hard coral was recorded, but cover of octocoral *Echinomericea* sp. was relatively high (5 to 10%). Moreover, the level of partial mortality in *Echinomuricea* sp. was lower than at Sites DS1 and DS2 (Table 2.3).

Site DS7

2.1.9 Site DS7 is an artificial boulder shore at Tung Chung New Town. The substrate was dominated by rock boulders which formed a steep slope from the shore to ~12m, reaching the depth of ~6.4m and connecting to a mud and silt bottom (Fig 3.1 and Annex I). The rock surface was generally covered with barnacles, oysters, mussel, encrusting algae and bryozoans. Scattered colonies of octocoral *Echomuricea* sp. were observed (< 5%), in which the level of partial mortality was lower than at Sites DS1 and DS2 (Table 2.3; Annex II).

Fig. A3.1. *Map showing Locations of the Dive Survey Sites.*

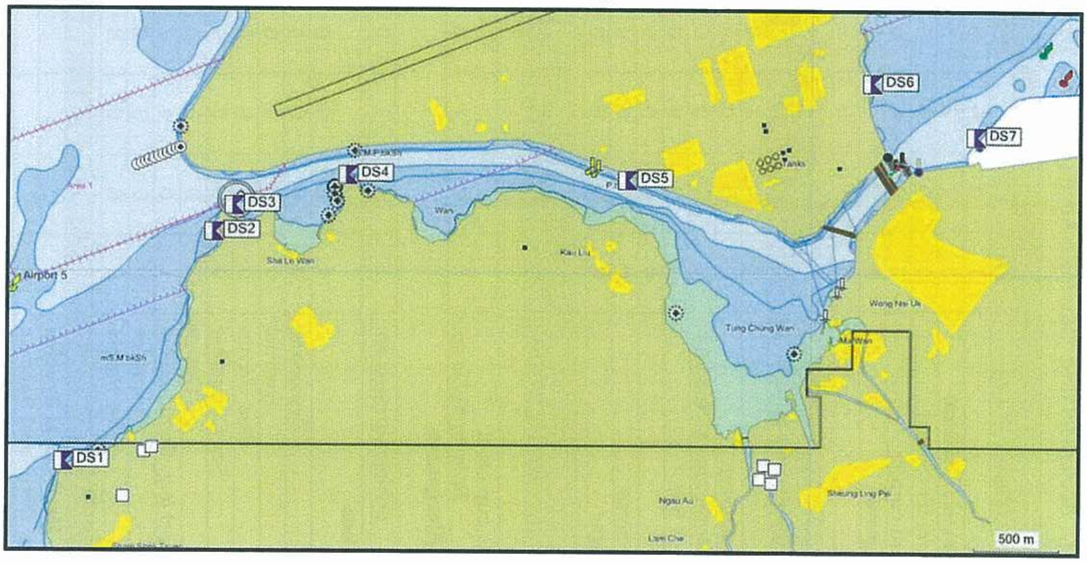


Table A3.3. *Ecological and Substrate Attributes, and Taxonomic Inventories. T1 and T2 are transects parallel and perpendicular to shore, respectively.*

	DS1		DS2		DS3		DS4		DS5		DS6		DS7	
Substrate attributes (0 – 6)	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**
Bedrock	1	0	0	0	3	0	0	0	0	0	0	0	0	0
Boulder (diameter >50cm)	5	3	2	3	1	0	3	0	5	0	1	3	6	3
Cobble (diameter<50cm)	0	0	4	0	3	3	4	3	3	5	6	0	3	0
Rubble (dead corals)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand with gravel	3	3	4	5	5	5	4	6	3	3	3	6	2	0
Mud & Silt	0	4	0	3	0	0	0	0	0	3	0	0	0	5

	DS1		DS2		DS3		DS4		DS5		DS6		DS7	
Ecological attributes (0 – 6)	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**
Hard coral	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Dead coral skeleton	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soft coral (Gorgonian Octocoral)	2	1	2	0	0	0	0	0	0	0	2	1	1	0
Sea anemone bed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macroalgae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Encrusting algae	0	0	0	0	0	0	0	0	0	0	2	0	2	0
Coralline algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	DS1		DS2		DS3		DS4		DS5		DS6		DS7	
Taxonomic inventories (0 – 5)	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**
Hard Coral														
Ahermatypic cup coral *Balanophyllia* sp.	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Soft Coral (Gorgonian Octocoral)														
Echinomuricaea sp.	1	1	1	0	0	0	0	0	0	0	2	1	1	0
Other benthos														
Sponge	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoans	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroid	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Urchin	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Cucumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oyster	1	0	3	0	3	1	4	0	1	0	2	0	3	1
Mussel (e.g. *Perna viridis*)	1	0	4	1	3	1	4	0	1	1	3	1	2	0
Barnacles	0	0	3	2	1	0	3	0	1	0	4	2	4	1
Tube worms	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	DS1	DS2	DS3	DS4	DS5	DS6	DS7
No. Hard Coral Species	1	1	0	0	0	0	0
No. Octocoral Species	1	1	0	0	0	1	1

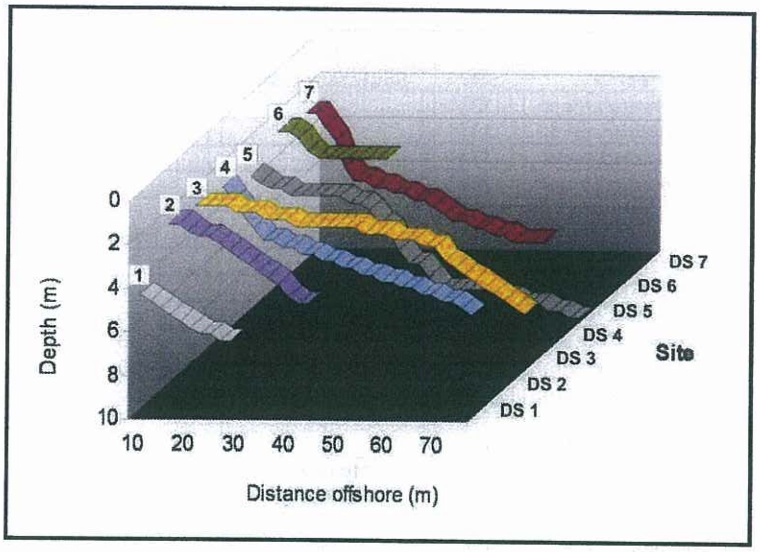


Fig. A3.2. Depth Profile of Perpendicular Transects at the Dive Survey Sites.

2.2 Coral community

Hard Coral

2.2.1 Only one species of hard coral was recorded in this survey, the ahermatypic cup-coral from the genus *Balanophyllia* (Dendrophylliidae). The genus mainly contains azooxanthellate species inhabiting deep waters and waters of low clarity. In local waters, the taxonomic identity and the distribution of the cup-coral has not been well described, with sightings mainly reported from the western waters (Highways Department 2001, Oceanway 2003).

2.2.2 Among the seven survey sites, *Balanophyllia* sp. was only observed in Sites DS1 and DS2 that are located outside Airport Channel to the west. The recorded colonies were solitary in form and occurred in patches of 5 to 20 colonies, the corallite size was < 1cm^2. In both sites, all the observed colonies were associated with boulders of diameter >50cm. Translocation of these colonies is not considered feasible due to the large associated substratum which are not readily moved without damaging the attached colonies. No colonies showed signs of suffering from sedimentation, bleaching or partial mortality.

Octocoral

2.2.3 One taxon of octocoral, *Echinomuricea* sp. (Plexauridae), was recorded from four of the seven survey sites (DS1, DS2, DS6 and DS7). No octocoral was found from the sites within the Airport Channel (DS3, DS4 and DS5). *Echinomuricea* sp. is a common octocoral in local seas, usually recorded at greater depth in eastern waters but occurring in shallow habitat in the more murky southern and western waters.

2.2.4 In these four survey sites, 37 *Echinomuricea* colonies were found sparsely distributed on the rock surface. All colonies recorded suffered from different levels of partial mortality (Table 2.3), with colonies at Sites DS1 and DS2 generally exhibiting higher percentages of sedimentation and mortality than those in other sites.

Table A3.4. *Octocoral Colonies, Percentage Area of Sedimentation and Partial Mortality in the Dive Survey Sites.*

No.	Species	Site	% Sedimentation	% Mortality
1	*Echinomuricea* sp.	DS1	50	60
2	*Echinomuricea* sp.	DS1	30	65
3	*Echinomuricea* sp.	DS1	35	80
4	*Echinomuricea* sp.	DS1	40	70
			Mean % mortality	**68.75**
5	*Echinomuricea* sp.	DS2	70	80
6	*Echinomuricea* sp.	DS2	80	70
7	*Echinomuricea* sp.	DS2	75	65
8	*Echinomuricea* sp.	DS2	80	85
9	*Echinomuricea* sp.	DS2	50	60
10	*Echinomuricea* sp.	DS2	55	60
11	*Echinomuricea* sp.	DS2	75	70
12	*Echinomuricea* sp.	DS2	65	70
			Mean % mortality	**70**
13	*Echinomuricea* sp.	DS6	15	25
14	*Echinomuricea* sp.	DS6	15	40
15	*Echinomuricea* sp.	DS6	25	50
16	*Echinomuricea* sp.	DS6	40	55
17	*Echinomuricea* sp.	DS6	10	15
18	*Echinomuricea* sp.	DS6	10	10
19	*Echinomuricea* sp.	DS6	45	80
20	*Echinomuricea* sp.	DS6	10	65
21	*Echinomuricea* sp.	DS6	20	75
22	*Echinomuricea* sp.	DS6	25	60
23	*Echinomuricea* sp.	DS6	30	55
24	*Echinomuricea* sp.	DS6	30	25
25	*Echinomuricea* sp.	DS6	20	50
26	*Echinomuricea* sp.	DS6	25	15
27	*Echinomuricea* sp.	DS6	10	80
28	*Echinomuricea* sp.	DS6	10	75
29	*Echinomuricea* sp.	DS6	45	55
30	*Echinomuricea* sp.	DS6	40	65
31	*Echinomuricea* sp.	DS6	15	65
32	*Echinomuricea* sp.	DS6	25	10
33	*Echinomuricea* sp.	DS6	15	55
34	*Echinomuricea* sp.	DS6	35	40
			Mean % mortality	**48.4**
35	*Echinomuricea* sp.	DS7	15	15
36	*Echinomuricea* sp.	DS7	10	15
37	*Echinomuricea* sp.	DS7	10	30
			Mean % mortality	**20**

Annex Ia. *Depth Profile and Substrate Type of the Parallel Transect of the Dive Survey Sites.*

	Depth (m)						
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7
2	4.5	2.4	2.7	3.0	2.7	2.1	3.0
4	4.5	2.4	2.7	3.0	2.7	2.1	3.0
6	4.5	2.4	2.7	3.0	2.7	2.4	3.0
8	4.5	2.7	2.7	3.0	3.0	2.4	3.0
10	4.5	2.4	2.7	3.0	3.0	2.4	3.0
12	4.8	2.4	2.7	3.0	3.0	2.4	3.3
14	4.8	2.7	2.7	3.0	3.0	2.4	3.6
16	4.8	2.4	2.7	3.0	2.7	2.4	3.9
18	4.8	2.4	2.7	3.0	2.7	2.4	3.9
20	4.5	2.7	2.7	3.0	2.7	2.4	3.6
22	4.5	3.0	2.7	3.3	2.7	2.4	3.6
24	4.5	3.0	2.7	3.3	2.7	2.7	3.9
26	4.5	3.0	2.7	3.0	2.7	2.7	3.9
28	4.5	3.0	2.7	3.3	2.7	2.7	3.6
30	4.2	3.0	2.7	3.6	2.7	3.0	3.6
32	4.5	3.0	2.7	3.3	3.0	3.0	3.6
34	4.5	3.3	2.7	3.3	3.0	3.0	3.6
36	4.8	3.3	2.7	3.3	2.7	3.0	3.3
38	4.8	3.0	2.7	3.3	2.7	3.0	3.3
40	4.8	3.6	3.0	3.6	3.0	3.0	3.3
42	4.5	3.6	3.0	3.3	3.0	3.0	3.3
44	4.5	3.0	3.0	3.3	3.0	3.0	3.6
46	4.5	3.3	3.0	3.3	3.0	3.0	3.6
48	4.5	3.3	3.0	3.3	3.0	3.0	3.6
50	4.5	3.0	2.7	3.3	3.3	3.0	3.6
52	4.5	3.0	2.7	3.3	3.3	3.0	3.6
54	4.5	2.7	2.7	3.0	3.3	3.0	3.6
56	4.5	3.0	2.7	3.0	3.0	3.0	3.6
58	4.5	2.7	2.7	3.0	3.0	3.0	3.6
60	4.5	2.4	2.7	3.0	2.7	3.0	3.6
62	4.5	2.4	3.0	2.7	3.0	3.0	3.6
64	4.5	2.7	3.0	2.7	3.0	3.0	3.6
66	4.5	2.4	3.0	2.7	3.0	3.0	3.6
68	4.5	2.1	3.0	2.7	3.0	3.0	3.6
70	4.5	1.8	3.0	2.7	3.3	3.0	3.6
72	4.5	2.1	3.0	2.7	3.3	3.0	3.6
74	4.5	1.8	3.0	2.7	3.3	3.0	3.6
76	4.5	2.4	3.0	2.7	3.0	3.0	3.6
78	4.5	2.4	3.0	2.7	3.0	3.0	3.6
80	4.5	2.1	3.0	2.7	3.0	3.0	3.6
82	4.5	2.4	2.7	2.7	2.7	3.0	3.6
84	4.5	2.4	2.7	2.7	2.7	3.0	3.6

	Substrate type							
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7	**Legend**
2	BD	BD	SD	SD	BD	SD	BD	BR = Bedrock
4	BD	BD	SD	SD	BD	CB	BD	BD = Boulder
6	BD	BD	SD	BD	BD	CB	BD	CB = Cobble
8	BD	BD	SD	BD	BD	BD	BD	RB = Rubble
10	BD	BD	SD	SD	BD	CB	BD	SD = Sand
12	BD	BD	CB	SD	BD	SD	BD	ST = Silt and Mud
14	BD	BD	SD	SD	BD	CB	BD	
16	BD	BD	CB	SD	BD	CB	BD	
18	BD	SD	CB	SD	BD	CB	BD	
20	BD	SD	SD	SD	BD	CB	BD	
22	BD	CB	CB	SD	BD	SD	BD	
24	BD	CB	CB	SD	BD	CB	SD	
26	BD	BD	CB	SD	BD	CB	SD	
28	BD	SD	CB	SD	BD	CB	BD	
30	BD	CB	CB	BD	BD	CB	BD	
32	BD	SD	CB	BD	BD	CB	BD	
34	BD	BD	CB	BD	BD	SD	BD	
36	SD	BD	SD	SD	SD	CB	SD	
38	SD	BD	SD	SD	CB	SD	CB	
40	SD	BD	SD	SD	SD	CB	SD	
42	BD	BD	SD	SD	BD	CB	BD	
44	BD	BD	SD	SD	BD	CB	BD	
46	BD	SD	SD	SD	BD	CB	BD	
48	BD	BD	BD	BD	BD	CB	CB	
50	BD	BD	BR	CB	BD	CB	SD	
52	SD	CB	BR	CB	CB	CB	BD	
54	SD	CB	BR	CB	CB	CB	BD	
56	SD	BD	BR	CB	SD	CB	BD	
58	BD	BD	BR	CB	BD	CB	BD	
60	BD	BD	BR	CB	BD	CB	BD	
62	BD	BD	BR	CB	BD	CB	BD	
64	BD	BD	CB	CB	BD	CB	BD	
66	SD	BD	SD	CB	CB	CB	BD	
68	SD	SD	SD	CB	CB	CB	BD	
70	SD	CB	SD	CB	CB	SD	BD	
72	BD	CB	SD	CB	BD	SD	BD	
74	BD	SD	SD	CB	BD	CB	BD	
76	BD	BD	SD	CB	BD	CB	BD	BR = Bedrock
78	BD	BD	SD	CB	BD	CB	BD	BD = Boulder
80	BD	BD	SD	CB	BD	CB	BD	CB = Cobble
82	BD	CB	SD	CB	BD	CB	BD	RB = Rubble
84	BD	SD	SD	CB	BD	CB	BD	SD = Sand

	Depth (m)						
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7
86	4.2	2.4	2.7	2.7	2.7	3.0	3.6
88	4.5	2.7	2.7	3.0	2.7	3.0	3.6
90	4.5	2.7	2.7	3.0	2.7	3.0	3.6
92	4.5	2.7	2.7	3.0	3.0	3.0	3.9
94	4.5	2.4	2.7	3.0	3.0	2.7	3.9
96	4.5	3.0	2.7	3.0	2.7	2.7	3.9
98	4.5	3.0	2.7	3.0	2.7	2.7	4.2
100	4.5	3.0	2.7	3.0	2.7	2.7	4.5

	Substrate type							
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7	Legend
86	SD	BD	SD	CB	CB	CB	BD	ST = Silt and Mud
88	SD	BD	SD	CB	SD	CB	BD	
90	SD	CB	SD	CB	SD	CB	BD	
92	SD	SD	SD	SD	SD	CB	BD	
94	BR	CB	SD	SD	BD	CB	CB	
96	SD	BD	SD	SD	CB	SD	CB	
98	SD	BD	CB	CB	SD	SD	CB	
100	BD	CB	CB	CB	BD	SD	CB	

Annex Ib. *Depth Profile and Substrate Type of the Perpendicular Transect of the Dive Survey Sites.*

	Depth (m)						
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7
2	4.5	2.4	2.7	3.0	3.6	2.7	3.0
4	4.8	2.4	2.7	3.6	3.9	2.7	3.0
6	5.2	2.7	2.7	4.2	4.2	3.0	3.6
8	5.5	3.0	2.7	4.8	4.2	3.6	4.2
10	5.8	3.0	3.0	5.5	4.5	3.9	5.5
12	6.1	3.3	3.0	5.5	4.5	3.9	6.1
14	6.4	3.6	3.0	5.8	4.5	3.9	6.1
16	6.4	3.9	3.3	5.8	4.5	3.9	6.4
18	6.7	4.2	3.3	6.1	4.5	3.9	6.4
20	6.7	4.5	3.3	6.1	4.5	3.9	6.7
22		4.8	3.6	6.4	4.8	3.9	6.7
24		5.2	3.6	6.4	4.8	3.9	7.0
26		5.8	3.6	6.7	5.2		7.0
28		6.1	3.6	6.7	5.8		7.3
30		6.1	3.6	7.0	6.1		7.6
32			3.6	7.0	7.0		7.9
34			3.6	7.3	7.6		7.9
36			3.9	7.3	7.6		8.2
38			3.9	7.6	8.2		8.2
40			3.9	7.6	8.8		8.5
42			4.2	7.9	8.8		8.5
44			4.2	7.9	8.8		8.8
46			4.2	8.2	8.8		8.8
48			4.5	8.2	8.8		8.8
50			4.5	8.5	8.8		8.8
52			5.2	8.8	9.1		
54			5.5		9.1		
56			5.8		9.4		
58			6.1		9.4		

	Substrate type							
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7	Legend
2	BD	BD	CB	SD	CB	BD	BD	BR = Bedrock
4	SD	BD	CB	SD	CB	BD	BD	BD = Boulder
6	BD	BD	CB	CB	CB	SD	BD	CB = Cobble
8	SD	SD	CB	SD	CB	SD	BD	RB = Rubble
10	SD	BD	CB	CB	CB	SD	BD	SD = Sand
12	ST	SD	CB	CB	CB	SD	BD	ST = Silt and Mud
14	ST	SD	CB	SD	CB	SD	BD	
16	ST	SD	CB	CB	CB	SD	ST	
18	ST	SD	SD	CB	CB	SD	ST	
20	ST	SD	CB	SD	CB	SD	ST	
22		SD	CB	SD	CB	SD	ST	
24		SD	SD	SD	CB	SD	ST	
26		SD	SD	SD	CB		ST	
28		ST	SD	SD	CB		ST	
30		ST	SD	SD	SD		ST	
32			SD	SD	SD		ST	
34			SD	SD	CB		ST	
36			SD	SD	SD		ST	
38			SD	SD	SD		ST	
40			SD	SD	ST		ST	
42			SD	SD	ST		ST	
44			SD	SD	ST		ST	
46			SD	SD	ST		ST	
48			SD	SD	ST		ST	
50			SD	SD	ST		ST	
52			SD	SD	ST			
54			SD		ST			
56			SD		ST			
58			SD		ST			

	Depth (m)						
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7
60			6.4		9.4		
62			6.7		9.7		
64			7.0		9.7		
66			7.3		10.0		
68			7.6		10.0		
70							
72							

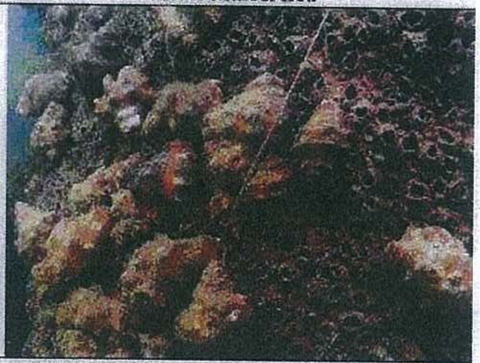
	Substrate type							
Meter	DS1	DS2	DS3	DS4	DS5	DS6	DS7	Legend
60			SD		ST			
62			SD		ST			
64			SD		ST			
66			SD		ST			
68			SD		ST			
70								
72								

Annex Ib......Continued.

DS6: Rock Oysters

DS6: Mussel Bed

DS6: Pearl Oyster – *Pinctada* sp.



DS7: Predatory gastropods – *Thais leutostoma*

DS7: Gorgonians - *Echinomuricea sp.*

DS7: Predatory gastropods - *Gyrinum natator*

DS7: Rock Oysters

DS7: Barnacles

Annex IIa. *Photos of the Dive survey Sites*

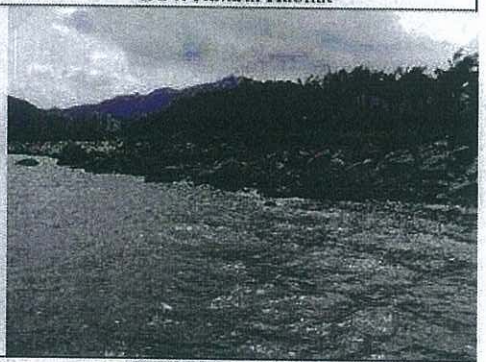
DS1: Natural Habitat

DS2: Natural Habitat

DS3: Natural Habitat

DS4: Natural Habitat

DS5: Artificial Habitat

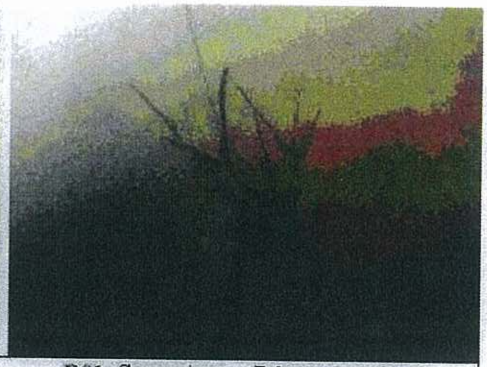


DS6: Natural Habitat

DS7: Artificial Habitat

Annex IIb. *Photos of Representative Taxa at the Dive Survey Sites*

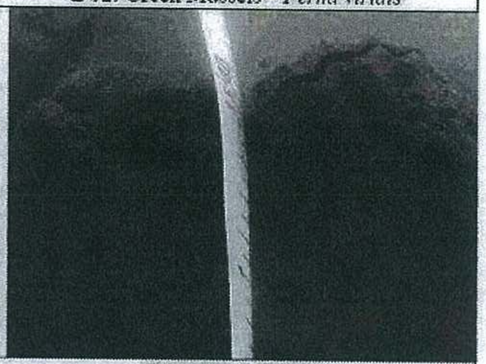

DS1: Green Mussels – *Perna viridis*

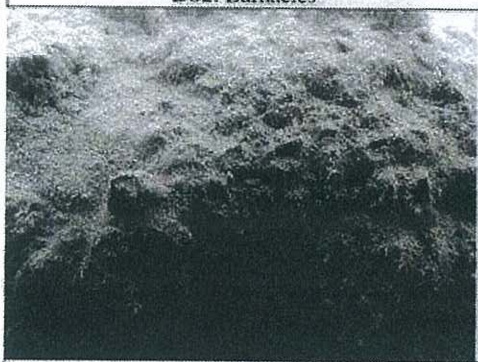

DS1: Gorgonians - *Echinomuricea sp.*


DS1 & DS2: Ahermatypic cup corals


DS2: Green Mussels – *Perna viridis*


DS2: Barnacles


DS3: Rock Oysters


DS5: Barnacles


DS6: Gorgonians - *Echinomuricea sp.*

APPENDIX 4 – INTERIDAL SURVEY RESULTS

Table A4.1. *Fauna observed in soft shore habitats during qualitative and quantitative surveys*

Species Name	Common Name	Conser-vation Status	SW	SSW	SLW	HHW	ST	TCB
Fish								
Bathygobius fuscus	Dusky Frillgoby	-		++				
Favonigobius reichei	Indo-Pacific Tropical Sand Goby	a	+++	+++	+++	++++	+++	+++
Gerres filamentosus	Whipfin Silver-biddy	-			+		++	
Gerres oyena	Common Silver-biddy	-	+		+	++		++
Liza sp.	Mullet		+++		+++	++	++++	+++
Lucigobius guttatus	Flat-headed Goby	b		+				
Lutjanus argentimaculatus	Mangrove Red Snapper	-		+*				
Mugilogobius abei	Goby	-	++		+++*			
Mugilogobius chulae	Yellowstripe Goby	-	++		+++*	++		
Omobranchus fasciolatoceps	Flesh-crested Blenny	-				+	+	
Omobranchus punctatus	Muzzled Blenny	-		+				
Oreochromis mossambicus	Mozambique Tilapia	-	++*					
Parazacco spilurus	Predaceous Chub	c		+*				
Periophthalmus modestus	Common Mudskipper	-	++++	++	++++	++++	++++	+++
Pterocryptis cochinchinensis	Vietnam Catfish	-		+*				
Scartelaos histophorus	Walking Goby	d	++		++	+	+	
Sillago sihama	Silver Sillago	-				++	+++	++
Takifugu niphobles	Snowy Puffer	e				+	+	
Terapon jarbua	Jarbua Terapon	-	++++	++	+++	+++	++++	+++
Tridentiger trigonocephalus	Chameleon Goby	-		+*	++*			
Echinoderm								
Holothuria leucospilota	Sea Cucumber	f	+					
Merostomata								
Tachypleus tridentatus	Horseshoe Crab	f					+	+
Unknown species	Horseshoe Crab		+#					
Crustacean								
Alpheus lobidens	Pistol Shrimp	-		+				
Alpheus sp.	Pistol Shrimp			+				
Balanus amphitrite	Striped Barnacle	-		+	+	+		+
Balanus reticulatus	Striped Barnacle	-	+++	+++	+++	+++	+++	+++
Charybdis acutifrons	Portunid Crab	-			+			
Clibanarius striolatus	Hermit Crab	-	++	++	++	+++	+++	++
Gaetice depressus	Grapsid Crab	-	+	+++	+	+	+	+
Hemigrapsus penicillatus	Grapsid Crab	-	+++	++	+++	+++	++	+++
Hemigrapsus sanguineus	Grapsid Crab	-	+	++	+	+	+	+
Leptodius exaratus	Xanthid Crab	-		+				
Ligia exotica	Sea Slater	-	++	++++	++	++	++	
Macrobrachium nipponense	Freshwater Shrimp	-			+*	+*		
Macrophthalmus boteltobagoe	Sentinel Crab	-			+	+	+	+
Macrophthalmus erato	Sentinel Crab	-	+	+	++	+	++	+
Matuta lunaris	Burrowing Sand Crab	-		+				

Species Name	Common Name	Conser-vation Status	SW	SSW	SLW	HHW	ST	TCB
Metapenaeus ensis	Greasyback Shrimp	g	+		+	+	+	
Metaplax elegans	Sesarmine Crab	-				+		
Metopograpsus quadridentatus	Grapsid Crab	-		+				
Nanosesarma minutum	Sesarmine Crab	-	+	+	+	+	+	
Ocypode ceratophthalma	Ghost Crab	-		++	+			
Pagurus dubius	Hermit Crab	-	++	+++	+++	+++	+++	+
Palaemon serrifer	Shrimp	-		+				
Parasesarma pictum	Sesarmine Crab	-				+	++	
Parasesarma plicata	Sesarmine Crab	-	+	+++	++	+	+	+
Penaeus japonica	Japanese King Prawn	-	+					
Perisesarma bidens	Sesarmine Crab	-	++++		++++	+++	+++	++++
Philyra carinata	Pebble Crab	-				+		
Portunus pelagicus	Blue Crab	-	+	+	+	+	++	+
Scopimera globosa	Sand Bubbler Crab	-		+				
Scylla serrata	Mud Crab	-	++		+			++
Sphaerozius nitidus	Xanthid Crab	-				+		
Tetraclita squamosa	Black Barnacle	-					+	
Uca acuta	Fiddler Crab	-	+++		+++			
Uca arcuata	Fiddler Crab	-	+		+			+
Uca borealis	Fiddler Crab	-			++	+++		++
Uca crassipes	Fiddler Crab	-	++		+++	+		++
Uca lactea	Fiddler Crab	-			++	+++		+++
Varuna sp.	Grapsid Crab				+			
Amphipoda	Amphipod		++++	++++	++	++	++	++
Amphipoda 2	Amphipod 2							+
Isopoda	Isopod		+			+		
Bivalve		-						
Barbatia virescens	Bearded Ark Shell	-	++	++	++	++	+++	++
Caecella chinensis	Small Sand Clam	-	+	++	+	+	++	+
Circe sp.	Venus Shell						+	+
Cyclina sinensis	Venus Shell	-					+	+
Dosinia japonica	Japanese Artemis	-	+			+	++	
Geloina erosa	Large Mangrove Clam	-	+			+		
Glauconome chinensis	Clam	-	+		+	+	+	
Gafrarium pectinatum	Mangrove Clam	-					+	
Isognomon isognomum	Hammer Oyster	-						+
Marcia sp.	Venus Shell							+
Meretrix meretrix	Asiatic Hard Clam	-		+	+	+		
Paphia undulata	Clam	-				+		
Perna viridis	Green Mussel	-			+			
Ruditapes philippinarum	Common Clam	-				+	++++	++
Ruditapes variegatus	Common Clam	-					+++	++
Saccostrea cucullata	Rock Oyster	-	++++	+++++	+++++	+++++	+++++	+++++
Septifer virgatus	Purplish Bifurcate Mussel	-	+	+++	+++	+++	++	+++
Soletellina diphos	Sunset Clam	-					+	
Trapezium sp.	Clam		+	+	+	++	++	+
Gastropod								

Species Name	Common Name	Conser-vation Status	SW	SSW	SLW	HHW	ST	TCB
Acanthopleura japonica	Chiton	-		+		+	+	
Batillaria multiformis	Sand Snail	-	++		+++	++	+++	+++
Batillaria zonalis	Sand Snail	-	+++		++++	++++	++++	+++
Cellana grata	Limpet	-				+		+
Cellana toreuma	Limpet	-					+	+
Cerithidea alata	Mud Snail	-					+++	+++
Cerithidea cingulata	Mud Snail	-	+++		+++++	++++	+++++	++++
Cerithidea djadjariensis	Mud Snail	-	++					++
Cerithidea rhizophorarum	Mud Snail	-	++		+			++
Clithon faba	Clithon	-		++	+	+		+
Clithon oualaniensis	Clithon	-	++	+++	+	++	++	++
Clithon retropictus	Clithon	-		+		+		
Clypeomorus sp.	Mud Snail	-			+	+	+	
Echinolittorina malaccana	Periwinkle	-		+				
Echinolittorina radiata	Periwinkle	-	+		+			
Echinolittorina vidua	Periwinkle	-						+
Littoraria ardouiniana	Periwinkle	-	++					++
Littoraria melanostoma	Black-mouth Littorine	-						++
Littoraria sinensis	Periwinkle	-	++	++	++	++	++	++
Lunella coronata	Common Turban Shell	-		+			+	+
Monodonta labio	Top Shell	-		++	+	++	++++	+++
Nassarius festivus	Festive Nassa	-		+	++	++	+	++
Nerita costata	Nerita	-		+			+	+
Nerita yoldii	Nerita	-	+++	+++	+++	+++	+++	+++
Nipponacmea concinna	Limpet	-						+
Omphalius nigerrimus	Top Shell	-				+	+	+
Onchidium hongkongensis	Seashore Slug	-			+			
Patelloida pygmaea	Limpet	-					++	
Planaxis sulcatus	Ribbed Clusterwink	-		+				
Siphonaria laciniosa	False Limpet						+	
Thais clavigera	Dog Whelk	-	+	+	+	+	+	+
Thais luteostoma	Dog Whelk	-			+			
Thais sp.	Dog Whelk			+				
Terebralia sulcata	Large Mangrove Snail	-					+	++
Turritella sp.	Turritella Snail			+				
Unknown Gastropod	Snail				+	+		
Scaphopod								
Dentalioida	Dentalioid						+	+
Annelid								
Aglaophamus dibranchis	Polychaete	-		+	+	+	+	+
Ampharetidae	Polychaete						+	
Capitella capitata	Polychaete	-					+	+
Ceratonereis sp.	Polychaete		+	+	+			
Chaetonzone sp.	Polychaete						+	+
Chone sp.	Polychaete			+			+	
Cirratulus sp.	Polychaete						+	+
Cossura sp.	Polychaete			+				
Diopatra neapolitana	Polychaete	-			+	+	+	+

Species Name	Common Name	Conser-vation Status	SW	SSW	SLW	HHW	ST	TCB
Euclymene sp.	Polychaete				+	+	+	+
Glycera sp.	Polychaete							+
Harmothoe imbricata	Polychaete	-			+			
Heteromastus sp.	Polychaete			+			+	+
Hydroides sp.	Tube Worm				+			
Laonice cirrata	Polychaete	-		++				
Lumbrineris sp.	Polychaete			+		+		
Maldanidae 1	Bamboo Worm 1		+				+	
Maldanidae 2	Bamboo Worm 2				+	+		
Mediomastus sp.	Polychaete							+
Nectoneanthes sp.	Polychaete		+					
Nephtys sp.	Polychaete						+	+
Nereis sp.	Polychaete		+++	+++	++	++	++	++
Pectinariidae	Polychaete			+				
Perinereis sp.	Polychaete		++	+	++	+		+
Poecilochaetus sp.	Polychaete					+		
Scolelepis sp.	Polychaete			+				
Scoloplos sp.	Polychaete			+				
Sigambra sp.	Polychaete		+	+		+		+
Spio sp.	Polychaete						+	
Sipunculid								
Phascolosoma sp.	Peanut Worm		++	++	++	++	++	++
Siphonosoma cumanense	Peanut Worm	-		+				
Nemertean								
Nemertean 1	Ribbon Worm 1		+		+	+	+	
Nemertean 2	Ribbon Worm 2						+	+
Nemertean 3	Ribbon Worm 3					+		
Cnidarian								
Haliplanella lineata	Sea Anemone	-		+	+	+		
Poriferan								
Unknown Sponge	Sponge			+				
Total Number of Species			**57**	**69**	**72**	**75**	**76**	**76**

Key

+++++: Dominant; ++++: Abundant; +++: Frequent; ++: Occasional; +: Scarce.
- = Not recorded/ evaluated in any local, China and global conservation lists.
a = IUCN red list: lower risk/ near threatened (www.iucnredlist.org)
b = Uncommon (Lee *et al.* 2002)
c = CSIS red list: vulnerable (www.baohu.org), vulnerable (Yue & Chen 1998)
d = Uncommon (AEC staff per. obs.)
e = IUCN red list: data deficient (www.iucnredlist.org)
f = CSIS red list: endangered (www.baohu.org)
g = CSIS red list: vulnerable (www.baohu.org)
* = Observed in intertidal creeks or freshwater streams running across the shore.
# = Only tracks were observed. Local villagers said that horseshoe crabs are common at Sham Wat and a mating pair had been collected in August 2008.

Table A4.2. *Epifauna (on and within the surface layer of sediment (5 cm)) observed in soft shore habitats during quantitative surveys*

		SW		SSW		SLW		HHW		ST		TCB	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Fish													
Bathygobius fuscus	Dusky Frillgoby				3								
Favonigobius reichei	Indo-Pacific Tropical Sand Goby							1					
Lucigobius guttatus	Flat-headed Goby				2								
Omobranchus fasciolatoceps	Flesh-crested Blenny							2			1		
Omobranchus punctatus	Muzzled Blenny				1								
Scartelaos histophorus	Walking Goby										2		
Merostomate													
Tachypleus tridentatus	Horseshoe Crab										1		
Crustacean													
Alpheus lobidens	Pistol Shrimp				3								
Alpheus sp.	Pistol Shrimp			4									
Balanus amphitrite	Striped Barnacle				3		1		2				13
Balanus reticulatus	Striped Barnacle	21	632	51	335	110	796	7	393	2	205	96	596
Charybdis acutifrons	Portunid Crab						1						
Clibanarius striolatus	Hermit Crab		5	2	2	7	3	7	4	12	4	2	1
Gaetice depressus	Grapsid Crab		1	86	19	4		2	6	14	5	12	
Hemigrapsus penicillatus	Grapsid Crab	9	11	1	3	30	28	55	27	7	23	27	17
Hemigrapsus sanguineus	Grapsid Crab		1	4	10	8	7		7	4			2
Leptodius exaratus	Xanthid Crab				1								
Ligia exotica	Sea Slater			26	16								
Macrophthalmus boteltobagoe	Sentinel Crab							2		1	1		1
Macrophthalmus erato	Sentinel Crab	6	5	2	18	3	4	10		4	8	1	9
Metapenaeus ensis	Greasyback Shrimp	4				1		3		1	2		
Nanosesarma minutum	Sesarmine Crab	1		5		4		14		1	7		
Pagurus dubius	Hermit Crab	3	20		23	31	32	31	10	3	7	3	6
Parasesarma plicata	Sesarmine Crab		2		140		37		7		5		4
Penaeus japonica	Japanese King Prawn		2										

Species Name	Common Name	SW		SSW		SLW		HHW		ST		TCB	
		W	D	W	D	W	D	W	D	W	D	W	D
Perisesarma bidens	Sesarmine Crab	1											
Philyra carinata	Pebble Crab							1					
Portunus pelagicus	Blue Crab				1	2				1			
Sphaerozius nitidus	Xanthid Crab							1					
Scylla serrata	Mud Crab						1						
Tetraclita squamosa	Black Barnacle										1		
Uca borealis	Fiddler Crab					2						1	
Uca lactea	Fiddler Crab							1	2			2	
Uca sp.	Fiddler Crab	1						13					
Amphipoda	Amphipod	10	56		1431		2		1		41		3
Amphipoda 2	Amphipod 2												1
Isopoda	Isopod		1						1				
Bivalve													
Barbatia virescens	Bearded Ark Shell				4			15	9	2	69	17	16
Caecella chinensis	Small Sand Clam	1				3		3	1	1	1	1	1
Circe sp.	Venus Shell										1	21	
Cyclina sinensis	Venus Shell										1	12	
Dosinia japonica	Japanese Artemis	2							1	12	17		
Glauconome chinensis	Clam						6		4		12		
Gafrarium pectinatum	Mangrove Clam									1			
Marcia sp.	Venus Shell											1	
Meretrix meretrix	Asiatic Hard Clam					2	1						
Paphia undulata	Clam								1				
Perna viridis	Green Mussel					13							
Ruditapes philippinarum	Common Clam								2	6	27		15
Ruditapes variegatus	Common Clam									3	30	1	
Saccostrea cucullata	Rock Oyster	70	275	542	844	141	658	266	466	60	745	265	644
Septifer virgatus	Purplish Bifurcate Mussel	1	7	1	324	6	77	6	204	1	8	58	38
Soletellina diphos	Sunset Clam									3	2		
Trapezium sp.	Clam		3	1		2	3	6	60		58		3
Gastropod													

Species Name	Common Name	SW		SSW		SLW		HHW		ST		TCB	
		W	D	W	D	W	D	W	D	W	D	W	D
Acanthopleura japonica	Chiton			1					1		2		
Batillaria spp.	Sand Snails	4	5			530	455	346	361	450	207	2248	884
Cellana grata	Limpet								1			2	
Cellana toreuma	Limpet									6	2	3	6
Cerithidea spp.	Mud Snails	4	9			1403	483	315	971	803	235	1562	934
Clithon faba	Clithon			4	9	1						1	
Clithon oualaniensis	Clithon		36	4	117	10	3	28	21	5	14	31	4
Clithon retropictus	Clithon			2				5					
Clypeomorus sp.	Mud Snail						1		1		22		
Echinolittorina vidua	Periwinkle												1
Littoraria sinensis	Periwinkle	12	5	6	3	16	7	3	8	2	10	10	32
Lunella coronata	Common Turban Shell				1							1	
Monodonta labio	Top Shell			3	1	4	2	58	10	217	666	264	21
Nassarius festivus	Festive Nassa				5	12	21	34	33	10	4	24	7
Nerita costata	Nerita				3						6		1
Nerita yoldii	Nerita	11	2	15	15	44	17	20	4	6	29	21	11
Nipponacmea concinna	Limpet												1
Omphalius nigerrimus	Top Shell							1	1	7	5		9
Patelloida pygmaea	Limpet										46		
Planaxis sulcatus	Ribbed Clusterwink				7								
Siphonaria laciniosa	False Limpet										1		
Thais clavigera	Dog Whelk			1	11		3	1	2		8		1
Thais luteostoma	Dog Whelk					1							
Thais sp.	Dog Whelk				2								
Unknown Gastropod	Gastropod					1		1					
Scaphopod													
Dentalioida	Dentalioid												3
Annelid													
Aglaophamus dibranchis	Polychaete								1		3		1
Ampharetidae	Polychaete									8			
Ceratonereis sp.	Polychaete				1		2						

		SW		SSW		SLW		HHW		ST		TCB	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Chaetozone sp.	Polychaete												2
Chone sp.	Polychaete										1		
Cirratulus sp.	Polychaete										6		2
Diopatra neapolitana	Polychaete							1					
Euclymene sp.	Polychaete										3		
Glycera sp.	Polychaete												1
Harmothoe imbricata	Polychaete						1						
Hydroides sp.	Tube Worm					2							
Laonice cirrata	Polychaete				1								
Maldanidae 1	Bamboo Worm 1	1											
Maldanidae 2	Bamboo Worm 2					2							
Mediomastus sp.	Polychaete												1
Nephtys sp.	Polychaete										1		
Nereis sp.	Polychaete	2	6	1	16		8		2			3	6
Perinereis sp.	Polychaete				1		4						1
Spio sp.	Polychaete									3			
Sipunculid													
Phascolosoma sp.	Peanut Worm	1	9	1	3	11	5	11	2	1	6	10	21
Nemertea													
Nemertean 1	Ribbon Worm 1		1			3				2			
Nemertean 2	Ribbon Worm 2									2		1	
Nemertean 3	Ribbon Worm 3								1				
Cnidarian													
Haliplanella lineata	Sea Anemone				5	1		1					
Number of Species		20	22	22	37	32	30	34	36	34	48	30	39
Pielou's Evenness Index		0.71	0.44	0.38	0.48	0.41	0.53	0.60	0.52	0.44	0.58	0.42	0.48
Shannon Diversity Index		2.11	1.36	1.17	1.75	1.43	1.81	2.12	1.88	1.53	2.26	1.42	1.77
Abundance		165	1094	763	3384	2410	2669	1271	2628	1661	2561	4701	3320
Ind./ m²		22	146	102	451	321	356	169	350	221	341	627	443

Key

W = wet season, D = dry season.

Table A4.3. *Infauna observed in soft shore habitats during quantitative surveys (core sampling)*

		SW		SSW		SLW		HHW		ST		TCB	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Crustacean													

		SW		SSW		SLW		HHW		ST		TCB	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Balanus reticulatus	Striped Barnacle					1							1
Clibanarius striolatus	Hermit Crab				1								
Hemigrapsus penicillatus	Grapsid Crab							2					1
Leptodius exaratus	Xanthid Crab				1								
Macrophthalmus boteltobagoe	Sentinel Crab							1					
Macrophthalmus erato	Sentinel Crab		2				2	1					
Parasesarma plicata	Sesarmine Crab		2				1						
Portunus pelagicus	Hermit Crab										1	1	
Uca borealis	Fiddler Crab					1							
Uca lactea	Fiddler Crab							2				1	
Uca sp.	Fiddler Crab	1											
Amphipoda	Amphipod				11								
Bivalve													
Caecella chinensis	Small Sand Clam			5		1			1			2	1
Circe sp.	Venus Shell											2	
Cyclina sinensis	Venus Shell											5	
Dosinia japonica	Japanese Artemis									11	5		
Glauconome chinensis	Clam		1								1		
Meretrix meretrix	Asiatic Hard Clam						1						
Ruditapes philippinarum	Common Clam									7	9		4
Ruditapes variegatus	Common Clam									5	9		
Saccostrea cucullata	Rock Oyster		1										
Gastropod													
Batillaria spp.	Sand Sanils					15	5	3	4	6	5	152	31
Cerithidea spp.	Mud Snails					19	6	1	14	7	12	50	33
Clithon faba	Clithon					1							
Clithon oualaniensis	Clithon	1			2							1	
Littoraria sinensis	Periwinkle											1	
Monodonta labio	Top Shell										2		
Nassarius festivus	Festive Nassa						1	1	2			10	1
Annelid													

		SW		SSW		SLW		HHW		ST		TCB	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Aglaophamus dibranchis	Polychaete				5		2		3		1		
Capitella capitata	Polychaete										1		1
Ceratonereis sp.	Polychaete		8				3						
Chaetozone sp.	Polychaete										2		1
Chone sp.	Polychaete				1								
Cirratulus sp.	Polychaete										2		1
Cossura sp.	Polychaete				4								
Diopatra neapolitana	Polychaete					1		2		1			1
Euclymene sp.	Polychaete						2		4		1		3
Heteromastus sp.	Polychaete				2						1		1
Laonice cirrata	Polychaete				84								
Lumbrineris sp.	Polychaete				1				1				
Maldanidae 1	Bamboo Worm 1									1			
Maldanidae 2	Bamboo Worm 2							1					
Nectoneanthes sp.	Polychaete		1										
Nephtys sp.	Polychaete												1
Nereis sp.	Polychaete	3	115	2	126	1	6	3	4	11		1	6
Pectinariidae	Polychaete				1								
Perinereis sp.	Polychaete		17		3		12		2				1
Poecilochaetus sp.	Polychaete								1				
Scolelepis sp.	Polychaete				2								
Scoloplos sp.	Polychaete				2								
Sigambra sp.	Polychaete		2		5				1				1
Spio sp.	Polychaete									1			
Sipunculid													
Phascolosoma sp.	Peanut Worm		10	1	3	1	1	1	1	4	9	6	15
Siphonosoma cumanense	Peanut Worm				2								
Nemertea													
Nemertean 1	Ribbon Worm 1				1								
Number of Species		3	10	3	19	9	12	11	12	10	15	12	18
Pielou's Evenness Index		0.86	0.46	0.82	0.51	0.62	0.86	0.96	0.83	0.89	0.86	0.45	0.67
Shannon Diversity Index		0.95	1.06	0.90	1.49	1.36	2.15	2.29	2.07	2.06	2.32	1.12	1.93

		SW		SSW		SLW		HHW		ST		TCB	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Abundance		5	159	8	257	41	42	18	38	54	61	232	104

Key

W = wet season, D = dry season.

Table A4.4. *Fauna observed in rocky shore habitats during qualitative and quantitative surveys*

Species Name	Common Name	Conservation Status	SSWW	SSWE	SLWP	AS	AE
Fish							
Ambassis gymnocephalus	Bald Glassy	-				++	
Bathygobius fuscus	Dusky Frillgoby	-		+			
Liza sp.	Mullet					++	
Lutjanus argentimaculatus	Mangrove Red Snapper	-				+	
Gerres oyena	Common Silver-biddy	-				+	
Omobranchus sp.	Blenny					++	
Periophthalmus modestus	Common Mudskipper	-			+++		
Siganus canaliculatus	White-spotted Spinefoot	-				++	
Terapon jarbua	Jarbua Terapon	-			+	++	
Crustacean							
Alpheus sp.	Pistol Shrimp		+				
Balanus reticulatus	Striped Barnacle	-	+++++	+++++	+++++	+++++	+++++
Capitulum mitella	Stalked Barnacle	-	+++				+
Clibanarius striolatus	Hermit Crab	-	+	+	+	+	+
Euraphia withersi	Barnacle	-			+		
Gaetice depressus	Grapsid Crab	-	+	+	+		
Hemigrapsus sanguineus	Grapsid Crab	-	++	+		+	
Leptodius exaratus	Xanthid Crab	-	+	+	+	+	
Ligia exotica	Sea Slater	-	+++	+++	+++	+++	+++
Metopograpsus quadridentatus	Grapsid Crab	-			+		
Nanosesarma minutum	Sesarmine Crab	-	++++	++++	++++	++	++
Pagurus dubius	Hermit Crab	-	+++	+	+		
Parasesarma pictum	Sesarmine Crab	-	++	+	+	+	
Tetraclita squamosa	Acorn Barnacle	-	+	+			++
Amphipoda	Amphipod		+				
Bivalve							
Barbatia virescens	Bearded Ark Shell	-	++++	++++	++++	++++	++++
Isognomon isognomum	Hammer Oyster	-	+	+	+		
Perna viridis	Green Mussel	-	+	+	+	+	+
Saccostrea cucullata	Rock Oyster	-	+++++	+++++	+++++	+++++	+++++
Septifer virgatus	Purplish Bifurcate Mussel	-	+++++	+++++	+++++	++	+++
Trapezium sp.	Clam			+	+++		
Gastropod							
Acanthopleura japonica	Chiton	-		+			+
Cellana grata	Limpet	-	++	++	+		+
Cellana toreuma	Limpet	-	+				+
Echinolittorina radiata	Periwinkle	-	++	++	++	++	++
Echinolittorina malaccana	Periwinkle	-		+			+
Echinolittorina vidua	Periwinkle	-					+
Littoraria melanostoma	Black-mouth Littorine	-			+		
Littoraria sinensis	Periwinkle	-	+++	+++	+++	+++	+++

Species Name	Common Name	Conser-vation Status	SSWW	SSWE	SLWP	AS	AE
Monodonta labio	Top Shell	-	+	+	++	+++	+
Monodonta neritoides	Top Shell	-				+	
Nerita yoldii	Nerita	-	++++	++++	++++	++++	++++
Nipponacmea concinna	Limpet	-					+
Omphalius nigerrimus	Top Shell	-				++	++
Patelloida pygmaea	Limpet	-	+	+	+	++++	++++
Planaxis sulcatus	Ribbed Clusterwink	-					+
Siphonaria japonica	False Limpet	-	+			+	++
Siphonaria laciniosa	False Limpet	-				+	++++
Thais clavigera	Dog Whelk	-	+++	+++	++	+++	+++
Thais luteostoma	Dog Whelk	-	+				
Thais sp.	Dog Whelk			+			
Unknown Gastropod				+			
Annelid							
Hydroides sp.	Tube Worm		+			+	
Cnidarian							
Haliplanella lineata	Sea Anemone	-	++	+	+		
Sipunculid							
Phascolosoma sp.	Peanut Worm				+++		
Total Number of Species			**30**	**29**	**28**	**29**	**26**

Table A4.5. *Fauna observed in rocky shore habitats during quantitative surveys*

		SSWW		SSWE		SLWP		AS		AE	
Species Name	**Common Name**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Fish											
Bathygobius fuscus	Dusky Frillgoby			1							
Crustacean											
Alpheus sp.	Pistol Shrimp	1									
Balanus reticulatus	Striped Barnacle	1825	2040	4590	1180	1265	440	350	1668	6550	4475
Capitulum mitella	Stalked Barnacle	3	8							2	
Clibanarius striolatus	Hermit Crab	5		1		5		1	2	1	
Euraphia withersi	Barnacle						1				
Gaetice depressus	Grapsid Crab	1		1		1					
Hemigrapsus sanguineus	Grapsid Crab	8		1				1			
Leptodius exaratus	Xanthid Crab	1			1	2		1			
Ligia exotica	Sea Slater	138				13		24		35	
Nanosesarma minutum	Sesarmine Crab	115	1	179		365		3		12	
Pagurus dubius	Hermit Crab	35	1	6	6	6	2				
Parasesarma pictum	Sesarmine Crab	24		3		7		1			
Tetraclita squamosa	Acorn Barnacle	5	6	2						15	20
Amphipoda	Amphipod	1									
Bivalve											
Barbatia virescens	Bearded Ark Shell	70	180	86	287	222	146	19	31	24	2
Isognomon isognomum	Hammer Oyster	1		1	1						
Perna viridis	Green Mussel	13	2	7	9	2	1		1	1	
Saccostrea cucullata	Rock Oyster	4230	9200	4116	9845	6780	13380	8610	2601	7510	3009
Septifer virgatus	Purplish Bifurcate Mussel	2654	2455	6100	4345	836	113	2	46	125	117
Trapezium sp.	Clam				6	55					
Gastropod											
Acanthopleura japonica	Chiton				1					1	
Cellana grata	Limpet		62		68		4			1	
Cellana toreuma	Limpet		5								13
Echinolittorina radiata	Periwinkle	11	11		1	3	9			2	44
Echinolittorina malaccana	Periwinkle										1
Echinolittorina vidua	Periwinkle										3
Littoraria melanostoma	Periwinkle					1					

Species Name	Common Name	SSWW		SSWE		SLWP		AS		AE	
		W	D	W	D	W	D	W	D	W	D
Littoraria sinensis	Periwinkle	182	161	64	270	484	450	5	140	32	91
Monodonta labio	Top Shell		2		2	11	8	52	16	7	10
Monodonta neritoides	Top Shell								10		
Nerita yoldii	Nerita	132	31	90	110	94	74	363	17	38	4
Nipponacmea concinna	Limpet										4
Omphalius nigerrimus	Top Shell				1			15	31	13	1
Patelloida pygmaea	Limpet	5	5		1	3		98	64	870	360
Planaxis sulcatus											4
Siphonaria japonica	False Limpet		1						8		35
Siphonaria laciniosa	False Limpet							11		211	11
Thais clavigera	Dog Whelk	67	11	37	46	9	1	32	10	39	28
Thais luteostoma	Dog Whelk	1									
Thais sp.	Dog Whelk				1						
Unknown Gastropod					1						
Annelid											
Hydroides sp.	Tube Worm	20						1			
Cnidarian											
Haliplanella lineata	Sea Anemone	14	20	5	5	2					
Sipunculid											
Phascolosoma sp.	Peanut Worm					52					
Number of Species		26	19	18	21	22	13	18	14	20	19
Pielou's Evenness Index		0.45	0.35	0.43	0.35	0.40	0.16	0.17	0.40	0.36	0.37
Shannon Diversity Index		1.45	1.04	1.25	1.08	1.23	0.42	0.49	1.05	1.07	1.08
Abundance		9562	14202	15290	16187	10218	14629	9589	4645	15489	8232
Ind./ m²		1275	1894	2039	2158	1362	1951	1279	619	2065	1098

Key

W = wet season, D = dry season.

APPENDIX 5- HABITATS AND VEGETATION SURVEYS

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
Abrus mollis	Climber	Restricted		Y								
Acacia auriculiformis	Tree	Exotic, common, often planted in plantation					Y					Y
Acacia confusa	Tree	Exotic, common, often planted in plantation	Y		Y	Y	Y					Y
Acacia mangium	Tree	Exotic, common, often planted in plantation					Y					Y
Acanthus ilicifolius	Shrub	Common						Y				
Achyranthes aspera	Herb	Common					Y					
Acronychia pedunculata	Tree	Very common		Y		Y		Y				
Adenosma glutinosum	Herb	Very common		Y								
Adiantum capillus-veneris	Herb	Common	Y	Y								
Aegiceras corniculatum	Shrub	Common								Y	Y	
Agave americana	Herb	Exotic, common					Y					Y
Ageratum conyzoides	Herb	Exotic, common		Y								Y
Aglaia odorata	Shrub/small tree	Exotic, often planted for ornamental purpose										Y
Alangium chinense	Shrub/small tree	Common	Y	Y		Y	Y					
Albizia lebbeck	Tree	Exotic, common, often planted										Y
Alchornea trewioides	Shrub	Common			Y			Y				
Alocasia odora	Herb	Very common					Y		Y			
Alpinia zerumbet	Herb	Very common										Y
Alternanthera nodiflora	Herb	Exotic, common										Y
Alternanthera sessilis	Herb	Common										Y
Alyxia sinensis	Climber	Common		Y		Y						
Annona squamosa	Tree	Exotic					Y					
Antidesma bunius	Tree	Common		Y								
Antirhea chinensis	Shrub/small tree	Very common	Y	Y								
Aporusa dioica	Tree	Very common	Y	Y	Y	Y	Y					
Aquilaria sinensis	Tree	Common		Y		Y		Y				
Archidendron	Tree	Common		Y	Y	Y						

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
clypearia												
Archidendron lucidum	Tree	Common			Y	Y						
Ardisia crenata	Shrub	Common		Y	Y	Y		Y				
Ardisia lindleyana	Shrub	Common				Y						
Ardisia quinquegona	Shrub	Very common			Y	Y						
Artocarpus macrocarpus	Tree	Exotic					Y		Y			
Asparagus cochinchinensis	Herb	Exotic		Y								
Aster baccharoides	Herb	Very common	Y	Y				Y				
Averrhoa carambola	Tree	Exotic			Y							
Axonopus compressus	Herb	Exotic										Y
Bambusa spp.	Bamboo	Exotic		Y	Y		Y					
Baeckea frutescens	Shrub	Very common	Y									
Bauhinia blakeana	Tree	Common, often planted										Y
Bauhinia championii	Climber	Common		Y								
Bauhinia purpurea	Tree	Exotic, common, often planted					Y					Y
Bauhinia variegata	Tree	Exotic, common, often planted										Y
Berchemia floribunda	Climber	Common	Y			Y						
Bidens alba	Herb	Exotic, very common	Y				Y					Y
Blechnum orientale	Herb	Very common		Y		Y	Y					
Boehmeria nivea	Shrub	Exotic, restricted			Y							
Bougainvillea glabra	Climber	Exotic, common, often planted										Y
Breynia fruticosa	Shrub	Very common	Y	Y		Y						
Bridelia tomentosa	Shrub/small tree	Very common		Y	Y	Y	Y		Y			
Bruguiera gymnorhiza	Shrub/small tree	Restricted in mangrove forest						Y		Y	Y	
Caesalpinia crista	Climber	Very common		Y						Y	Y	
Caesalpinia pulcherrima	Shrub/small tree	Exotic, often planted										Y
Calliandra haematocephala	Shrub	Exotic, common, often planted for ornamental purpose										Y
Callicarpa nudiflora	Shrub	Common				Y						

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
Callicarpa spp.	Shrub	Common			Y							
Callistemon vimilias	Tree	Exotic, often planted										Y
Carallia brachiata	Tree	Common		Y		Y						
Cassia siamea	Tree	Exotic, common										Y
Cassia surattensis	Shrub/small tree	Exotic, often planted										Y
Casuarina equisetifolia	Tree	Exotic, rare, often planted, apparently semi-naturalized					Y					
Celtis biondii	Tree	Restricted in coastal area			Y							
Celtis sinensis	Tree	Common, often planted	Y		Y	Y	Y					Y
Centotheca lappacea	Herb	Common	Y			Y						
Cerbera manghas	Tree	Common		Y						Y	Y	Y
Chloris barbata	Herb	Very common				Y	Y					
Chloris formosana	Herb	Common										Y
Chrysalidocarpus lutescens	Palm	Exotic, often planted										Y
Chrysopogon aciculatus	Herb	Very common		Y								
Cinnamomum camphora	Tree	Common					Y					Y
Clausena lansium	Tree	Exotic, common, fruit tree often planted			Y							
Clerodendrum cyrtophyllum	Shrub	Common		Y								
Clerodendrum fortunatum	Shrub	Common	Y									
Clerodendrum inerme	Shrub	Common								Y	Y	
Cocculus orbiculatus	Climber	Common		Y		Y						
Codiaeum variegatum	Shrub	Exotic, common, often planted										Y
Coix lacryma-jobi	Herb	Common							Y			
Colocasia esculenta	Herb	Common							Y			
Commelina diffusa	Herb	Common							Y			
Conyza canadensis	Herb	Exotic, very common	Y									
Conyza canadensis	Herb	Exotic, very common										Y
Cratoxylum cochinchinense	Shrub/small tree	Very common	Y	Y		Y		Y				
Cuscuta chinensis	Herb	Common						Y	Y			
Cyclosorus	Herb	Very common				Y	Y					

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
parasiticus												
Cyperus distans	Herb	Common										Y
Cyperus pilosus	Herb	Common						Y				
Cyrtococcum patens	Herb	Very common					Y	Y				Y
Dalbergia hancei	Climber	Common		Y								
Daphniphyllum calycinum	Shrub	Common		Y	Y	Y						
Delonix regia	Tree	Exotic, common, often planted	Y									Y
Derris trifoliata	Climber/shrub	Common						Y		Y	Y	
Desmodium gangeticum	Shrub	Common										Y
Desmodium heterocarpon	Subshrub	Very common	Y									
Desmos chinensis	Shrub	Common		Y	Y	Y						
Dianella ensifolia	Herb	Very common	Y	Y								
Dicranopteris pedata	Herb	Very common	Y	Y				Y				
Dimocarpus longan	Tree	Exotic, restricted, found in *Feng Shui* wood, widely cultivated and semi-naturalized	Y	Y	Y		Y					
Dioscorea cirrhosa	Climber	Common		Y								
Diospyros morrisiana	Tree	Very common	Y	Y								
Diospyros vaccinioides	Shrub	Very common	Y	Y		Y						
Diploclisia glaucescens	Climber	Common		Y		Y		Y				
Diplospora dubia	Shrub/small tree	Common		Y				Y				
Dodonaea viscosa	Shrub/small tree	Rare species found in coastal habitats in Ham Tin and Tung Chung										
Drosera indica	Herb	Very rare, found in Tung Chung						Y				
Duranta erecta	Climber/shrub	Exotic, common, often planted for ornamental purpose										Y
Elaeagnus loureiri	Climber	Common				Y						
Elephantopus scaber	Herb	Common	Y									
Elephantopus tomentosus	Herb	Common		Y								Y

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
Eleusine indica	Herb	Very common										Y
Embelia laeta	Climber	Very common	Y	Y				Y				
Embelia ribes	Climber	Common		Y		Y						
Emilia sonchifolia	Herb	Very common					Y					Y
Eragrostis unioloides	Herb	Common	Y									
Eriocaulon sexangulare	Herb	Very common		Y								
Eriochloa procera	Herb	Common		Y				Y				
Eupatorium catarium	Herb	Exotic, very common	Y	Y								Y
Euphorbia hirta	Herb	Exotic, very common	Y									Y
Euphorbia thymifolia	Herb	Very common										Y
Eurya chinensis	Shrub	Very common	Y									
Eurya nitida	Shrub/small tree	Very common	Y	Y								
Excoecaria agallocha	Tree	Common								Y	Y	
Ficus benejamina	Tree	Exotic, common, often planted										Y
Ficus elastica	Tree	Exotic, common, often planted										Y
Ficus hirta	Shrub/small tree	Common	Y	Y	Y	Y						Y
Ficus hispida	Shrub/small tree	Very common					Y		Y			
Ficus microcarpa	Tree	Common				Y	Y	Y				Y
Ficus microcarpa (golden leaves)	Shrub/small tree	Exotic, often planted										Y
Ficus pandurata	Shrub	Restricted, along margin of lowland forest and *Feng Shui* wood				Y						
Ficus pumila	Climber	Very common	Y									Y
Ficus superba var. *japonica*	Tree	Common										Y
Ficus variolosa	Shrub/small tree	Very common	Y			Y		Y				
Ficus virens var. *sublanceolata*	Tree	Common			Y	Y						
Gahnia tristis	Herb	Very common		Y								
Garcinia oblongifolia	Tree	Very common	Y	Y	Y	Y						
Gardenia jasminoides	Shrub	Common		Y								Y
Glochidion eriocarpum	Shrub	Very common	Y	Y								
Glochidion hirsutum	Shrub/small tree	Common		Y								
Gmelina chinensis	Tree	Common		Y								
Gnetum luofuense	Climber	Very common	Y	Y								
Gordonia	Shrub/small	Very common										Y

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
axillaris	tree											
Grevillea robusta	Tree	Exotic, often planted										Y
Gymnema sylvestre	Climber	Very common	Y	Y		Y						
Halophila minor	Herb	Very rare, found in mudflat								Y		
Hedychium coccineum	Herb	Exotic, often planted										Y
Hedyotis acutangula	Herb	Very common	Y	Y								
Helicteres angustifolia	Shrub	Very common	Y	Y				Y				Y
Hibiscus rosa-sinensis	Shrub	Exotic, often planted					Y					Y
Hibiscus tiliaceus	Shrub/small tree	Very common	Y				Y	Y			Y	Y
Hylocereus undatus	Herb	Exotic, common		Y								
Hymenocallis littoralis	Herb	Exotic		Y								Y
Ilex asprella	Shrub	Very common	Y	Y		Y						
Ilex pubescens	Shrub	Very common			Y	Y						
Ilex rotunda	Tree	Exotic, common			Y	Y						
Ilex viridis	Tree	Common	Y									
Imperata koenigii	Herb	Common										
Inula cappa	Herb	Common	Y									
Ipomoea cairica	Climber/herb	Exotic, very common						Y	Y			
Ipomoea pes-caprae	Herbaceous climber	Common										Y
Ipomoea triloba	Herb	Common										Y
Ischaemum spp.	Herb	Common	Y	Y								
Itea chinensis	Shrub/small tree	Very common	Y	Y								
Ixora chinensis	Shrub	Restricted, in lowland forest and *Feng Shui* wood, also widely cultivated										Y
Jarcaranda mimosifolia	Tree	Exotic, often planted										Y
Jasminum lanceolarium	Climber/shrub	Exotic, very common		Y		Y						
Kandelia obovata	Shrub/small tree	Very common								Y		
Kyllinga aromatica	Herb	Exotic, common										Y
Kyllinga brevifolia	Herb	Common				Y						
Kyllinga monocephala	Herb	Common				Y						
Lagerstroemia indica	Shrub/small tree	Exotic, rare species but widely cutivated in										Y

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
		developed area, protected by law										
Lagerstroemia speciosa	Tree	Exotic, often planted										
Lantana camara	Shrub	Exotic, very common	Y	Y	Y	Y	Y		Y			Y
Lantana montevidensis	Shrub	Exotic, often planted										Y
Lemmaphyllum microphyllum	Herb	Common				Y						
Leucaena leucocephala	Tree	Exotic, common				Y	Y					Y
Ligustrum sinense	Shrub/small tree	Common					Y			Y		
Lindernia antipoda	Herb	Common				Y						Y
Liriope spicata	Herb	Very common		Y								
Litchi chinensis	Tree	Exotic					Y					
Litsea glutinosa	Tree	Very common		Y		Y						Y
Litsea monopetala	Tree	Restricted, sometimes planted			Y		Y					
Litsea rotundifolia var. *oblongifolia*	Shrub	Very common	Y	Y		Y	Y	Y				
Lonicera japonica	Climber	Restricted, but often found in forest margin		Y		Y						
Lophatherum gracile	Herb	Very common		Y		Y						
Lophostemon confertus	Tree	Exotic, often planted					Y					Y
Lygodium flexuosum	Climber/herb	Very common	Y			Y						
Lygodium japonicum	Climber/herb	Very common	Y			Y		Y				
Lygodium scandens	Climber/herb	Common	Y									
Macaranga tanarius	Tree	Common	Y	Y	Y		Y					Y
Macrothelypteris torresiana	Herb	Very common	Y									
Maesa perlarius	Shrub	Common		Y	Y	Y						
Mallotus apelta	Shrub/small tree	Common										Y
Mallotus paniculatus	Shrub/small tree	Very common	Y	Y	Y	Y	Y	Y	Y			Y
Malvaviscus arboreus var. *penduliflorus*	Shrub	Exotic										Y
Mangifera indica	Tree	Exotic, fruit tree often planted					Y					
Melastoma candidum	Shrub	Common	Y									Y
Melastoma dodecandrum	Shrub	Common	Y	Y								
Melastoma sanguineum	Shrub	Common	Y			Y						
Melia azedarach	Tree	Exotic,				Y	Y					Y

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
		common										
Melicope pteleifolia	Shrub/small tree	Common		Y		Y		Y				
Microcos paniculata	Shrub/small tree	Common		Y	Y	Y	Y		Y			
Mikania micrantha	Climber/herb	Exotic, very common			Y	Y	Y		Y			
Millettia nitida	Climber/shrub	Very common	Y	Y		Y						
Millettia reticulata	Climber	Common		Y	Y	Y						
Millettia speciosa	Climber	Common		Y		Y						
Mimosa pudica	Shrub	Exotic, very common	Y									Y
Miscanthus sinensis	Herb	Very common	Y	Y				Y				
Monstera deliciosa	Climber/shrub	Exotic, often planted										Y
Murraya panciulata	Tree	Exotic, often planted										Y
Musa x paradisiaca	Herb	Exotic, common, often cultivated					Y					Y
Mussaenda pubescens	Climber/shrub	Very common					Y					
Myrsine seguinii	Tree	Common			Y	Y						
Nephrolepis auriculata	Herb	Common	Y									
Nerium oleander	Shrub	Exotic, often planted					Y					Y
Neyraudia reynaudiana	Herb	Very common	Y				Y					
Oplismenus compositus	Herb	Very common	Y		Y		Y					
Osbeckia chinensis	Herb/subshrub	Very common	Y									
Osmanthus fragrans	Shrub/small tree	Exotic, often planted										Y
Paederia scandens	Climber	Very common		Y	Y			Y				
Pandanus tectorius	Shrub/small tree	Very common	Y	Y		Y			Y	Y	Y	Y
Panicum maximum	Herb	Exotic, very common	Y									Y
Paspalum conjugatum	Herb	Exotic, common										Y
Paspalum orbiculare	Herb	Common										Y
Pavetta hongkongensis	Shrub/small tree	Protected, common		Y								
Pellionia scabra	Herb/shrub	Common		Y								
Pennisetum alopecuroides	Herb	Common					Y					
Pennisetum purpureum	Herb	Exotic, common										Y
Pentaphylax euryoides	Tree	Common	Y									
Pericampylus glaucus	Climber	Restricted, but often found in lowland forest and *Feng Shui*		Y				Y				

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
		wood										
Phoenix roebelenii	Palm tree	Exotic, often planted										Y
Photinia benthamiana	Shrub/small tree	Common				Y						
Phragmites australis	Herb	Very common						Y				
Phragmites karka	Herb	Very common						Y				
Phyllanthus cochinchinensis	Shrub	Very common		Y								
Phyllanthus emblica	Shrub/small tree	Very common	Y	Y		Y						Y
Phyllanthus urinaria	Herb	Common										Y
Phyllodium elegans	Shrub	Common	Y									
Pinus elliotii	Tree	Exotic, often planted in plantation		Y		Y						Y
Pinus massoniana	Tree	Common, often planted in plantation	Y			Y	Y					Y
Pittosporum glabratum	Shrub	Very common		Y		Y						
Plumeria rubra	Tree	Exotic, often planted										Y
Pogonatherum crinitum	Herb	Common		Y								
Polygonum chinense	Herb	Very common			Y				Y			
Psidium guajava	Tree	Exotic, common							Y			
Psychotria asiatica	Shrub/small tree	Very common	Y	Y	Y	Y	Y					
Psychotria serpens	Climber	Very common	Y	Y								
Pteris semipinnata	Herb	Very common				Y						
Pueraria lobata	Climber	Very common			Y		Y		Y			
Pycreus polystachyus	Herb	Common	Y									
Rhaphiolepis indica	Shrub/small tree	Very common	Y	Y								Y
Rhapis excelsa	Palm	Exotic, often planted										Y
Rhododendron pulchrum	Shrub	Exotic, often planted										Y
Rhododendron simsii	Shrub	Very common, wild population is protected by law, often planted										Y
Rhodomyrtus tomentosa	Shrub	Very common	Y			Y		Y				Y
Rhus chinensis	Shrub/small tree	Common	Y	Y			Y					
Rhus succedanea	Shrub/small tree	Common	Y	Y		Y	Y	Y				
Rhynchelytrum repens	Herb	Exotic, very common	Y	Y			Y	Y				Y

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
Rosa laevigata	Climber/shrub	Common				Y						
Rourea microphylla	Climber/shrub	Common	Y	Y	Y	Y	Y	Y	Y		Y	
Rourea minor	Climber/shrub	Common	Y	Y	Y	Y	Y	Y			Y	
Roystonea regia	Palm	Exotic, often planted										Y
Rubus reflexus	Climber/shrub	Very common		Y		Y		Y				
Sageretia thea	Shrub	Very common			Y							
Sapium discolor	Tree	Very common		Y		Y		Y				
Sapium sebiferum	Tree	Common	Y	Y			Y					Y
Sarcosperma laurinum	Tree	Very common		Y								
Scaevola taccada	Shrub	Very common					Y			Y	Y	Y
Schefflera arboricola	Climber/shrub	Exotic, often planted										Y
Schefflera heptaphylla	Climber/shrub	Very common	Y	Y	Y	Y		Y				
Scleria ciliaris	Herb	Common	Y								Y	
Scleria laevis	Herb	Common	Y	Y				Y		Y	Y	
Scolopia chinensis	Shrub/small tree	Common		Y	Y							
Scolopia saeva	Shrub/small tree	Common		Y								
Senecio scandens	Herb	Common		Y	Y							
Setaria glauca	Herb	Very common	Y	Y								
Severinia buxifolia	Shrub	Common	Y	Y	Y		Y					
Smilax china	Climber/shrub	Very common	Y	Y	Y	Y		Y				
Smilax glabra	Climber/shrub	Very common		Y		Y						
Solanum nigrum	Herb	Common										Y
Sterculia lanceolata	Tree	Very common	Y	Y	Y	Y	Y					
Strophanthus divaricatus	Climber	Common	Y	Y							Y	
Strychnos angustiflora	Climber	Common	Y	Y		Y		Y				
Strychnos umbellata	Climber	Common		Y		Y						
Stylidium uliginosum	Herb	Common						Y				
Suaeda australia	Shrub	Common								Y	Y	
Symplocos congesta	Tree	Common				Y						
Symplocos glauea	Tree	Common		Y								
Syngonium podophyllum	Herb	Exotic, often planted										Y
Syzygium jambos	Tree	Exotic, common					Y					
Tadehagi triquetrum	Shrub	Very common	Y									Y
Tetracera asiatica	Climber	Very common	Y	Y		Y		Y				
Tetradium glabrifolium	Tree	Common				Y						
Thespesia	Shrub/small	Restricted in		Y							Y	Y

Species	Growth form	Status in Hong Kong	Grassland/ Shrubland	Tall Shrubland	Young woodland	Secondary woodland	Plantation	Stream/ Channel	Seasonally wet grassland	Mangrove	Associate mangrove	Developed Area
populnea	tree	coastal area										
Thevetia peruviana	Shrub/small tree	Exotic, often planted										Y
Trema tomentosa	Shrub/small tree	Common	Y					Y				
Tridax procumbens	Herb	Exotic, very common										Y
Urena lobata	Herb/shrub	Common										Y
Uvaria macrophylla	Climber/shrub	Common		Y		Y	Y	Y				
Vernonia cinerea	Herb	Very common					Y					Y
Viburnum odoratissimum	Shrub/small tree	Very common			Y		Y					
Viola diffusa	Herb	Common		Y								
Vitex quinata	Tree	Common	Y		Y		Y					
Vitex rotundifolia	Shrub	Common	Y	Y			Y		Y	Y	Y	
Wedelia chinensis	Herb	Common								Y	Y	
Wedelia trilobata	Herb	Exotic, common					Y				Y	Y
Youngia japonica	Herb	Very common				Y						Y
Zanthoxylum avicennae	Tree	Common	Y	Y	Y	Y	Y	Y				
Zanthoxylum nitidum	Climber	Very common	Y	Y								
Zostera japonica	Herb	Rare, found in mudflat								Y		
Zoysia sinica	Herb	Common								Y		
			95	**121**	**49**	**90**	**66**	**48**	**19**	**18**	**20**	**109**

APPENDIX 6. AVIFAUNA RECORDED WITHIN STUDY AREA

Table A6.1. *Aviauna observed during wet and dry season surveys*

Bird Species	***Season recorded***	***Species of Conservation Interest***	**Stream**	**Soft Shore (Sandy Shore and /or intertidal Sandflat/ Mudflat)**	**Hard Shore (Artificial and /or Natural Rocky Shores)**	**Shrubland**	**Developed Area**	**Plantation**	**Woodland**	**Active Dry Agriculture**	**Overhead**	**Total Habitats Recorded**
Grey Heron *Ardea cinerea*	*d*	*PRC*		1	1							2
Great Egret *Egretta alba*	*w, d*	*PRC (RC)*			1							
Little Egret *Egretta garzetta*	*w, d*	*PRC (RC)*		3	23							
Pacific Reef Egret *Egretta sacra*	*w*	*(LC)*			1							
Striated Heron *Butorides striatus*	*w, d*	*(RC)*	2	1								
Black-crowned Night Heron *Nycticorax nycticorax*	*w, d*	*(LC)*	3									
Black Kite *Milvus migrans*	*w, d*										3	
Crested Goshawk *Accipiter trivirgatus*	*d*										2	
Common Buzzard *Buteo buteo*	*d*										2	
Common Kestrel *Falco tinnunculus*	*d*					1						
Little Ringed Plover *Charadrius dubius*	*w, d*	*(LC)*		14								
Whimbrel *Numenius phaeopus*	*w*	*LC*		5								
Common Sandpiper *Actitis hypoleucos*	*w, d*			7	6							
Grey-tailed Tattler *Heteroscelus brevipes*	*w*	*LC*		3								
Oriental Turtle Dove *Streptopelia orientalis*	*d*										1	
Spotted Dove *Streptopelia chinensis*	*w, d*					1	4					
Emerald Dove *Chalcophaps indica*	*w, d*					6						
Collared Scops Owl *Otus bakkamoena*	*w*					2						
Common Kingfisher *Alcedo atthis*	*w, d*				2							
Dollarbird *Eurystomus orientalis*	*w*									1		
Grey Wagtail *Motacilla cinerea*	*w, d*		1	2								
White Wagtail *Motacilla alba*	*w, d*			3								
Richard's Pipit *Anthus richardi*	*d*							1				
Olive-backed Pipit *Anthus hodgsoni*	*d*								2			
Black-winged Cuckoo-shrike *Coracina melaschistos*	*d*									1		
Red-whiskered Bulbul *Pycnonotus jocosus*	*w, d*					20	30			10		
Chinese Bulbul *Pycnonotus sinensis*	*w, d*					50	10			10		
Sooty-headed Bulbul *Pycnonotus aurigaster*	*d*					3						
Brown Shrike *Lanius cristatus*	*w*							1				
Long-tailed Shrike *Lanius schach*	*w, d*									1		
Rufous-tailed Robin *Luscinia sibilans*	*d*								2			
Oriental Magpie Robin *Copsychus saularis*	*w, d*			1		1	2					

Bird Species	***Season recorded***	***Species of Conservation Interest***	**Stream**	**Soft Shore (Sandy Shore and /or intertidal Sandflat/ Mudflat)**	**Hard Shore (Artificial and /or Natural Rocky Shores)**	**Shrubland**	**Developed Area**	**Plantation**	**Woodland**	**Active Dry Agriculture**	**Overhead**	**Total Habitats Recorded**
Blue Rock Thrush *Monticola solitarius*	*d*				3							
Grey-backed Thrush *Turdus hortulorum*	*d*					2						
Pale Thrush *Turdus pallidus*	*d*					2			15			
Masked Laughingthrush *Garrulax perspicillatus*	*w, d*					8	2		8			
Hwamei *Garrulax canorus*	*w*											
Japanese Bush Warbler *Cettia diphone*	*d*							1				
Yellow-bellied Prinia *Prinia flaviventris*	*d*					1						
Common Tailorbird *Orthotomus sutorius*	*w, d*					2	1	2				
Pallas's Leaf Warbler *Phylloscopus proregulus*	*d*								1			
Yellow-browed Warbler *Phylloscopus inornatus*	*d*					6	6	1				
Dusky Warbler *Phylloscopus fuscatus*	*d*							3				
Arctic Warbler *Phylloscopus borealis*	*w, d*							3				
Pale-legged/Sakhalin Leaf Warbler *Phylloscopus tenellipes*	*w*							1				
Blyth's Leaf Warbler *Phylloscopus reguloides*	*d*	*LC*						1				
Asian Brown Flycatcher *Muscicapa dauurica*	*d*								1			
Red-throated Flycatcher *Ficedula albicilla*	*d*								1			
Yellow-rumped Flycatcher *Ficedula zanthopygia*	*w*							1				
Great Tit *Parus major*	*w, d*					2			2			
Fork-tailed Sunbird *Aethopyga christinae*	*d*					1	1	1	1			
Japanese White-eye *Zosterops japonicus*	*w, d*					10						
Common Rosefinch *Carpodacus erythrinus*	*d*	*LC*					1					
Scaly-breasted Munia *Lonchura punctulata*	*d*									3		
Eurasian Tree Sparrow *Passer montanus*	*d*						5					
Black-collared Starling *Sturnus nigricollis*	*d*						4					
White-shouldered Starling *Sturnus sinensis*	*w*	*(LC)*								1		
Crested Myna *Acridotheres cristatellus*	*d*						2					
Black-naped Oriole *Oriolus chinensis*	*w*	*LC*					1					
Black Drongo *Dicrurus macrocercus*	*w*						1					
Common Magpie *Pica pica*	*d*					2						
Large-billed Crow *Corvus macrorhynchos*	*w, d*							1			2	
Total number of species recorded for each habitat			**3**	**10**	**7**	**18**	**14**	**12**	**9**	**7**	**5**	**61**

KEY:
*= denotes wetland dependent bird species
PRC= Potential Regional Concern; RC=Regional Concern; LC = Local Concern, as of Fellowes *et al.* (2002). Those in parenthesis indicate that the assessment is on the basis of restrictedness in breeding and/or roosting rather than general occurrence.
w = Recorded during wet season*; d* = recorded during dry season.

APPENDIX 7 – DRAGONFLIES RECORDED WITHIN STUDY AREA

Table A7.1. *Dragonfly species observed during total study period*

Species	Status and Distribution*	Scenic Hill	San Tau	Kau Liu	Hau Hok Wan	Sha Lo Wan
Indochinese Copperwing *Mnais mneme*	Common in Wooodland Streams				2	
Black-banded Gossamerwing *Euphaea decorata*	Abundant in Mountain Streams				1	
Chinese Yellowface *Agrimorpha fusca*	Abundant in woodland streams				1	
Orange-tailed Sprite *Ceriagrion auranticum*	Abundant and widespread					1
Red-faced Skimmer *Orthetrum chrysis*	Common and widespread.				2	
Common Blue Skimmer *Orthetrum glaucum*	Abundant and widespread.				2	4
Common Red Skimmer *Orthetrum pruinosum*	Abundant and widespread				2	2
Wandering Glider *Pantala flavescens*	Abundant and widespread	+++	+++	+++	+++	+++

*Following Wilson (2004)
+++= high numbers, i.e. 100+ individuals

APPENDIX 8. BUTTERFLY SPECIES RECORDED WITHIN STUDY AREA

Table A8.1. *Butterfly species observed during both wet and dry season surveys*

Species	Soft Shore (Sandy Shore and/or intertidal Sandflat/Mudflat)	Hard Shore (Artificial and /or Natural Rocky Shores)	Grassland	Shrubland	Developed Area	Plantation	Woodland	Active Dry Agriculture	Mangrove and Associate Mangrove	Total Number of Habitats Recorded
Chestnut Angle *Odontoptilum angulatum*				1			1			2
Chestnut Bob *Iambrix salsala*				1						1
Grass Demon *Udaspes folus*				1						1
Common Redeye *Matapa aria*						1				1
Dart Sp. *Potanthus sp.*							1			1
Contiguous Swift *Polytremis lubricans*				1						1
White Dragontail *Lamproptera curius**					1					1
Common Bluebottle *Graphium sarpedon*				2	1		1			3
Common Jay *Graphium doson*								1		1
Tailed Jay *Graphium agamemnon*							2			1
Five-bar Swordtail *Pathysa antiphates*	1		1							2
Lime Butterfly *Papilio demoleus*				1			1			2
Red Helen *Papilio helenus*					1		1			2
Common Mormon *Papilio polytes*				4	7	1		1	1	5
Great Mormon *Papilio memnon*					2		2			2
Spangle *Papilio protenor*							1			1
Chinese Peacock *Papilio bianor*				1	1					2
Paris Peacock *Papilio paris*					1					1
Red-base Jezebel *Delias pasithoe*	1	2		4	1	1				5
Indian Cabbage White *Pieris rapae*				1						1
Common Gull *Cepora nerissa*				2		2				2
Yellow Orange Tip *Ixias pyrene*							1			1
Great Orange Tip *Hebomoia glaucippe*							1	1		2
Lemon Emigrant *Catopsilia pomona*					1					1
Common Grass Yellow *Eurema hecabe*			1		1		22			3
Silver Streak Blue *Iraota timoleon*							1			1
Long-banded Silverline *Spindasis lohita*				1			1			2
Chocolate Royal *Remelana jangala*									1	1
Purple Sapphire *Heliophorus epicles*					1			1		2
Dark Cerulean *Jamides bochus*				1						1

Species	**Soft Shore (Sandy Shore and/or intertidal Sandflat/Mudflat)**	**Hard Shore (Artificial and /or Natural Rocky Shores)**	**Grassland**	**Shrubland**	**Developed Area**	**Plantation**	**Woodland**	**Active Dry Agriculture**	**Mangrove and Associate Mangrove**	**Total Number of Habitats Recorded**
Pale Grass Blue *Zizeeria maha*				1			1			2
Dark Grass Blue *Zizeeria karsandra*				2						1
Lesser Grass Blue *Zizina otis*				2						1
Tailed Cupid *Everes lacturnus*				1						1
Common Hedge Blue *Acytolepis puspa*				1						1
Lime Blue *Chilades lajus*				6						1
Plum Judy *Abisara echerius*				1		1	2			3
Common Evening Brown *Melanitis leda*							1			1
Dark Evening Brown *Melanitis phedima*							1			1
Common Palmfly *Elymnias hypermnestra*						1				1
Dark-brand Bush Brown *Mycalesis mineus*				6			1			2
South China Bush Brown *Mycalesis zonata*				1						1
Common Five-ring *Ypthima baldus*				2						1
Large Faun *Faunis eumeus*							5			1
Tawny Rajah *Charaxes bernardus*				1						1
Angled Castor *Ariadne ariadne*					1			1		2
Rustic *Cupha erymanthis*				25			1		1	3
Common Leopard *Phalanta phalanta*				1						1
Blue Admiral *Kaniska canace*				1						1
Peacock Pansy *Junonia almana*			1							1
Grey Pansy *Junonia atlites*				1	1			1		3
Lemon Pansy *Junonia lemonias*					1					1
Chocolate Pansy *Junonia iphita*							1			1
Great Egg-fly *Hypolimnas bolina*				2			2		1	3
Common Sailer *Neptis hylas*				1						1
Staff Sergeant *Athyma selenophora*				1						1
Black Prince *Rohana parisatis*							1			1
Glassy Tiger Parantica aglea					1					1
Common Tiger *Danaus genutia*				2	1					2
Total number of species per habitat	**2**	**1**	**3**	**32**	**16**	**6**	**24**	**6**	**4**	**59**

*Species of 'Local Concern' as per Fellowes *et al. (2002)*

APPENDIX 9 – STREAM FAUNA RECORDED WITHIN STUDY AREA

Table A9.1. *Aquatic fauna recorded during stream surveys*

		San Tau				Hau Hok Wan						Sha Lo Wan			
Species and Common Names	**Conser-vation Status**	**ST9**		**ST12**		**HH2**		**HH3**		**HH5**		**SL3**		**SL8**	
Season		**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Water Level					**Dried**		**#**		**#**		**#**			**#**	**Dried**
Reptile															
Trachemys scripta Red-eared Slider													1		
Amphibian															
Paa exilispinosa Lesser Spiny Frog (Tadpole)	a					*		2							
Fish															
Acanthopagrus latus Yellowfin Seabream											5		10		
Acrossocheilus beijiangensis Beijiang Thick-lipped Barb	b		1												
Ambassis gymnocephalus Glassperch			100+									100+			
Cyprinus carpio Ornamental Carp		1	1												
Favonigobius reichei Indo-Pacific Tropical Sand Goby	c		50+								1		30		
Gambusia affinis Mosquito Fish												1	5		
Gerres filamentosus Whipfin silverbiddy			50+												
Gerres oyena Silver-biddy		1								10		10			
Glossogobius sp. Goby		2	2									10	1		
Kuhlia marginata Dark-margined Flagtail	d		1												
Liza affinis Mullet										50		50			
Liza sp. 1 Mullet		50	100+							30		50	100+		
Liza sp. 2 Mullet		30								100		50			
Mugil cephalus Grey Mullet		1													
Mugilogobius chulae Yellowstripe Goby												30			
Mugilogobius abei Goby												10			
Oreochromis niloticus Nile Tilapia													2		
Oryzias curvinotus Rice Fish	e	20	100					1		1	1				
Parazacco spilurus Predaceous Chub	f	100+	100+									100+	100+		
Periophthalmus modestus Mudskipper		1	20	4				20	3	60	11	50	100+		
Redigobius sp. Goby											1				
Rhinogobius duospilus Freshwater Goby			8									20			
Scatophagus argus Scat		2													
Terapon jarbua Jarbua Terapon			100+							30		10	30		
Tridentiger trigonocephalus Chameleon Goby			1								1	3	20		

		San Tau				Hau Hok Wan						Sha Lo Wan			
Species and Common Names	**Conser-vation Status**	**ST9**		**ST12**		**HH2**		**HH3**		**HH5**		**SL3**		**SL8**	
Season		**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**	**W**	**D**
Valamugil sp. Mullet			100+										100+		
Xiphophorus hellerii Swordtail												30	35		
Zenarchopterus striga Hooghly Halfbeak										25		10			
Crustacean															
Amphipoda Amphipod			50+								20		10		
Caridina cantonensis Atyid Shrimp			10			2		30			4	60	100+		
Chiromantes sereni Sesarmine Crab	g							3				5			
Macrobrachium nipponense Long-armed Shrimp		100+	50+	1		1	5	6		1	22	30	50+		
Metapenaeus ensis Greasyback Shrimp	h		3									2			
Nanosesarma minutum Sesarmine Crab													50		
Pagurus dubius Hermit Crab			100+								3				
Parasesarma pictum Sesarmine Crab				2											
Perisesarma bidens Sesarmine Crab			10	7						20	1	30	50		
Portunus pelagicus Swimming Crab			1												
Somanniathelphusa zanklon Freshwater Crab	i			2											
Scylla serrata Mud Crab			1								1	1			
Varuna sp. Grapsid Crab		30	40								15		10		
Insect															
Coenagrionidae sp. Damselfly (Nymph)													25		
Enithares sp. Backswimmer						4		2		10				2	
Gomphidae sp. Dragonfly (Nymph)											2				
Libelluidae sp. Dragonfly (Nymph)															
Orthetrum Sabina Green Skimmer (Nymph)														1	
Platycnemididae sp. Damselfly (Nymph)													25		
Tipulidae sp. True Fly (Larvae)							1								
No. of Species		**12**	**24**	**5**	**0**	**3**	**2**	**7**	**1**	**11**	**14**	**22**	**21**	**2**	**0**
Total No. of Species		**28**		**5**		**4**		**7**		**21**		**32**		**2**	

Key
W = wet season, D = dry season.
a = IUCN and CSIS Red list: vulnerable (www.iucnredlist.org; www.baohu.org), potential global concern (Fellowes *et al.*, 2002)
b = rare (Lee *et al.* 2004), global concern (Fellowes *et al.* 2002)
c = IUCN red list: lower risk/ near threatened (www.iucnredlist.org)
d = IUCN red list: lower risk/ least concern (www.iucnredlist.org), regional concern (Fellowes *et al.* 2002), very rare (AEC Staff per. obs.)
e = uncommon (Lee *et al.*2004), global concern (Fellowes *et al.* 2002)
f = CSIS red list: vulnerable (www.baohu.org), vulnerable (Yue and Chen, 1998)
g = endemic (Kwok and Tang, 2005)
h = CSIS red list: vulnerable (www.baohu.org)
i = IUCN red list: endangered (www.iucnredlist.org), global concern (Fellowes *et al.* 2002)
* = Three Lesser Spiny Frog's tadpoles have been observed during other surveys.
# = Water level low

APPENDIX 10. PHOTOS OF SPECIES OF CONSERVATION CONCERN

Plate A.10.1. *Photos of Species of Conservation Concern in Intertidal Areas*

1: Horseshoe Crab Juvenile at TCB

2: Dead Horseshoe Crab Subadult at TCB

3: Horseshoe Crab Juvenile at ST

4: Horseshoe Crab's Footprints at SW

5: Indo-Pacific Tropical Sand Goby

6: Walking Goby

7: *Zostera japonica* at ST

8: *Halophila minor* at ST

Plate A10.2. *Photos of Species of Conservation Concern in Streams and Terrestrial Areas*

1: Tadpole of Lesser Spiny Frog

2: Rice Fish

3: Predaceous Chub

4: White Dragontail

5. *Eulophia graminea*

6. *Aquilaria sinensis*

7. *Dodonaea viscosa*

8. *Drosera indica*


9: *Pavetta hongkongensis*	10: *Thespesia populnea*

APPENDIX 11. PHOTOS SHOWING EXAMPLES OF HABITATS PRESENT WITHIN STUDY AREA

1: Active Dry Agriculture

2: Associated Mangrove

3: Developed Area

4: Grassland

5. Grassland/Shrubland

6. Mangrove

7. Plantation

8. Mudflat

9: Seasonally Wet Grassland

10: Secondary Woodland

11: Shrubland

12: Stream

13: Tall Shrubland

14: Young Woodland

APPENDIX 12. PHOTOS OF SOFT & HARD SHORE SURVEY LOCATIONS

Plate A12.1 *Photos of Soft Shore Survey Locations*

1: Sham Wat	2: San Shek Wan

3: Sha Lo Wan	4: Hau Hok Wan

5. San Tau	6. Tung Chung Bay

Plate A12.2 *Photos of Hard Shore Survey Locations*

1: San Shek Wan West

2: San Shek Wan East

3: Sha Lo Wan Pier

4: Airport South

5: Airport East

APPENDIX 10C

Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Final Supplementary Ecological Survey Report, July 2009

Highways Department

Quotation Reference: Hy(S)Q/045/2008

Hong Kong-Zhuhai-Macao Bridge
Hong Kong Link Road
Supplementary Ecological Survey

Final Supplementary
Ecological Survey Report

July 2009

	Name	Signature
Prepared & Checked:	Gigi Lam	
Reviewed & Approved:	Josh Lam	

Version: Final Date: 16 July 2009

The information contained in this report is, to the best of our knowledge, correct at the time of printing. The interpretation and recommendations in the report are based on our experience, using reasonable professional skill and judgment, and based upon the information that was available to us. These interpretations and recommendations are not necessarily relevant to any aspect outside the restricted requirements of our brief. This report has been prepared for the sole and specific use of our client and AECOM Environment accepts no responsibility for its use by others.

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Annexes

Annex A Rapid Ecological Assessment

1 BACKGROUND

1.1 AECOM Asia Co. Ltd. was commissioned by Highways Department to provide professional services in relation to the Supplementary Ecological Survey with a view to provide all necessary information to facilitate the investigation of Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road. Ecological profile of the Survey Area based on survey findings would be provided so as to enable the impact assessments in the EIA Study.

1.2 The Study is to complete the following:

(a) field surveys and investigations covering both the wet and dry seasons;
(b) investigation and description of the existing wildlife uses of various habitats; and
(c) establish the ecological profile of the Survey Area and description of the characteristics of each habitat found.

2 INTRODUCTION

2.1 This Final Supplementary Ecological Survey Report presents the marine ecological baseline information (dry season and wet season) at the southeast of Airport Island to facilitate the assessment on the potential ecological impacts on benthic, coral and intertidal communities of the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road.

3 SURVEY METHODOLOGY

3.1 The Survey Area is located at the southeast of Airport Island (**Figure 1** refers). The survey methodology and schedule are described below.

Table 1 Survey Programme for Ecological Surveys

Items	**2009**				
	Jan	**Feb**	**Mar**	**Apr**	**May**
Marine grab sampling	■				■
Dive survey		■			
Intertidal survey	■	■		■	■

3.2 Marine Grab Sampling

3.2.1 To survey marine soft bottom benthic fauna, grab sampling of seabed sediment were carried out in dry (January 2009) and wet (May 2009) seasons. Eight sampling sites were proposed at the Survey Area (**Figure 1** refers). At each of the sampling sites, five replicates of grab samples were collected using a van Veen grab. Each grab sample covered over 0.1 m^2 of seabed substrate. Samples were then sieved through 0.5 mm sieves, preserved in 5% borax-buffered formalin and stained with Rose Bengal. Collected organisms were counted, weighed and identified to the lowest practicable taxon as possible.

3.2.2 Species composition, abundance, biomass, species diversity *H'* and evenness *J* were calculated for pooled data, using the formulae:

$$H' = -\sum (Ni / N) \ln (Ni / N); \text{ and}$$
$$J = H' / \ln S$$

where S is the total number of species in the sample, N is the total number of individuals, and Ni is the number of individuals of the i^{th} species.

3.2.3 Abundance / Biomass Comparison (ABC) plots were also provided for evaluating and ranking the ecological values.

3.3 Dive Survey

3.3.1 Spot reconnaissance dives for corals and other hard substrate marine organisms were conducted in February 2009 to check for the presence of corals (including hard corals, octocorals and black corals) and other marine organisms with conservation importance within the Survey Area. Eight dive spots were proposed at the Survey Area (**Figure 1** refers). Circular paths at each dive spot were adopted during the reconnaissance dives due to low underwater visibility. Rapid Ecological Assessment (REA) was conducted at two locations within the Survey Area based on the findings of the spot reconnaissance dives (**Figure 1** refers). REA surveys were performed along 100 m and 50 m transects parallel and perpendicular to the coastlines. Depth and substrate along the perpendicular transects were recorded at 3 m interval. Benthic cover, taxon abundance and ecological attributes of the transects were recorded in a swathe of 2 m wide. Locations and routes of REA transects were recorded on site by GPS and map. Representative photographs of dive locations and fauna found were taken. Details of REA are given in **Annex A**.

3.4 Intertidal Survey

3.4.1 Intertidal surveys for epifauna communities were conducted in dry (January and February 2009) and wet (April and May 2009) seasons at four locations within the Survey Area (**Figure 1** refers). Horizontal transects (50 m) at three tidal levels (high, middle and low) were established. Ten 0.5 m x 0.5 m quadrats were deployed on each transect. The infauna within the top 5 cm sediment inside the quadrat as well as from one core (10 cm x 20 cm depth) were also collected, identified and recorded for soft shores. Species found and their abundance were recorded. Diversity index and evenness index were provided. Walk-through survey was conducted at each site by two surveyors for 30 minutes. The walk-through survey could help assess whether the sampling exercise had collected representative data (e.g. the number and type of species encountered) and whether the sampling effort is deemed adequate.

4 SURVEY FINDINGS

4.1 Benthic Community

4.1.1 Marine grab sampling was conducted in dry (17th January 2009) and wet (1st May 2009) seasons. The sediment samples collected from the Survey Area consisted of about 85% silt-clay fraction (particle diameter <64 µm) and 15% coarse materials (gravels, coarse sand and leaf litter). The sediment was grey in colour and no special odour was detected.

4.1.2 A total of 917 and 345 organisms were identified from the sediment samples collected in dry and wet season surveys. Out of 105 taxa recorded, 100 taxa were identified to genus or species levels. The most diverse phylum was polychaetes (51 species) followed by molluscs (18 species), crustaceans (13 species), echinoderms (6 species), fishes (5 species), cnidarians (4 species), echiurans (3 species), and sipunculan (1 species).

4.1.3 In dry season, 43%, 35%, 11%, 6% and 5% of organisms collected (in terms of number of individuals) were polychaetes, crustaceans, molluscs, nemerteans and other phyla, respectively. The total biomass (wet weight) was 119.68 g, in which 71%, 13%, 9%, 5% and 2% of total biomass were accounted by molluscs, echiurans, fishes, polychaetes and other phyla, respectively. In wet season, 58%, 15%, 12%, 8% and 7% of organisms collected were polychaetes, molluscs, crustaceans, echinoderms and other phyla, respectively. The total biomass was 130.87 g, in which 52%, 27%, 15% and 6% of total biomass were accounted by echinoderms, molluscs, crustaceans and other phyla, respectively. **Table 2** lists the total abundance and biomass of each faunal group.

Table 2 Total Abundance and Biomass of Each Faunal Group

Faunal Group	No. of Individuals	Percentage (%) (1)	Biomass (g)	Percentage (%) (1)
Dry Season				
Polychaeta	397	43	5.7830	5
Crustacea	325	35	1.9302	2
Mollusca	103	11	84.7337	71
Nemertea	58	6	0.4037	0
Echiura	14	2	15.3756	13
Echinodermata	7	1	0.4026	0
Fish	6	1	10.9851	9
Cnidaria	4	0	0.0689	0
Sipuncula	2	0	0.0015	0
Phoronia	1	0	0.0001	0
Total	**917**	**100**	**119.6844**	**100**
Wet Season				
Polychaeta	200	58	2.6714	2
Mollusca	52	15	35.4167	27
Crustacea	40	12	19.3636	15
Echinodermata	27	8	67.5864	52
Nemertea	12	3	0.2896	0
Sipuncula	5	1	0.0267	0
Fish	4	1	3.5464	3
Cnidaria	3	1	1.9587	1
Platyhelminthes	2	1	0.0061	0
Total	**345**	**100**	**130.8656**	**100**

Note:

(1) 0% means total individual / biomass of the faunal group is less than 1% of all organisms recorded.

4.1.4 In dry season, the total number of species, abundance and biomass ranged between 14 – 54 spp. 0.5 m^{-2}, 50 – 686 individual m^{-2} and 4.5 – 104.7 g m^{-2}, respectively among the eight sampling points. In wet season, the number of species, abundance and biomass decreased to 12 – 27 spp. 0.5 m^{-2}, 48 – 110 individual m^{-2} and 7.6 – 72.0 g m^{-2}. The *H'* and *J* were similar at different sites in the Survey Area with no seasonal pattern, which ranged between 1.91 – 3.11 and 0.61 – 0.96 respectively. **Table 3** lists the total number of species, abundance, biomass, species diversity and evenness at each sampling point.

Table 3 Total Number of Species, Abundance, Biomass, Species Diversity and Evenness at Each Sampling Point

	B1	B2	B3	B4	B5	B6	B7	B8
Dry Season								
Total no. of species (spp. 0.5 m^{-2})	30	30	39	26	16	14	54	16
Total abundance (individual m^{-2})	142	196	384	138	144	50	686	94
Total biomass (g m^{-2})	24.2	11.5	104.7	4.5	35.5	7.2	35.9	16.0
Species diversity (*H'*)	2.82	2.74	2.94	2.81	2.26	2.31	2.42	2.10
Species evenness (*J*)	0.83	0.80	0.80	0.86	0.82	0.88	0.61	0.76
Wet Season								

	B1	B2	B3	B4	B5	B6	B7	B8
Total no. of species (spp. 0.5 m^{-2})	21	22	17	23	27	12	23	13
Total abundance (individual m^{-2})	96	110	56	104	104	48	102	70
Total biomass (g m^{-2})	72.0	38.2	32.7	43.8	23.0	19.3	25.1	7.6
Species diversity (*H'*)	2.75	2.37	2.73	2.59	3.11	2.24	2.95	1.91
Species evenness (*J*)	0.90	0.77	0.96	0.83	0.94	0.90	0.94	0.75

4.1.5 In dry season, polychaetes and crustaceans were the dominant groups at all sampling points that they constituted about 80% of total abundance. The Survey Area was dominated by amphipods and polychaetes *Mediomastus* sp. and *Sigambra hanaokai*. In wet season, polychaetes became the dominant group (dominated by *Mediomastus* sp.) with approximately 60% of total abundance. **Table 4** and **Table 5** present the proportion of each faunal group (in total abundance) and the five most abundant species at each sampling point. A complete list of collected organisms is shown in **Appendix 1**. All the species recorded are common and no rare species or species with conservation importance was found.

Table 4 Percentage Proportion of Faunal Groups (in Total Abundance) at Each Sampling Point

% Proportion of Faunal Groups	B1	B2	B3	B4	B5	B6	B7	B8
Dry Season								
Polychaeta	45	50	60	49	65	44	28	26
Crustacea	24	32	14	35	7	32	56	45
Nemertea	17	9	5	6	11	8	3	9
Mollusca	11	7	19	9	15	4	8	11
Others	3	2	2	1	1	12	5	11
Wet Season								
Polychaeta	58	64	46	54	54	63	51	77
Mollusca	19	9	11	31	13	13	14	6
Crustacea	13	11	14	6	21	4	16	3
Echinodermata	10	11	18	4	2	13	8	3
Others	0	5	11	5	10	7	11	11

Table 5 The Five Most Abundant Species at Each Sampling Point

Sampling Point	Group (1)	Species	Mean Density (individual m^{-2})	Mean Biomass (g m^{-2})	Relative Abundance (%)
Dry Season					
B1	C	Amphipod spp.	28	0.0076	20
	N	Nemertean spp.	24	0.2142	17
	P	*Mediomastus* sp.	20	0.0212	14
	P	*Aglaophamus dibranchis*	8	0.0262	6
	P	*Linopherus paucibranchiata*	4	0.0268	3
B2	C	Amphipod spp.	52	0.0110	27
	P	*Sigambra hanaokai*	26	0.0068	13

Sampling Point	Group (1)	Species	Mean Density (individual m^{-2})	Mean Biomass (g m^{-2})	Relative Abundance (%)
	N	Nemertean spp.	18	0.0354	9
	P	*Mediomastus* sp.	16	0.0292	8
	P	*Glycera alba*	10	0.0084	5
B3	P	*Mediomastus* sp.	82	0.2388	21
	C	Amphipod spp.	46	0.0126	12
	P	*Sigambra hanaokai*	34	0.0090	9
	M	*Paphia undulata*	30	31.8768	8
	N	Nemertean spp.	20	0.3860	5
B4	C	Amphipod spp.	36	0.0188	26
	P	*Sigambra hanaokai*	10	0.0058	7
	P	*Laonice cirrata*	10	0.0854	7
	P	*Poecilochaetus hystricosus*	10	0.0406	7
	N	Nemertean spp.	8	0.0318	6
B5	P	*Mediomastus* sp.	38	0.0904	26
	P	*Sigambra hanaokai*	26	0.0096	18
	N	Nemertean spp.	16	0.0624	11
	P	*Schistomeringos rudolphi*	16	0.0174	11
	M	*Paphia undulata*	10	17.7178	7
B6	C	Amphipod spp.	16	0.0010	32
	P	*Notomastus* sp.	6	0.0546	12
	N	Nemertean spp.	4	0.0036	8
	P	*Aglaophamus dibranchis*	4	0.0132	8
	P	*Mediomastus* sp.	2	0.0190	4
B7	C	Amphipod spp.	364	0.1590	53
	M	*Paphia undulata*	22	7.7270	3
	P	*Lumbrineris nagae*	20	0.1914	3
	N	Nemertean spp.	18	0.0664	3
	P	*Glycera chirori*	14	0.0924	2
B8	C	Amphipod spp.	42	0.0098	45
	N	Nemertean spp.	8	0.0076	9
	P	*Mediomastus* sp.	8	0.0164	9
	P	*Sigambra hanaokai*	6	0.0024	6
	Eh	*Urechis* sp.	4	7.5602	4
Wet Season					
B1	P	*Mediomastus* sp.	20	0.0298	21
	M	*Paphia undulata*	10	3.2622	10
	C	Amphipod spp.	8	0.0108	8
	Ec	*Acaudina molpadioides*	8	63.4606	8
	P	*Notomastus* sp.	6	0.0248	6
B2	P	*Mediomastus* sp.	46	0.0942	42
	Ec	*Protankyra bidentata*	8	28.0116	7

Sampling Point	Group (1)	Species	Mean Density (individual m^{-2})	Mean Biomass (g m^{-2})	Relative Abundance (%)
	C	Amphipod spp.	6	0.0092	5
	P	*Lumbrineris shiinoi*	6	0.0036	5
	P	*Sigambra hanaokai*	4	0.0010	4
B3	P	*Mediomastus* sp.	6	0.0034	11
	Ec	*Amphiura hexactis*	6	0.1724	11
	N	Nemertean spp.	6	0.2156	11
	P	*Terebellides stroemii*	4	0.0434	7
	P	*Ophelina acuminata*	4	0.3456	7
B4	P	*Mediomastus* sp.	26	0.0620	25
	M	*Paphia undulata*	22	25.1432	21
	M	*Macoma candida*	8	11.9442	8
	N	Nemertean spp.	4	0.1262	4
	P	*Terebellides stroemii*	4	0.0272	4
B5	C	Amphipod spp.	10	0.0048	10
	P	*Glycera rouxii*	10	0.4208	10
	M	*Macoma candida*	8	9.5050	8
	P	*Mediomastus* sp.	6	0.0086	6
	N	Nemertean spp.	6	0.1988	6
B6	P	*Mediomastus* sp.	14	0.0286	29
	Ec	*Protankyra bidentata*	6	7.2698	13
	P	*Aglaophamus sinensis*	4	0.0088	8
	P	*Laonice cirrata*	4	0.0218	8
	M	*Azorinus coartata*	4	5.2096	8
B7	C	Amphipod spp.	16	0.0074	16
	Sp	*Apionsoma trichocephalus*	8	0.0458	8
	M	*Paphia undulata*	6	4.4786	6
	P	*Lumbrineris nagae*	6	0.3144	6
	P	*Euchymene oerstedii*	6	0.0196	6
B8	P	*Mediomastus* sp.	34	0.1062	49
	P	*Notomastus* sp.	6	0.0392	9
	P	*Sigambra hanaokai*	6	0.0034	9
	N	Nemertean spp.	4	0.0260	6
	Cn	*Metedwardsia akkeshi*	4	3.9132	6

Note:

(1) P=Polychaeta; C=Crustacea; M=Mollusca; N=Nemertea; Eh=Echiura; Ec=Echinodermata; Sp=Sipuncula; Cn=Cnidaria

4.1.6 The benthic community was spatially divided into four groups in Hong Kong waters (Shin *et al.*, 2004). The biodiversity and evenness of benthic community lied between "Eastern and Southern Waters" and other polluted groups, reflecting a mild pollution status (**Table 6** refers).

The Abundance / Biomass Comparison plots were shown in **Appendix 2**. The positive values of *W* statistics of the Abundance / Biomass Comparison plots showed that all sampling points were under "mildly disturbed" conditions (Clarke, 1990).

Table 6 Comparison of Mean *H'* and *J* of Benthic Communities at Different Hong Kong Waters with the Survey Area

Water Zone	Southeast of Airport Island (Survey Area)	Tolo Harbour	Eastern and Southern Waters	Victoria Harbour	Deep Bay
H'	2.55 (Dry) 2.58 (Wet)	1.36	2.82	1.64	2.32
J	0.79 (Dry) 0.87 (Wet)	0.83	0.81	0.44	0.73

4.2 Coral Community

4.2.1 The marine water around Hong Kong (especially in the west) is relatively turbid and has low salinity, due to the influence of the Pearl River to the west. Corals mainly grow in the northeastern and eastern waters, where the waters are both sheltered and free from the influence of the Pearl River. Therefore, the general absence of hermatypic corals from the Survey Area at the southeast of Airport Island is not unexpected.

4.2.2 Spot reconnaissance dives in the current survey were conducted on 14th and 15th February 2009. The weather conditions for the dive surveys were summarised in **Table 7**. A total of eight spot reconnaissance dives were carried out (**Figure 1** refers) and the site conditions were given in **Table 8**.

Table 7 Weather Conditions during the Spot Reconnaissance Dive Surveys

Survey Date	Weather Condition	Underwater Visibility (m)
14th February 2009	Cloudy with southeast force 3	0.5
15th February 2009	Cloudy with southeast force 2 – 3	0.5

Table 8 Conditions of the Spot Reconnaissance Dive Sites

Site	Starting Location (GPS)	Maximum Depth (m)	Bottom Substrate	Visibility (m)
D1	E113°56'17.4" N22°17'43.1"	4	Boulder / Rock	0.5
D2	E113°56'14.2" N22°17'55.7"	3	Bedrock / Boulder	0.5
D3	E113°56'11.2" N22°18'03.7"	3	Bedrock / Rubble	0.5
D4	E113°56'17.6" N22°18'08.9"	3	Boulder / Rock	0.5
D5	E113°56'23.3" N22°18'15.9"	3	Sand / Rubble	0.5
D6	E113°56'20.7" N22°18'21.2"	3	Bedrock / Boulder	0.5

Site	Starting Location (GPS)	Maximum Depth (m)	Bottom Substrate	Visibility (m)
D7	E113°56'25.2" N22°18'41.4"	3	Boulder / Rock	0.5
D8	E113°56'29.1" N22°18'44.5"	4	Boulder / Rock	0.5

4.2.3 D1 and D8 were mainly composed of slopping boulders and rocks at the bottom (**Appendix 3** refers). Substrates beyond the maximum depth were muddy with visibility of less than 0.5 m. Snail *Thais luteostoma* was found on surfaces of big boulders while green mussel *Perna viridis* was found at shallow water in the clefts between boulders (**Appendix 4** refers). Both species are commonly found in Hong Kong. No hard coral was recorded in these two sites. One species of gorgonian coral *Echinomuricea* sp. was found on the boulder surfaces (**Appendix 4** refers). The gorgonian is a very common octocoral species found in Hong Kong. This species is adapted to harsh and turbid environment with low visibility and could be found in many places in Hong Kong. The percentage cover of the gorgonian recorded was low (<1%) and the gorgonians were in fair condition (**Table 9** refers).

Table 9 Coral Species Found during the Spot Reconnaissance Dives

Site	Coral Species	Coverage (%)	Size in Height (cm)
D1	*Echinomuricea* sp.	<1	5 – 20
D8	*Echinomuricea* sp.	<1	5 – 20

4.2.4 D2, D3, D4, D6 and D7 are composed of natural bedrock and scattered boulders with sand and smaller rocks at the bottom (**Appendix 3** refers). Common species including black mussel *Septifer virgatus*, snail *Thais luteostoma* and green algae *Ulva* sp. were recorded on the surface of bedrocks and boulders. No coral was found in these sites.

4.2.5 D5 is a natural sandy beach with scattered rubbles at the bottom. Black mussel *Septifer virgatus*, green algae *Ulva* sp. and unidentified oyster were found on the surfaces of the scattered rocks. The species recorded are common in Hong Kong. No coral was recorded.

4.2.6 All the sites in the Survey Area supported limited marine life only (**Table 10** refers). No hard coral was found in the Survey Area. One species of gorgonian *Echinomuricea* sp. was found on boulder surfaces at D1 and D8. All the fauna found in the Survey Area are common, occurred in low abundance and sparsely distributed. No rare or species of conservation importance was recorded. As gorgonian was recorded, more detailed REA was carried out at D1 and D8.

Table 10 Dominating Species and Coral Found during the Spot Reconnaissance Dives

Site	Dominating Species	Rarity	Coral Species	Rarity
D1	*Thais luteostoma, Perna viridis*	Common	*Echinomuricea* sp.	Common
D2	*Thais luteostoma, Septifer virgatus, Ulva* sp.	Common	N/A	N/A
D3	*Thais luteostoma, Septifer virgatus, Ulva* sp.	Common	N/A	N/A
D4	*Thais luteostoma, Septifer virgatus, Ulva* sp.	Common	N/A	N/A

Site	Dominating Species	Rarity	Coral Species	Rarity
D5	*Septifer virgatus, Ulva* sp.	Common	N/A	N/A
D6	*Thais luteostoma, Septifer virgatus, Ulva* sp.	Common	N/A	N/A
D7	*Thais luteostoma, Septifer virgatus, Ulva* sp.	Common	N/A	N/A
D8	*Thais luteostoma, Perna viridis*	Common	*Echinomuricea* sp.	Common

4.2.7 REA surveys were conducted on 28th February 2009. **Table 11** gives the weather condition on the day of survey. Two 100 m transects and two 50 m (due to low underwater visibility) transects were laid parallel and perpendicular to the shore respectively, covering D1 and D8 (**Figure 1** refers). The site conditions were summarised in **Table 12**.

Table 11 Weather Conditions during the REA Surveys

Survey Date	Weather Condition	Underwater Visibility (m)
28th February 2009	Sunny with northeast force 4	1

Table 12 Conditions of the REA Transects

Site	Starting Location (GPS)	Ending Location (GPS)	Maximum Depth (m)	Bottom Substrate	Visibility (m)
D1	Horizontal				
	E113°56'17.7" N22°17'42.4"	E113°56'15.8" N22°17'46.2"	4	Boulder / Rock	1
	Perpendicular				
	E113°56'15.7" N22°17'45.5"	E113°56'16.5" N22°17'45.6"	5	Boulder / Muddy	0.5
D8	Horizontal				
	E113°56'24.8" N22°17'41.1"	E113°56'28.1" N22°18'44.5"	4	Boulder / Rock	1
	Perpendicular				
	E113°56'27.1" N22°18'43.3"	E113°56'27.6" N22°18'43.0"	5	Boulder / Muddy	0.5

4.2.8 The ecological composition of D1 and D8 were similar. The REA transects at both sites were mainly composed of boulders down to 4 m depth. Areas deeper than 4 m were muddy with visibility of less than 0.5 m. The sites supported limited marine life only, with snail *Thais luteostoma* and green mussel *Perna viridis* found on surfaces of boulders and at the clefts between boulders at shallow water, respectively. **Table 13** gives the ecological and substratum attributes of the horizontal and perpendicular transects at D1 and D8.

Table 13 REA Ecological and Substratum Attributes of Transects at D1 and D8

	Site 1		Site 8	
	Horizontal Transect	Perpendicular Transect	Horizontal Transect	Perpendicular Transect
Ecological attributes	*Rank*	*Rank*	*Rank*	*Rank*
Hard corals	0	0	0	0

	Site 1		**Site 8**	
	Horizontal Transect	**Perpendicular Transect**	**Horizontal Transect**	**Perpendicular Transect**
Octocorals (soft corals and gorgonians)	1	1	1	1
Black corals	0	0	0	0
Dead standing corals	0	0	0	0
Substratum	*Rank*	*Rank*	*Rank*	*Rank*
Bedrock / continuous pavement	0	0	0	0
Boulder blocks (diameter >50 cm)	5	3	5	3
Boulder blocks (diameter <50 cm)	2	2	2	2
Rubbles	2	0	0	0
Other	0	0	0	0
Soft substrata	0	0	0	0
Sand	0	0	2	0
Mud / silt	2	5	2	5

* Rank in percentage cover: 0=None recorded; 1=1-5%; 2=6-10%; 3=11-30%; 4=31-50%; 5=51-75%; 6=76-100%.

4.2.9 Both D1 and D8 supported sparse and patchy cover (1 – 5%) of gorgonian coral *Echinomuricea* sp.. A total of 23 and 18 colonies of gorgonian were recorded in the REA transects at D1 and D8 respectively, and all of them were found attached on boulders and rock surfaces. The gorgonians were small in size (about 10 – 20 cm at D1 and 5 – 20 cm at D8) and recorded in low coverage. Most of the colonies were in fair condition with some of them exhibited a mortality of 10 – 20% at D1 and 10 – 30% at D8 (**Appendix 1** refers).

4.3 Intertidal Community

4.3.1 Intertidal surveys were conducted at four selected sites in dry (17th January 2009 and 14th February 2009) and wet (25th April 2009 and 23rd May 2009) seasons. The majority of the Survey Area was artificial shores or modified shorelines. Sections of rocky shore remnants and patchy sandy beaches were scattered among the artificial shores. **Table 14** gives the descriptions of the four sites and photos of the habitats are given in **Appendix 3**.

Table 14 Characteristics of Intertidal Survey Sites in the Survey Area

Site	**Characteristics**
T1	- Located northward to the artificial seawalls at the southeast end of Airport Island. - Mainly a boulder shore covered by rocks of irregular shapes and cobbles.
T2	- Located to the south of the Dragonair / CNAC Building. - A boulder shore with partially sandy substrates.
T3	- Located to the north of the Dragonair / CNAC Building. - A sandy beach with artificial riprap slope at both ends.
T4	- Located near an airport signal lighthouse. - Mainly boulder and sandy at the northern end and rocky shore remnant at the southern end.

4.3.2 A total of 19 taxa were recorded during the quantitative surveys in dry and wet seasons, which had low species richness. The most frequently recorded species included rock oyster *Saccostrea cucullata*, snails *Monodonta labio* and *Nerita yoldii*, littorid snails *Echinolittorina raidata* and *Echinolittorina trochoides*, and crab *Gaetice depressus*. All the species found are common and widespread intertidal fauna in Hong Kong. The abundance of the intertidal fauna recorded was generally low, especially in areas covered by sandy substrates. No infauna was recorded in the top 5 cm of sediment and from the core samples in sandy substrates. A list of intertidal organisms recorded and representative photos of the species recorded were shown in **Appendix 1** and **4** respectively. A total of 26 species of intertidal epifauna and flora were observed during the walk-through surveys (**Appendix 1** refers). The species recorded were similar to that from the transect surveys. All the species recorded are common and widespread.

4.3.3 Species diversity (*H'*) and evenness (*J*) were shown in **Table 15**. The average diversity index recorded were 1.85 (dry season) and 2.04 (wet season) with the evenness index of around 0.80 (dry season) and 0.84 (wet season), demonstrating low diversity and evenness.

Table 15 Species Diversity and Evenness of Intertidal Community in the Survey Area

Site	T1	T2	T3	T4
Dry Season				
January 2009				
H'	1.93	1.82	1.74	2.04
J	0.81	0.79	0.75	0.85
February 2009				
H'	1.96	1.71	1.79	1.83
J	0.82	0.78	0.81	0.80
Wet Season				
April 2009				
H'	2.18	1.95	1.79	2.14
J	0.88	0.84	0.78	0.84
May 2009				
H'	2.23	1.98	1.91	2.13
J	0.90	0.82	0.83	0.81

5 ECOLOGICAL PROFILE

5.1 Benthic Community

5.1.1 All the recorded species are common without conservation importance. Although some sensitive species were present such as polychaetes *Ophelina acuminata*, *Aglaophamus dibranchis*, *Aglaophamus sinensis*, *Terebellides stroemii* and *Loimia* sp. (Borja *et al*., 2000; Cheung *et al*., 2008), the abundance was very low.

5.2 Coral Community

5.2.1 The gorgonian coral species *Echinomuricea* sp. found during the spot reconnaissance dives and REA are widespread and common in Hong Kong waters, including more turbid and harsh environment in the western waters. They are sparsely distributed (<1% coverage) and small-sized.

5.3 Intertidal Community

5.3.1 The intertidal community in the Survey Area had low species richness, with only 26 taxa recorded. All species recorded are common and widespread in Hong Kong. No species of conservation importance was recorded.

6 **CONCLUSION**

6.1 The marine species recorded in the Survey Area during the surveys are common and widespread in Hong Kong. No species of conservation importance was found.

7 **REFERENCE**

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Cheung, S.G., Lam, N.W.Y., Wu, R.S.S. and Shin, P.K.S., 2008. Spatio-temporal changes of marine macrobenthic community in sub-tropical waters upon recovery from eutrophication. II. Life-history traits and feeding guilds of polychaete community. *Marine Pollution Bulletin 56*, 297-307.

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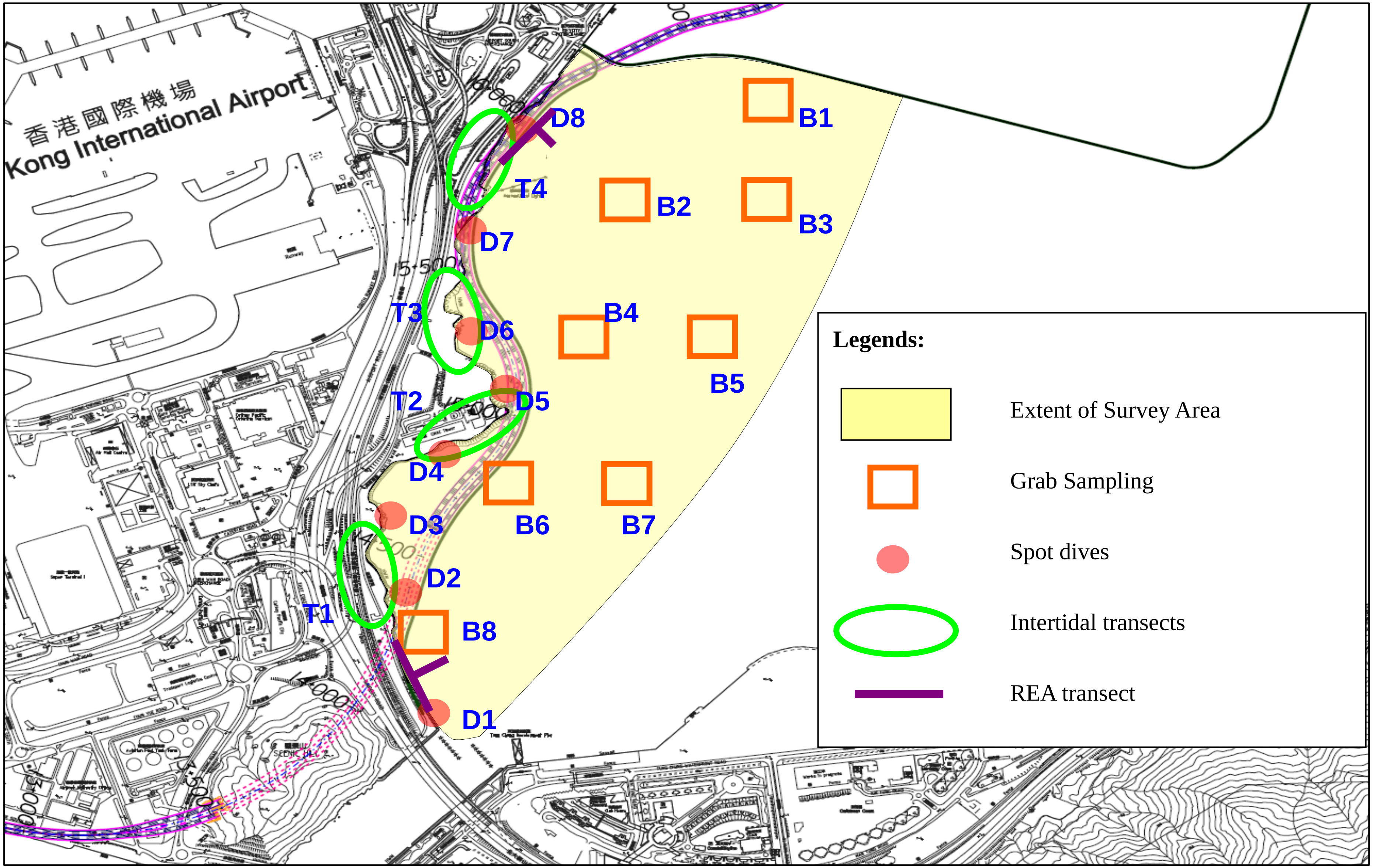
FIGURE 1

SAMPLING LOCATIONS WITHIN THE SURVEY AREA

Figure 1   Sampling Locations within the Survey Area



APPENDIX 1

MARINE FAUNA RECORDED FROM THE SURVEY AREA

Appendix 1 - Marine Fauna Recorded from the Survey Area

Benthic Organisms

Group	Species	Abundance (individual 0.5 m^{-2})	Wet Weight (g 0.5 m^{-2}) (1)
	Dry Season		
B1			
Polychaeta	*Aglaophamus dibranchis*	4	0.01
Polychaeta	*Ehlersileanira hwanghaiensis*	1	0.00
Polychaeta	*Euchymene oerstedii*	1	0.00
Polychaeta	*Glycinde gurjanovae*	1	0.00
Polychaeta	*Harmothoe asiatica*	1	0.00
Polychaeta	*Laonice cirrata*	1	0.00
Polychaeta	*Linopherus paucibranchiata*	2	0.01
Polychaeta	*Loimia bandera*	1	0.91
Polychaeta	*Loimia medusa*	1	0.30
Polychaeta	*Lumbrineris shiinoi*	1	0.00
Polychaeta	*Mediomastus* sp.	10	0.01
Polychaeta	*Neanthes* sp. 1	1	0.00
Polychaeta	*Otopsis* sp.	1	0.00
Polychaeta	*Phyllodoce* sp. 1	1	0.00
Polychaeta	*Poecilochaetus hystricosus*	1	0.00
Polychaeta	*Schistomeringos rudolphi*	2	0.00
Polychaeta	*Sigambra hanaokai*	1	0.00
Polychaeta	*Terebellides stroemii*	1	0.00
Sipuncula	*Apionsoma trichocephalus*	1	0.00
Nemertea	Nemertean spp.	12	0.11
Echiura	*Urechis* sp.	1	3.24
Crustacea	Amphipod spp.	14	0.00
Crustacea	*Diastylis* sp.	1	0.00
Crustacea	*Neoxenophthalmus obscurus*	1	0.06
Crustacea	*Typhlocarcinus villosus*	1	0.32
Mollusca	*Mabellarca consociata*	1	0.86
Mollusca	*Macoma candida*	2	3.09
Mollusca	*Nitidotellina minuta*	2	0.01
Mollusca	*Paphia undulata*	2	2.79
Mollusca	*Solen dunkerianus*	1	0.33
Total		71	12.09
B2			
Polychaeta	*Aglaophamus sinensis*	1	0.00
Polychaeta	*Anobothrus* sp.	1	0.00
Polychaeta	*Bhawania brevis*	1	0.00
Polychaeta	*Glycera alba*	5	0.00
Polychaeta	*Gyptis pacificus*	1	0.00
Polychaeta	*Laonice cirrata*	1	0.00
Polychaeta	*Loimia medusa*	2	1.45
Polychaeta	*Lumbrineris nagae*	2	0.28
Polychaeta	*Mediomastus* sp.	8	0.01
Polychaeta	*Minuspio cirrifera*	1	0.00
Polychaeta	*Ophiodromus obscura*	2	0.00
Polychaeta	*Paraprionospio pinnata*	2	0.02
Polychaeta	*Poecilochaetus hystricosus*	4	0.02
Polychaeta	*Rhynchospio* sp.	2	0.00
Polychaeta	*Schistocomus* sp.	1	0.00
Polychaeta	*Sigambra hanaokai*	13	0.00
Polychaeta	*Terebellides stroemii*	1	0.05
Polychaeta	*Tharyx* sp.	1	0.00
Nemertea	Nemertean spp.	9	0.02
Echiura	*Amphioplus lucidus*	1	0.01
Echinodermata	*Urechis* sp.	1	1.42
Crustacea	Amphipod spp.	26	0.01
Crustacea	*Diastylis* sp.	1	0.00
Crustacea	*Miyadiella podophthalmus*	3	0.10
Crustacea	*Typhlocarcinus villosus*	1	0.15
Mollusca	*Dosinia* sp. 1	1	0.38
Mollusca	*Mabellarca consociata*	1	0.81
Mollusca	*Macoma candida*	1	0.53
Mollusca	*Paphia undulata*	2	0.20
Mollusca	*Solen dunkerianus*	2	0.26
Total		98	5.73
B3			
Polychaeta	*Aglaophamus dibranchis*	9	0.02
Polychaeta	*Aglaophamus sinensis*	1	0.00
Polychaeta	*Euchymene oerstedii*	1	0.00
Polychaeta	*Glycera alba*	1	0.00
Polychaeta	*Glycera chirori*	3	0.05
Polychaeta	*Glycinde gurjanovae*	5	0.01
Polychaeta	*Harmothoe imbricata*	1	0.00
Polychaeta	*Laonice cirrata*	5	0.01
Polychaeta	*Linopherus paucibranchiata*	4	0.01
Polychaeta	*Lumbrineris nagae*	1	0.00
Polychaeta	*Lumbrineris shiinoi*	2	0.00
Polychaeta	*Lumbrineris* sp. 1	1	0.00
Polychaeta	*Mediomastus* sp.	41	0.12
Polychaeta	*Minuspio cirrifera*	5	0.00
Polychaeta	*Ophiodromus obscura*	1	0.00
Polychaeta	*Paraprionospio pinnata*	3	0.01

Group	Species	Abundance (individual 0.5 m^{-2})	Wet Weight (g 0.5 m^{-2}) [(1)]
Polychaeta	*Poecilochaetus hystricosus*	4	0.01
Polychaeta	*Prionospio malmgreni*	1	0.00
Polychaeta	*Schistomeringos rudolphi*	7	0.00
Polychaeta	*Sigambra hanaokai*	17	0.00
Polychaeta	Syllidae spp.	1	0.00
Polychaeta	*Tharyx* sp.	1	0.00
Nemertea	Nemertean spp.	10	0.19
Echiura	*Thalassema sabinum*	1	0.31
Echiura	*Urechis* sp.	1	3.87
Crustacea	Amphipod spp.	23	0.01
Crustacea	*Apseudes* sp.	1	0.00
Crustacea	*Miyadiella podophthalmus*	1	0.00
Crustacea	*Neoxenophthalmus obscurus*	1	0.00
Mollusca	*Anodontia* sp. 1	1	9.16
Mollusca	*Estellarca olivacea*	2	2.13
Mollusca	*Mabellarca consociata*	3	1.30
Mollusca	*Macoma candida*	9	13.14
Mollusca	*Mactra* sp. 1	2	0.11
Mollusca	*Nitidotellina minuta*	4	0.03
Mollusca	*Paphia undulata*	15	15.94
Mollusca	*Timoclea lionota*	1	0.13
Fish	*Cryptocentrus filifer*	1	0.89
Fish	*Trypauchen vagina*	1	4.87
Total		192	52.34
B4			
Polychaeta	*Aglaophamus dibranchis*	2	0.01
Polychaeta	*Ceratonereis marmorata*	1	0.00
Polychaeta	*Euchymene oerstedii*	2	0.01
Polychaeta	*Glycera alba*	1	0.00
Polychaeta	*Laonice cirrata*	5	0.04
Polychaeta	*Linopherus paucibranchiata*	1	0.00
Polychaeta	*Lumbrineris nagae*	2	0.18
Polychaeta	*Lumbrineris shiinoi*	1	0.00
Polychaeta	*Lumbrineris* sp. 1	2	0.00
Polychaeta	*Mediomastus* sp.	2	0.01
Polychaeta	*Minuspio cirrifera*	3	0.00
Polychaeta	*Ophelina acuminata*	1	0.12
Polychaeta	*Poecilochaetus hystricosus*	5	0.02
Polychaeta	*Rhynchospio* sp.	1	0.00
Polychaeta	*Sigambra hanaokai*	5	0.00
Nemertea	Nemertean spp.	4	0.02
Cnidaria	*Cerianthus filiformis*	1	0.05
Crustacea	Amphipod spp.	18	0.01
Crustacea	*Apseudes* sp.	1	0.00
Crustacea	*Miyadiella podophthalmus*	2	0.01
Crustacea	*Neoxenophthalmus obscurus*	1	0.20
Crustacea	*Typhlocarcinus villosus*	2	0.46
Mollusca	*Anodontia* sp. 1	1	0.54
Mollusca	*Nitidotellina iridella*	1	0.03
Mollusca	*Nitidotellina minuta*	1	0.02
Mollusca	*Solen dunkerianus*	3	0.50
Total		69	2.24
B5			
Polychaeta	*Glycera alba*	1	0.00
Polychaeta	*Linopherus paucibranchiata*	1	0.00
Polychaeta	*Mediomastus* sp.	19	0.05
Polychaeta	*Minuspio cirrifera*	4	0.00
Polychaeta	*Schistomeringos rudolphi*	8	0.01
Polychaeta	*Sigambra hanaokai*	13	0.00
Polychaeta	*Tharyx* sp.	1	0.00
Nemertea	Nemertean spp.	8	0.03
Crustacea	Amphipod spp.	4	0.00
Crustacea	*Typhlocarcinus nudus*	1	0.32
Mollusca	*Mabellarca consociata*	1	0.22
Mollusca	*Macoma candida*	3	1.31
Mollusca	*Mactra* sp. 1	1	5.09
Mollusca	*Natica tigrina*	1	1.75
Mollusca	*Paphia undulata*	5	8.86
Fish	*Cryptocentrus filifer*	1	0.11
Total		72	17.75
B6			
Polychaeta	*Aglaophamus dibranchis*	2	0.01
Polychaeta	*Linopherus paucibranchiata*	1	0.00
Polychaeta	*Lumbrineris nagae*	1	0.12
Polychaeta	*Mediomastus* sp.	1	0.01
Polychaeta	*Notomastus* sp.	3	0.03
Polychaeta	*Paraprionospio pinnata*	1	0.00
Polychaeta	*Rhynchospio* sp.	1	0.01
Polychaeta	*Sigambra hanaokai*	1	0.00
Nemertea	Nemertean spp.	2	0.00
Echiura	*Urechis* sp.	1	0.04
Phoronia	Phoronids	1	0.00
Crustacea	Amphipod spp.	8	0.00
Mollusca	*Saccella cuspidata*	1	0.02
Fish	*Taenioides anguillaris*	1	3.35

Group	Species	Abundance (individual 0.5 m^{-2})	Wet Weight (g 0.5 m^{-2}) [(1)]
Total		25	3.58
B7			
Polychaeta	*Aglaophamus dibranchis*	6	0.02
Polychaeta	*Aglaophamus sinensis*	6	0.03
Polychaeta	*Chloeia parva*	1	0.74
Polychaeta	*Euchymene oerstedii*	5	0.01
Polychaeta	*Glycera alba*	3	0.00
Polychaeta	*Glycera chirori*	7	0.05
Polychaeta	*Glycinde gurjanovae*	5	0.01
Polychaeta	*Harmothoe asiatica*	1	0.00
Polychaeta	*Harmothoe imbricata*	2	0.21
Polychaeta	*Harmothoe* sp. 1	1	0.00
Polychaeta	*Laonice cirrata*	2	0.01
Polychaeta	*Leonnates persica*	1	0.00
Polychaeta	*Linopherus paucibranchiata*	1	0.00
Polychaeta	*Loimia medusa*	4	0.12
Polychaeta	*Lumbrineris nagae*	10	0.10
Polychaeta	*Lumbrineris shiinoi*	2	0.00
Polychaeta	*Lumbrineris* sp.1	1	0.00
Polychaeta	*Magelona* sp.	3	0.00
Polychaeta	*Marphysa sanguinea*	4	0.12
Polychaeta	*Mediomastus* sp.	4	0.01
Polychaeta	*Micronephtys sphaerocirrata*	2	0.00
Polychaeta	*Notomastus* sp.	1	0.01
Polychaeta	*Ophiodromus obscura*	2	0.00
Polychaeta	*Paraprionospio pinnata*	4	0.24
Polychaeta	*Phyllodoce* sp.1	3	0.00
Polychaeta	*Poecilochaetus hystricosus*	2	0.00
Polychaeta	*Prionospio malmgreni*	7	0.01
Polychaeta	*Schistocomus* sp.	2	0.00
Polychaeta	*Scolelepis squamata*	1	0.00
Polychaeta	*Sternaspis sculata*	1	0.00
Polychaeta	*Tharyx* sp.	3	0.02
Sipuncula	*Apionsoma trichocephalus*	1	0.00
Nemertea	Nemertean spp.	9	0.03
Echiura	*Arhynchite* sp.	1	0.01
Echiura	*Urechis* sp.	6	2.71
Cnidaria	*Cerianthus filiformis*	1	0.00
Cnidaria	*Palythoa* sp.	1	0.02
Echinodermata	*Amphioplus laevis*	5	0.39
Echinodermata	*Amphioplus lucidus*	1	0.00
Crustacea	Amphipod spp.	182	0.08
Crustacea	*Apseudes* sp.	5	0.00
Crustacea	*Atypopenaeus stenodactylus*	1	0.16
Crustacea	*Diastylis* sp.	4	0.00
Crustacea	*Neoxenophthalmus obscurus*	1	0.02
Mollusca	*Anodontia* sp.1	2	4.14
Mollusca	*Azorinus coartata*	1	3.98
Mollusca	*Dosinia* sp.1	1	0.09
Mollusca	*Epicodakia divergens*	2	0.03
Mollusca	*Mactra* sp. 1	1	0.04
Mollusca	*Nitidotellina minuta*	5	0.10
Mollusca	*Paphia exarata*	1	0.25
Mollusca	*Paphia undulata*	11	3.86
Mollusca	*Saccella cuspidata*	2	0.02
Mollusca	*Solen dunkerianus*	2	0.32
Total		343	17.97
B8			
Polychaeta	*Harmothoe imbricata*	2	0.04
Polychaeta	*Mediomastus* sp.	4	0.01
Polychaeta	*Ophiodromus obscura*	1	0.00
Polychaeta	*Prionospio malmgreni*	1	0.00
Polychaeta	*Sigambra hanaokai*	3	0.00
Polychaeta	*Tharyx* sp.	1	0.00
Nemertea	Nemertean spp.	4	0.00
Echiura	*Urechis* sp.	2	3.78
Cnidaria	*Cerianthus filiformis*	1	0.00
Crustacea	Amphipod spp.	21	0.00
Mollusca	*Anodontia* sp. 1	1	2.25
Mollusca	*Marctra* sp. 1	2	0.11
Mollusca	*Nitidotellina minuta*	1	0.00
Mollusca	*Saccella cuspidata*	1	0.02
Fish	*Taenioides anguillaris*	1	1.29
Fish	*Trypauchen vagina*	1	0.48
Total		47	7.99
Wet Season			
B1			
Polychaeta	*Aglaophamus dibranchis*	2	0.01
Polychaeta	*Aglaophamus sinensis*	1	0.04
Polychaeta	*Ehlersileanira hwanghaiensis*	2	0.00
Polychaeta	*Glycinde gurjanovae*	1	0.00
Polychaeta	*Laonice cirrata*	2	0.01
Polychaeta	*Loimia medusa*	1	0.39
Polychaeta	*Mediomastus* sp.	10	0.01
Polychaeta	*Notomastus* sp.	3	0.01

Group	Species	Abundance (individual 0.5 m^{-2})	Wet Weight (g 0.5 m^{-2}) [1]
Polychaeta	*Ophiodromus obscura*	1	0.00
Polychaeta	*Poecilochaetus hystricosus*	1	0.00
Polychaeta	*Sigambra hanaokai*	2	0.00
Polychaeta	*Terebellides stroemii*	2	0.04
Crustacea	Amphipod spp.	4	0.01
Crustacea	*Atypopenaeus stenodactylus*	1	0.79
Crustacea	*Typhlocarcinus villosus*	1	0.36
Echinodermata	*Acaudina molpadioides*	4	31.73
Echinodermata	*Amphiura hexactis*	1	0.02
Mollusca	*Nitidotellina minuta*	2	0.07
Mollusca	*Paphia undulata*	5	1.63
Mollusca	*Solen dunkerianus*	1	0.28
Mollusca	*Tegillarca nodifera*	1	0.63
Total		48	36.0206
B2			
Polychaeta	*Aglaophamus dibranchis*	1	0.00
Polychaeta	*Aglaophamus sinensis*	2	0.03
Polychaeta	*Linopherus paucibranchiata*	1	0.00
Polychaeta	*Lumbrineris shiinoi*	3	0.00
Polychaeta	*Mediomastus* sp.	23	0.05
Polychaeta	*Notomastus* sp.	1	0.00
Polychaeta	*Sigambra hanaokai*	2	0.00
Polychaeta	*Sternaspis sculata*	1	0.00
Polychaeta	*Terebellides stroemii*	1	0.01
Platyhelminthes	*Platyhelminthes* sp.	2	0.01
Crustacea	Amphipod spp.	3	0.00
Crustacea	*Tritodynamia horvathi*	1	0.75
Crustacea	*Typhlocarcinus nudus*	1	0.13
Crustacea	*Typhlocarcinus villosus*	1	0.24
Echinodermata	*Acaudina molpadioides*	1	2.98
Echinodermata	*Amphiura hexactis*	1	0.08
Echinodermata	*Protankyra bidentata*	4	14.01
Mollusca	*Estellarca olivacea*	1	0.43
Mollusca	*Nitidotellina iridella*	2	0.16
Mollusca	*Nitidotellina minuta*	1	0.03
Mollusca	*Paphia undulata*	1	0.16
Nemertea	Nemertean spp.	1	0.00
Total		55	19.0916
B3			
Polychaeta	*Chloeia parva*	1	0.20
Polychaeta	*Euchymene oerstedii*	1	0.00
Polychaeta	*Glycera chirori*	1	0.11
Polychaeta	*Linopherus paucibranchiata*	1	0.01
Polychaeta	*Lumbrineris nagae*	1	0.00
Polychaeta	*Lumbrineris shiinoi*	1	0.01
Polychaeta	*Mediomastus* sp.	3	0.00
Polychaeta	*Ophelina acuminata*	2	0.17
Polychaeta	*Terebellides stroemii*	2	0.02
Crustacea	*Macrophthalmus latreillei*	2	13.25
Crustacea	*Typhlocarcinops canaliculata*	2	1.41
Echinodermata	*Amphioplus depressus*	2	0.52
Echinodermata	*Amphiura hexactis*	3	0.09
Mollusca	*Dosinia* sp.1	1	0.03
Mollusca	*Nitidotellina minuta*	1	0.04
Mollusca	*Paphia undulata*	1	0.40
Nemertea	Nemertean spp.	3	0.11
Total		28	16.3624
B4			
Polychaeta	*Cirriformia* sp.	1	0.01
Polychaeta	*Glycera chirori*	1	0.27
Polychaeta	*Glycera rouxii*	1	0.07
Polychaeta	*Gyptis pacificus*	1	0.02
Polychaeta	*Harmothoe* sp. 1	1	0.01
Polychaeta	*Linopherus paucibranchiata*	1	0.00
Polychaeta	*Loimia medusa*	1	0.31
Polychaeta	*Lumbrineris shiinoi*	2	0.00
Polychaeta	*Lumbrineris* sp. 1	1	0.01
Polychaeta	*Mediomastus* sp.	13	0.03
Polychaeta	*Notomastus* sp.	1	0.01
Polychaeta	*Schistomeringos rudolphi*	1	0.00
Polychaeta	*Sigambra hanaokai*	1	0.00
Polychaeta	*Terebellides stroemii*	2	0.01
Crustacea	Amphipod spp.	2	0.00
Crustacea	*Typhlocarcinus villosus*	1	0.32
Echinodermata	*Amphioplus depressus*	1	0.18
Echinodermata	*Protankyra bidentata*	1	1.67
Fish	*Muraenichthys sp.*	1	0.24
Mollusca	*Macoma candida*	4	5.97
Mollusca	*Paphia undulata*	11	12.57
Mollusca	*Tegillarca nodifera*	1	0.14
Nemertea	Nemertean spp.	2	0.06
Total		52	21.9095
B5			

Group	Species	Abundance (individual 0.5 m^{-2})	Wet Weight (g 0.5 m^{-2}) [(1)]
Polychaeta	*Aglaophamus sinensis*	3	0.00
Polychaeta	*Ehlersileanira hwanghaiensis*	2	0.00
Polychaeta	*Glycera rouxii*	5	0.21
Polychaeta	*Glycinde gurjanovae*	1	0.00
Polychaeta	*Laonice cirrata*	2	0.01
Polychaeta	*Linopherus paucibranchiata*	3	0.02
Polychaeta	*Loimia medusa*	1	0.07
Polychaeta	*Lumbrineris shiinoi*	1	0.00
Polychaeta	*Magelona* sp.	1	0.00
Polychaeta	*Mediomastus* sp.	3	0.00
Polychaeta	*Neanthes* sp. 1	1	0.00
Polychaeta	*Ophelina acuminata*	1	0.11
Polychaeta	*Ophiodromus angutifrons*	1	0.00
Polychaeta	*Tharyx* sp.	3	0.00
Crustacea	Amphipod spp.	5	0.00
Crustacea	*Austinogebia edulis*	1	0.09
Crustacea	*Metapenaeopsis dalei*	1	0.01
Crustacea	*Typhlocarcinus nudus*	2	0.46
Crustacea	*Typhlocarcinus villosus*	2	1.24
Echinodermata	*Protankyra bidentata*	1	1.64
Fish	*Cryptocentrus filifer*	1	0.02
Mollusca	*Clausinella calophylla*	1	1.85
Mollusca	*Macoma candida*	4	4.75
Mollusca	*Nitidotellina iridella*	1	0.03
Mollusca	*Tegillarca nodifera*	1	0.86
Nemertea	Nemertean spp.	3	0.10
Sipuncula	*Apionsoma trichocephalus*	1	0.00
Total		52	11.4947
B6			
Polychaeta	*Aglaophamus sinensis*	2	0.00
Polychaeta	*Dorvillea* sp. 1	2	0.00
Polychaeta	*Ehlersileanira hwanghaiensis*	1	0.00
Polychaeta	*Laonice cirrata*	2	0.01
Polychaeta	*Mediomastus* sp.	7	0.01
Polychaeta	*Notomastus* sp.	1	0.00
Crustacea	*Philyra olivacea*	1	0.30
Echinodermata	*Protankyra bidentata*	3	3.63
Fish	*Taenioides anguillaris*	1	2.89
Mollusca	*Azorinus coartata*	2	2.60
Mollusca	*Paphia undulata*	1	0.15
Nemertea	Nemertean spp.	1	0.01
Total		24	9.6308
B7			
Polychaeta	*Aglaophamus sinensis*	1	0.00
Polychaeta	*Euchymene oerstedii*	3	0.01
Polychaeta	*Eunice indica*	2	0.02
Polychaeta	*Glycinde gurjanovae*	2	0.00
Polychaeta	*Laonice cirrata*	1	0.00
Polychaeta	*Lumbrineris nagae*	3	0.16
Polychaeta	*Lumbrineris shiinoi*	1	0.00
Polychaeta	*Magelona* sp.	2	0.00
Polychaeta	*Mediomastus* sp.	1	0.00
Polychaeta	*Neanthes* sp. 1	1	0.00
Polychaeta	*Prionospio malmgreni*	2	0.00
Polychaeta	*Schistocomus* sp.	3	0.01
Polychaeta	*Sternaspis sculata*	2	0.01
Polychaeta	*Tharyx* sp.	2	0.00
Crustacea	Amphipod spp.	8	0.00
Cnidaria	*Edwardsia japonica*	1	0.00
Echinodermata	*Acaudina molpadioides*	1	9.33
Echinodermata	*Amphioplus laevis*	3	0.11
Fish	*Odontamblyopus rubicundus*	1	0.40
Mollusca	*Anodontia* sp. 1	1	0.11
Mollusca	*Dosinia* sp.1	3	0.12
Mollusca	*Paphia undulata*	3	2.24
Sipuncula	*Apionsoma trichocephalus*	4	0.02
Total		51	12.5467
B8			
Polychaeta	*Euchymene oerstedii*	1	0.01
Polychaeta	*Laonice cirrata*	1	0.00
Polychaeta	*Mediomastus* sp.	17	0.05
Polychaeta	*Notomastus* sp.	3	0.02
Polychaeta	*Paraprionospio pinnata*	1	0.00
Polychaeta	*Phyllodoce* sp.1	1	0.00
Polychaeta	*Sigambra hanaokai*	3	0.00
Crustacea	Amphipod spp.	1	0.00
Cnidaria	*Metedwardsia akkeshi*	2	1.96
Echinodermata	*Acaudina molpadioides*	1	1.60
Mollusca	*Nitidotellina minuta*	1	0.08
Mollusca	*Paphia undulata*	1	0.06
Nemertea	Nemertean spp.	2	0.01
Total		35	3.8093

Note:

(1) Biomass = 0.00 g 0.5 m^{-2}: the organism with total biomass less than 0.01 g 0.5 m^{-2}

Appendix 1 - Marine Fauna Recorded from the Survey Area

Corals (Recorded in REA)

Coral Colony	Coral Species	Size (cm)	Health Condition	Mortality (%)	Translocation Feasibility
D1					
1	*Echinomuricea* sp.	10	Fair	0	Yes
2	*Echinomuricea* sp.	15	Fair	10	Yes
3	*Echinomuricea* sp.	10	Fair	0	Yes
4	*Echinomuricea* sp.	12	Fair	0	Yes
5	*Echinomuricea* sp.	12	Fair	0	Yes
6	*Echinomuricea* sp.	15	Fair	10	Yes
7	*Echinomuricea* sp.	20	Fair	15	Yes
8	*Echinomuricea* sp.	12	Fair	0	Yes
9	*Echinomuricea* sp.	12	Fair	10	Yes
10	*Echinomuricea* sp.	12	Fair	0	Yes
11	*Echinomuricea* sp.	10	Fair	0	Yes
12	*Echinomuricea* sp.	15	Fair	0	Yes
13	*Echinomuricea* sp.	20	Fair	20	Yes
14	*Echinomuricea* sp.	20	Fair	15	Yes
15	*Echinomuricea* sp.	11	Fair	0	Yes
16	*Echinomuricea* sp.	18	Fair	0	Yes
17	*Echinomuricea* sp.	12	Fair	0	Yes
18	*Echinomuricea* sp.	17	Fair	0	Yes
19	*Echinomuricea* sp.	15	Fair	0	Yes
20	*Echinomuricea* sp.	15	Fair	0	Yes
21	*Echinomuricea* sp.	15	Fair	0	Yes
22	*Echinomuricea* sp.	10	Fair	10	Yes
23	*Echinomuricea* sp.	10	Fair	0	Yes
D8					
1	*Echinomuricea* sp.	5	Fair	0	Yes
2	*Echinomuricea* sp.	10	Fair	0	Yes
3	*Echinomuricea* sp.	10	Fair	0	Yes
4	*Echinomuricea* sp.	5	Fair	0	Yes
5	*Echinomuricea* sp.	8	Fair	0	Yes
6	*Echinomuricea* sp.	15	Fair	10	Yes
7	*Echinomuricea* sp.	15	Fair	15	Yes
8	*Echinomuricea* sp.	12	Fair	0	Yes
9	*Echinomuricea* sp.	15	Fair	0	Yes
10	*Echinomuricea* sp.	7	Fair	0	Yes
11	*Echinomuricea* sp.	5	Fair	0	Yes
12	*Echinomuricea* sp.	20	Fair	30	Yes
13	*Echinomuricea* sp.	10	Fair	0	Yes
14	*Echinomuricea* sp.	15	Fair	0	Yes
15	*Echinomuricea* sp.	10	Fair	0	Yes
16	*Echinomuricea* sp.	5	Fair	20	Yes
17	*Echinomuricea* sp.	10	Fair	15	Yes
18	*Echinomuricea* sp.	10	Fair	0	Yes

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Jan-09										
T1										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	49			15	1	3			4	72
Echinolittorina trochoides	7	18	11	13	3	7	54	48	31	15
Littoraria articulata										
Monodonta labio										
Nerita yoldii		2			1	1			3	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	15%	10%	<1%	20%	20%					25%
Septifer virgatus										
Cellana grata	4	2		1						4
Echinolittorina radiata							1			
Echinolittorina trochoides	2									
Littoraria articulata										
Monodonta labio	4	5	15		1	3	1	1	6	
Nerita yoldii	13	14		11	16			3	9	8
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica			10							
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens		1		3						5
Saccostrea cucullata	15%	30%		70%	80%		5%	5%	10%	75%
Septifer virgatus										
Cellana grata	6	70		10						3
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio	14		17	5		11	15	15	31	18
Nerita yoldii	13		12	2	5	15	3	5	25	35
Thais clavigera	2	1		1					5	
Balanus amphitrite			2		10			10		
Capitulum mitella										
Tetraclita japonica		10								
Ligia exotica			1							
Gaetice depressus	8		8			19	7	5	6	
T2										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata						2	1			1
Echinolittorina trochoides	8		11		5	3	6	4	12	3
Littoraria articulata										
Monodonta labio								1		
Nerita yoldii						1		4		
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	<5%		<1%	<5%	4%		<1%			
Septifer virgatus				16						
Cellana grata										
Echinolittorina radiata										
Echinolittorina trochoides			3						9	
Littoraria articulata										
Monodonta labio	5				34	4		18		2
Nerita yoldii					3	1	1	5	2	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria								5%		
Green algae										
Red algae										
Haliplanella lineata						1				
Barbatia virescens	15									
Saccostrea cucullata	50%					5%	10%	45%	5%	55%
Septifer virgatus	35									
Cellana grata	25					8				10
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	40									15
Monodonta labio	10					65		23	45	20
Nerita yoldii						31		15	21	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus						15		3	10	
T3										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata		3		23	1	12	9	10	25	2
Echinolittorina trochoides	8	4			3	6	12		4	15
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae							25%	20%		
Red algae								60%		
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	10%							15%	30%	5%
Septifer virgatus									5	
Cellana grata	7								5	
Echinolittorina radiata										
Echinolittorina trochoides								1		
Littoraria articulata									5	
Monodonta labio	6									19
Nerita yoldii	2									
Thais clavigera										
Balanus amphitrite									10	
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										3
Gaetice depressus										9
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Saccostrea cucullata	40%									
Septifer virgatus										
Cellana grata	10									
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
T4										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	13	8						73	27	45
Echinolittorina trochoides	1	7						32	18	10
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										10%
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	35%							<1%		15%
Septifer virgatus	8									
Cellana grata	13									15
Echinolittorina radiata								35	37	
Echinolittorina trochoides	15							45		
Littoraria articulata									16	40
Monodonta labio									7	5
Nerita yoldii								3	15	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella								5		
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens								15	9	
Saccostrea cucullata								15%	70%	
Septifer virgatus								60	11	
Cellana grata								25	30	
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio								5	9	
Nerita yoldii										
Thais clavigera										
Balanus amphitrite	85							9		
Capitulum mitella										
Tetraclita japonica								8	21	
Ligia exotica										
Gaetice depressus										
				Feb-09						
T1										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Septifer virgatus										
Cellana grata										
Echinolittorina radiata	23	15		6	19	10	31		9	50
Echinolittorina trochoides	15	8	2	4	15	11	23	56	28	22
Littoraria articulata										
Monodonta labio										
Nerita yoldii	1	1			1		1		1	5
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	5%	15%	5%	25%	10%		5%			30%
Septifer virgatus										
Cellana grata	2	3	3				1			1
Echinolittorina radiata								6		
Echinolittorina trochoides	10		3							
Littoraria articulata										
Monodonta labio		3	10			4	1	1	2	1
Nerita yoldii	10	11	1	11	15		2		2	5
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica				16						
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens	3			1					2	
Saccostrea cucullata	20%	20%		50%	60%	2%	5%	10%	5%	65%
Septifer virgatus										
Cellana grata	2	20	30	10	5		3			3
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio	17	3	10	2	1		15	17	11	41
Nerita yoldii	10	5	10	5	1	5	5	7	15	16
Thais clavigera	1	2		3				1	1	3
Balanus amphitrite	2		5		5		2	6		1
Capitulum mitella										
Tetraclita japonica	5	5					3			
Ligia exotica	2		3			3				
Gaetice depressus	1		3	11		14	2		1	
T2										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	3		1			3				
Echinolittorina trochoides	12		9			2	5	5	13	2
Littoraria articulata										
Monodonta labio		3						2		
Nerita yoldii					2	1		1		
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	10%		5%	<1%	<1%			<1%		5%
Septifer virgatus	5				10					
Cellana grata										
Echinolittorina radiata										
Echinolittorina trochoides				5						

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Littoraria articulata										
Monodonta labio	5	2			19		11	8		2
Nerita yoldii		2			1		6	2	2	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria							5%			**5%**
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens	5	11								
Saccostrea cucullata	35%		5%	10%		10%	15%	10%	20%	
Septifer virgatus			10	10				6		
Cellana grata	10			3			5			
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	10			6			12			21
Monodonta labio	16				16	60		26	10	35
Nerita yoldii	2				15	35		5	2	27
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus	5								6	
T3										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	6	10	2	12	21	10	5		18	5
Echinolittorina trochoides	5	12			11	5			21	14
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae						20%	10%	10%		5%
Red algae						20		30%		
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	10%							20%	25%	5%
Septifer virgatus									10	
Cellana grata	7							5	5	2
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata									5	7
Monodonta labio	11								5	16
Nerita yoldii	5									3
Thais clavigera										
Balanus amphitrite									10	2
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										5
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens	2									
Saccostrea cucullata	45%									
Septifer virgatus										
Cellana grata	7									
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
T4										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	19	11						94	35	20
Echinolittorina trochoides	10	2						36	21	5
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae	5%									5%
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	40%							5%		15%
Septifer virgatus	5									
Cellana grata	5							4		15
Echinolittorina radiata								27	45	
Echinolittorina trochoides								49	5	
Littoraria articulata								5	10	37
Monodonta labio								2	3	2
Nerita yoldii									13	5
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens								23	11	
Saccostrea cucullata								20%	70%	
Septifer virgatus								59	13	
Cellana grata								11	12	
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio									11	
Nerita yoldii										
Thais clavigera										
Balanus amphitrite								10		
Capitulum mitella										
Tetraclita japonica								14		
Ligia exotica										
Gaetice depressus										
Apr-09										
T1										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	35	31	20	14	22	16	31	45	22	33
Echinolittorina trochoides	21	17	12	14	25	9	23	41	41	26
Littoraria articulata										
Monodonta labio										
Nerita yoldii			6			3		1		1
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	35%	30%			25%	15%	15%		45%	25%
Septifer virgatus										
Cellana grata	6	5	5			2			5	1
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	5			10				8		
Monodonta labio	15	10	5	17		9	1	1	2	21
Nerita yoldii	5	10		10		2		6		8
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens	5				6				2	4
Saccostrea cucullata	30%	35%	25	60%	80%	20%			25%	75%
Septifer virgatus										
Cellana grata	15				21				3	4
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio	25	21	40			15			44	23
Nerita yoldii	20	5		12		10		8	31	16
Thais clavigera	1	2		1	3					4
Balanus amphitrite			15	25	45				35	10
Capitulum mitella										
Tetraclita japonica			15	25	10				15	5
Ligia exotica	15		25	10	10	5			15	5
Gaetice depressus	2	6			2	2	25	18	12	5
T2										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	15				8	5	11		11	5
Echinolittorina trochoides	5		16	12	10	6	6	4	6	5
Littoraria articulata										
Monodonta labio										
Nerita yoldii	3					3				
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	10%	5%	5%	15%			10%		5%	
Septifer virgatus	24	5					13		10	
Cellana grata										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	5	16								
Monodonta labio	10		19	28	37				27	12
Nerita yoldii	5		10	5	15		6		6	8
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria				5	5					
Green algae										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Red algae										
Haliplanella lineata		2	5		2					
Barbatia virescens		21	10							
Saccostrea cucullata		60%			15%		25%	5%	55%	65%
Septifer virgatus		15	38		5					
Cellana grata		5	23		13			10	10	5
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata		24	10		2			5		11
Monodonta labio		24	20		51			32	11	54
Nerita yoldii			5		21			5	11	5
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus		2	5					17	2	5
T3										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	12	31	15	15	1	12	9	10	25	
Echinolittorina trochoides	21	15	19	34	3	12	9		6	11
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae			15%		25%					
Red algae							5%			
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata		10%	10%		5%		20%		30%	25%
Septifer virgatus			8		2					
Cellana grata	7		6		3					
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata			10		11				5	
Monodonta labio	2		10		15				8	9
Nerita yoldii	2		5						2	
Thais clavigera										
Balanus amphitrite			21		15					
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										3
Gaetice depressus										9
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	40%				50%					
Septifer virgatus										
Cellana grata	2				1					
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio					5					
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
T4										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Cellana grata										
Echinolittorina radiata	24	21				15		65	56	85
Echinolittorina trochoides	5	26				10		35	23	21
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata	2									
Barbatia virescens										
Saccostrea cucullata	25%		25%		10%			15%	5%	25%
Septifer virgatus	10		2		3					
Cellana grata	11				2			2	6	8
Echinolittorina radiata	5			11		25	37			
Echinolittorina trochoides	15			9		36	16			
Littoraria articulata								21	16	23
Monodonta labio								23	17	
Nerita yoldii								23	5	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella									15	5
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens								12	17	5
Saccostrea cucullata								40%	25%	65%
Septifer virgatus								55	20	21
Cellana grata								5	15	31
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio								6	15	15
Nerita yoldii										
Thais clavigera										
Balanus amphitrite	65		68		90			26	39	26
Capitulum mitella										
Tetraclita japonica								5	18	35
Ligia exotica	5		15		26			23	10	
Gaetice depressus										

May-09										
T1										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	45	62	23	22		12		42	35	46
Echinolittorina trochoides	12	51	20	5		15		24	53	26
Littoraria articulata										
Monodonta labio										
Nerita yoldii	6		12			5			1	2
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	35%	40%			35%	10%	20%		55%	30%
Septifer virgatus										
Cellana grata	8	2	3			6	2		2	1
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	15	5		21		5		3		2

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Monodonta labio	13	2	16	21		6			6	4
Nerita yoldii	6	5	5	15		10			5	2
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens	6	2		1	4					3
Saccostrea cucullata	35%	30%	20%	55%	65%	45%	15%		20%	35%
Septifer virgatus										
Cellana grata	6	8		2	16		7			1
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio	12	35	21	2		5		1	38	35
Nerita yoldii	12	14	5	16		17		1	32	31
Thais clavigera		4	3		2	1				2
Balanus amphitrite		15	20	20	35	15			45	15
Capitulum mitella										
Tetraclita japonica		5	20	20	5	5			5	15
Ligia exotica	25	10	10	35	35	35		5	5	25
Gaetice depressus		8	8		5	3	19	18	10	10
T2										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	14		11	5	15		11	21		19
Echinolittorina trochoides	5		16	12	10		6	14		32
Littoraria articulata										
Monodonta labio										
Nerita yoldii	2		2							
Thais clavigera									1	
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	15%	10%	10%	15%		5%	5%		10%	
Septifer virgatus	16	2		2			10		8	
Cellana grata										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	11			5			6			
Monodonta labio	8	6	13	16	35		16		21	26
Nerita yoldii	12	12	2	3	24				14	6
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus				3			2			1
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria		5		5						
Green algae										
Red algae										
Haliplanella lineata	1		1		6					
Barbatia virescens	16		10		6					
Saccostrea cucullata	50%		5		20%		15%	15%	65%	55%
Septifer virgatus	12		38		5					
Cellana grata			6		3			16	11	10
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	21		10		2			15		8
Monodonta labio	16		20		51			37	26	36
Nerita yoldii	3		5		21			3	6	11
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Ligia exotica										
Gaetice depressus	1	2	6					10	11	1
T3										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	23	26		36	35	10	5	16	31	5
Echinolittorina trochoides	11	15		43	17	5	16		16	17
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	5%	15%	15%		10%		15%	5%	35%	25%
Septifer virgatus	5		3		6			2		
Cellana grata	2	2	4					6		
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata	8	11	6		15			2		
Monodonta labio	12	2	15		2			6	8	9
Nerita yoldii	10	5	5					7	8	
Thais clavigera										
Balanus amphitrite	15	15	20		15			10		
Capitulum mitella										
Tetraclita japonica										
Ligia exotica				9			6			10
Gaetice depressus				2						3
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata	55%		10%		55%					
Septifer virgatus										
Cellana grata										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio			5		15					
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
T4										
Species	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens										
Saccostrea cucullata										
Septifer virgatus										
Cellana grata										
Echinolittorina radiata	15	25		19		34		55	67	74
Echinolittorina trochoides	5	21		2		19		29	18	25
Littoraria articulata										
Monodonta labio										
Nerita yoldii										
Thais clavigera										
Balanus amphitrite										
Capitulum mitella										
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Cyanobacteria										
Green algae										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms

Red algae										
Haliplanella lineata	1		1		2					
Barbatia virescens										
Saccostrea cucullata	35%	5%	20%		15%			20%	15%	15%
Septifer virgatus	16		11		5					
Cellana grata	2		1					2	3	
Echinolittorina radiata	5			15		16	21			
Echinolittorina trochoides	15			15		32	26			
Littoraria articulata					10			18	32	21
Monodonta labio								34	15	3
Nerita yoldii					3			2	15	
Thais clavigera										
Balanus amphitrite										
Capitulum mitella									10	10
Tetraclita japonica										
Ligia exotica										
Gaetice depressus										
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Cyanobacteria										
Green algae										
Red algae										
Haliplanella lineata										
Barbatia virescens								5	11	8
Saccostrea cucullata								40%	30%	60%
Septifer virgatus								43	35	25
Cellana grata								2	12	6
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Monodonta labio								12	24	35
Nerita yoldii										
Thais clavigera								6	8	2
Balanus amphitrite	95		75		85			36	45	36
Capitulum mitella										
Tetraclita japonica								5	18	35
Ligia exotica	10		5		16			35	10	10
Gaetice depressus										

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms (Walk-through Survey)

Dry Season				
Species	**T1**	**T2**	**T3**	**T4**
Cyanobacteria	✓	✓	✓	
Green algae	✓	✓	✓	✓
Red algae		✓	✓	✓
Haliplanella lineata				✓
Hincksia mitchelliae		✓		
Gelidium pusillum				✓
Porphyra suborbiculata				✓
Barbatia virescens		✓		
Saccostrea cucullata	✓	✓	✓	✓
Septifer virgatus	✓	✓	✓	✓
Cellana grata	✓	✓	✓	✓
Cellana toreuma		✓		✓
Siphonaria laciniosa				✓
Patelloida pygmaea				✓
Echinolittorina radiata	✓	✓	✓	
Echinolittorina vidua	✓	✓		
Echinolittorina trochoides	✓	✓	✓	
Littoraria articulata		✓	✓	
Monodonta labio	✓	✓	✓	✓
Nerita yoldii	✓	✓	✓	
Thais clavigera				✓
Balanus amphitrite				✓
Capitulum mitella				✓
Tetraclita japonica	✓			✓
Ligia exotica	✓		✓	✓
Gaetice depressus		✓		

Appendix 1 - Marine Fauna Recorded from the Survey Area

Intertidal Organisms (Walk-through Survey)

Wet Season				
Species	**T1**	**T2**	**T3**	**T4**
Cyanobacteria	✓	✓	✓	
Green algae	✓	✓	✓	✓
Red algae		✓	✓	✓
Haliplanella lineata	✓			✓
Hincksia mitchelliae		✓		
Gelidium pusillum				✓
Porphyra suborbiculata				✓
Barbatia virescens		✓		
Saccostrea cucullata	✓	✓	✓	✓
Septifer virgatus	✓	✓	✓	✓
Cellana grata	✓	✓	✓	✓
Cellana toreuma		✓		✓
Siphonaria laciniosa				✓
Patelloida pygmaea				✓
Echinolittorina radiata	✓	✓	✓	
Echinolittorina vidua	✓	✓		
Echinolittorina trochoides	✓	✓	✓	
Littoraria articulata		✓	✓	
Monodonta labio	✓	✓	✓	✓
Nerita yoldii	✓	✓	✓	
Thais clavigera		✓		✓
Balanus amphitrite		✓		✓
Capitulum mitella				✓
Tetraclita japonica	✓			✓
Ligia exotica	✓	✓	✓	✓
Gaetice depressus		✓		

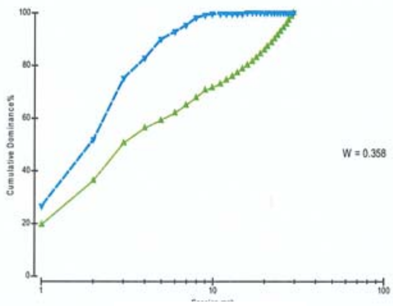
APPENDIX 2

ABC PLOTS OF BENTHIC SAMPLING POINTS

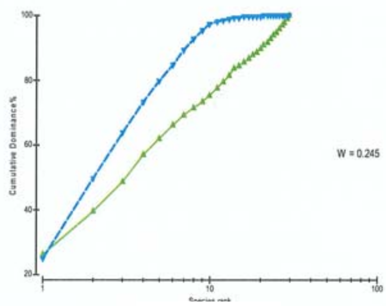
Appendix 2 ABC Plots of Benthic Sampling Points (blue dotted line: biomass curve; green solid line: abundance curve)

Dry Season

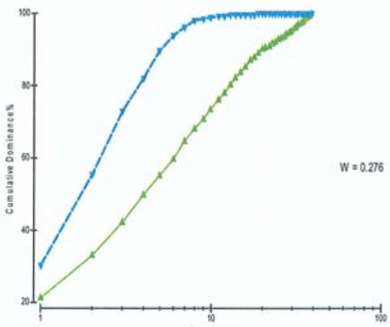
B1



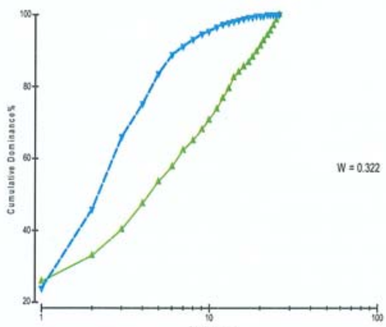
B2



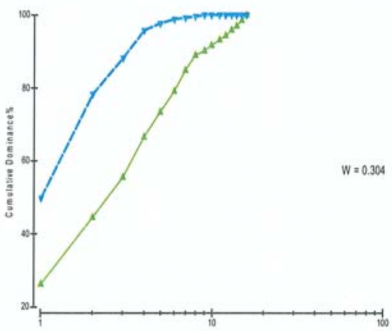
B3



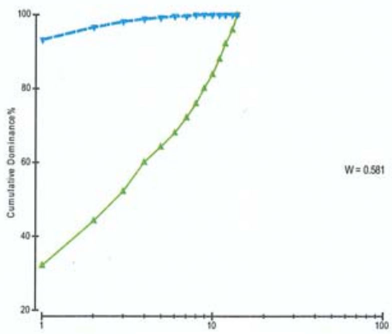
B4



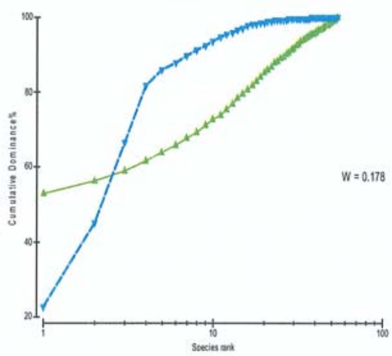
B5



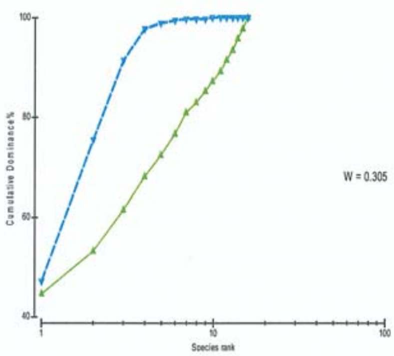
B6



B7



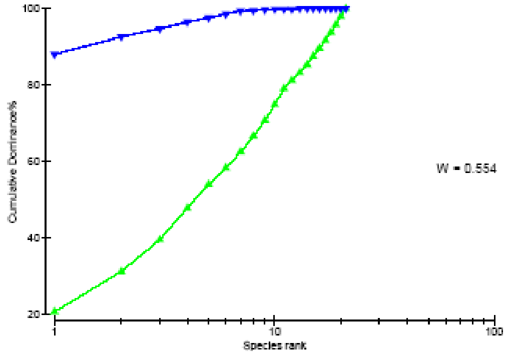
B8



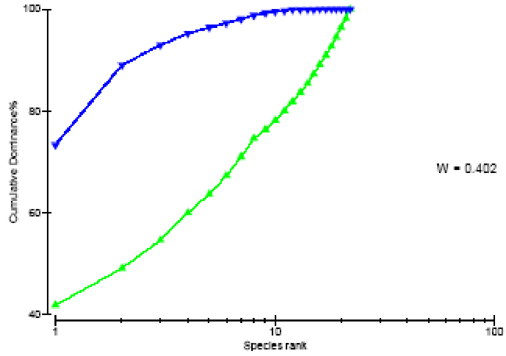
Appendix 2 ABC Plots of Benthic Sampling Points (blue dotted line: biomass curve; green solid line: abundance curve)

Wet Season

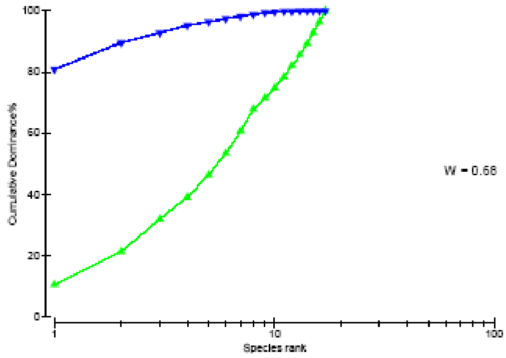
B1



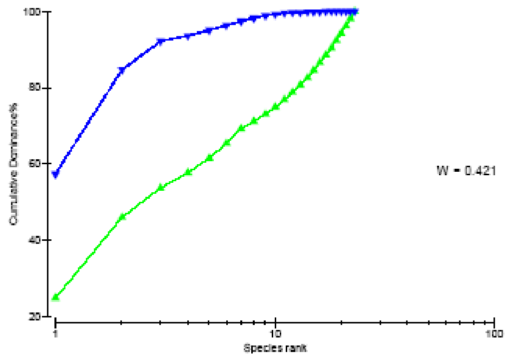
B2



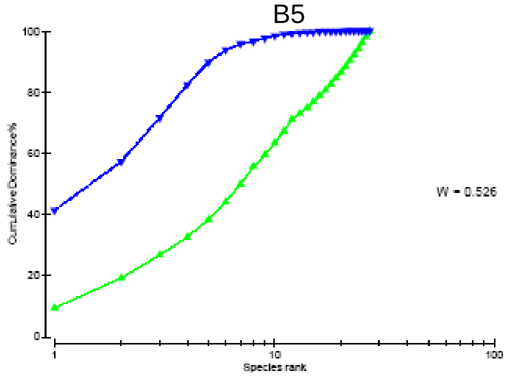
B3



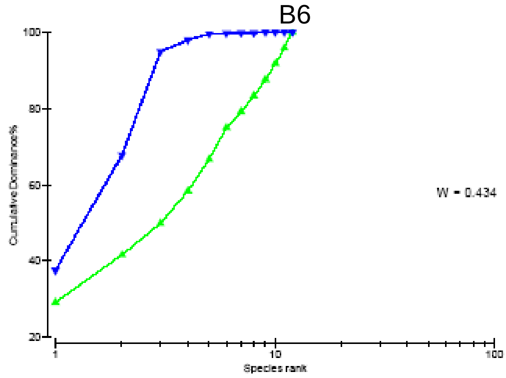
B4



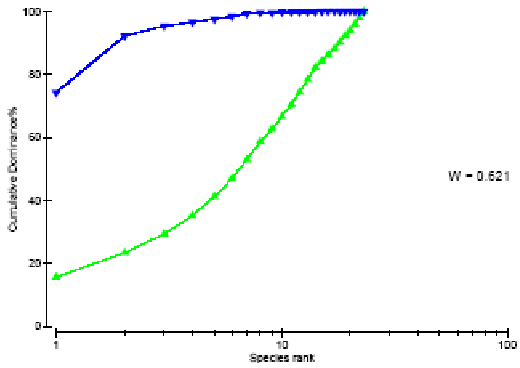
B5



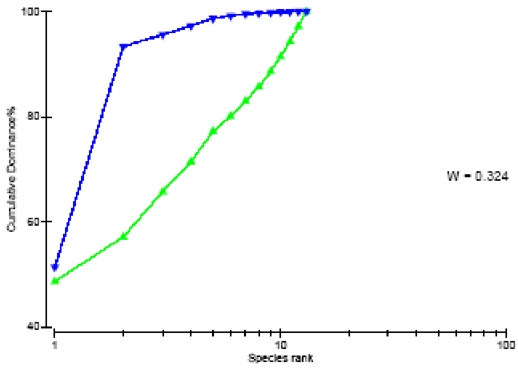
B6



B7



B8



APPENDIX 3

REPRESENTATIVE PHOTOGRAPHS OF HABITATS RECORDED WITHIN THE SURVEY AREA

Appendix 3 - Representative Photographs of Habitats Recorded within the Survey Area

Artificial Slopping Boulders at D1

Natural Bedrock at D4

Natural Coastline at D5

Natural Coastline at D6

Underwater Boulders

Underwater Boulders

Muddy Bottom

Sandy Bottom

Appendix 3 - Representative Photographs of Habitats Recorded within the Survey Area


Intertidal Transect at T1


Intertidal Transect at T2


Intertidal Transect at T3


Intertidal Transect at T4

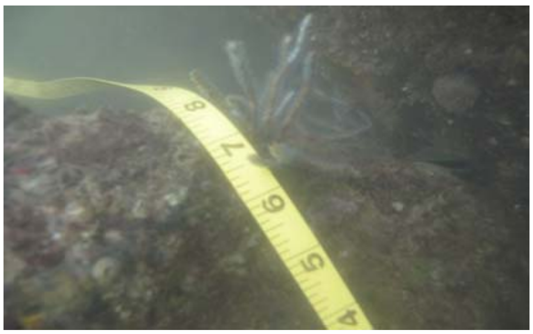
APPENDIX 4

REPRESENTATIVE PHOTOGRAPHS OF FAUNA RECORDED WITHIN THE SURVEY AREA

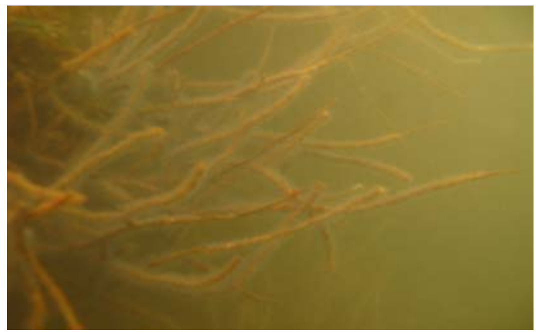
Appendix 4 - Representative Photographs of Fauna Recorded within the Survey Area

Echinomuricea sp.

Echinomuricea sp.



Echinomuricea sp.



Echinomuricea sp.

Septifer virgatus and *Perna viridis*

Perna viridis

Unidentified Oyster

Thais luteostoma

Appendix - 4 Representative Photographs of Fauna Recorded within the Survey Area

Saccostrea cucullata

Nerita yoldii

Thais clavigera

Gaetice depressus

Cellana toreuma

Littoraria articulata

Echinolittorina radiata

Echinolittorina trochoides

Appendix - 4 Representative Photographs of Fauna Recorded within the Survey Area

Monodonta labio

Capitulum mitella

Tetraclita japonica

Balanus amphitrite

Septifer virgatus

Hincksia mitchelliae

Green Algae

Red Algae

ANNEX A

RAPID ECOLOGICAL ASSESSMENT

Annex A Rapid Ecological Assessment

Rapid Ecological Assessment involves 'semi-quantitative' swim-surveys allowing for assessment and classification of survey areas. The field data are collected by divers experienced in the underwater identification of sessile benthic taxa, swimming down-current along coral communities or identified sections of coastline on SCUBA from haphazardly-chosen starting points.

REA surveys provide information on the assessment of relative cover of coral and other major benthic groups, as well as an inventory of sessile benthic taxa used to define community types.

Five ecological and seven substratum attributes shall be assessed on site and/or by reviewing video footages. Each of the attributes (**Table A-1**) should be assigned to one of the seven standard ranked categories (from zero to six, representing percentage cover from none to over 76%) (**Table A-2**).

An inventory of benthic taxa shall be complied for transect. Taxa shall be identified in situ to the following levels:

1) Hard corals to species level where possible;
2) Soft corals, anemones and macroalgae to genus level where possible; and
3) Other benthos to genus level where possible or phylum with growth form.

Each taxon in the inventory shall also be ranked to one of the six categories (**Table A-3**) in terms of abundance (from 0 to 5, representing from absent to dominant) in the community.

Table A-1 Ecological and Substratum attributes used in REA

Ecological attributes
Hard coral
Dead standing corals
Soft corals
Sea anemone beds
Macroalgae

Substratum
Hard substrate

Continuous pavement
Bedrock/boulders/sand
Rubble
Cobbles
Sand with gravel
Mud

Table A-2 Ranking of Ecological and substratum attributes

Rank	Percentage cover (%)
0	None recorded
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

Table A-3 Ranking of Benthos abundance

Rank	Abundance
0	Absent
1	Sparse
2	Uncommon
3	Common
4	Abundant
5	Dominant

APPENDIX 10D

Results of HKBCF Ecological Survey Programme

1 Introduction

Highways Department (hereafter the Client) is planning a project namely **"Agreement No. CE 14/2008 (CE) Hong Kong-Zhuhai-Macao Bridge - Hong Kong Boundary Crossing Facilities - Investigation"** (hereafter the Project).

An EIA Study Brief (ref: ESB-183/2008) was issued by EPD to Highways Department on 11 April 2008, to carry out an EIA study for the Project.

The Project involves reclamation at the western Hong Kong waters. In Accordance with the EIA Study Brief, marine ecological assessment is a component of the EIA study, and an ecological field survey programme covering intertidal survey, coral dive survey and marine benthic survey, is required.

This paper presents the results of the ecological survey programme for the HKBCF EIA study.

2 Staff

Ecosystems Limited was commissioned as the consultant for the Study. Two marine ecologists were responsible for the present marine ecological study.

Vincent Lai Chi-sing: Marine Ecologist. Mr. Lai joined Ecosystems Ltd. in January 1999. He is experienced in designing and conducting ecological field surveys and reporting for EIA and ecological studies. He has broad academic and practical experience with coastal and marine ecology. He has also conducted dive and benthic surveys and impact assessments for various EIA and ecological studies in Hong Kong.

Keith Kei: Dive Specialist. Mr. Kei is a dive specialist affiliated with Ecosystems Ltd. He has extensive experience in marine ecology, particularly in assessment and management of corals in Hong Kong. Mr. Kei has conducted coral surveys for a number of projects and studies in Hong Kong, including Impact Assessment of Sand Dredging at the West Po Toi Marine Borrow Area, and Proposed Extension of Public Golf Course at Kau Sai Chau Island, Sai Kung. Mr. Kei is leading the Reef Check Foundation and organised the activities of "Reef Check" in Hong Kong since 1998.

3 Objectives and Scopes of the Study

In accordance with the requirements of Section 5(1) of the EIAO, a project profile (No PP-346/2008) was submitted to Environmental Protection Department (EPD) for the application of an EIA Study Brief on 12 March 2008. Pursuant to Section 5(7)(a) of the EIAO, EPD issued to the Project Proponent, namely Highways Department, a study brief (ref: EIA Study Brief No: ESB-183/2008 dated 11 April 2008) to carry out an EIA study.

As stipulated in Section 3.4.5.4 (i) and (iii), the Ecological Impact Assessment will review the findings of relevant studies/surveys, including EIA studies for Tuen Mun Chek Lap Kok Link (TMCLKL) and the HZMB Hong Kong Link Road (HKLR), to collate ecological information of the assessment area. Necessary ecological field surveys will be carried out if information gap is identified.

The key issues of the present EIA study stipulated in the EIA Study Brief include:

- Coral communities
- Horseshoe Crabs
- Seagrass bed
- Chinese White Dolphin

In addition, the following two issues are also considered of concern given the nature of the Project:

- Marine benthic communities
- Intertidal habitat

In accordance with the EIA Study Brief for TMCLKL, the ecological field surveys for that EIA shall include coral communities, marine benthic communities, Horseshoe Crabs and avifauna and the duration shall be at least 9 months covering wet and dry seasons. Therefore it is anticipated that the TMCLKL ecological surveys could provide sufficient data for the North Lantau waters where its alignment goes through.

It is also anticipated that the coming ecological survey programme for Hong Kong Link Road would cover embayment along and close to Airport Channel where its alignment goes through or is in close distance, including Tung Chung Bay and San Tau. Information on horseshoe crabs and seagrass beds in those habitats would be available from HKLR.

Furthermore, AFCD annual dolphin monitoring programme provide the long-term and updated data sufficient for baseline establishment and impact assessment purposes.

Therefore the ecological field surveys for the present Ecological survey programme were conducted to fill in information gap, in particular the direct impact areas, i.e. the reclamation area and the landing points of connecting roads on Airport Island.

4 Methodology

a) Survey methodology

(1) Intertidal Survey

Intertidal survey is to investigate the intertidal habitats and communities. Intertidal surveys for epifauna communities were conducted on both natural and artificial coastlines at the northeast of Airport Island, during both wet season and dry season (August and November 2008).

The survey includes an active search survey within the Project Area, as well as quantitative survey on rocky shores, artificial seawall and sandy shores within the Project Area, to record the species and abundance of intertidal fauna, to evaluate and rank the ecological values at different locations.

Before the quantitative surveys, a walk-through survey was conducted within the Survey Area to collect information to facilitate the determination of representative sites for conducting the quantitative surveys. Walk-through surveys were also conducted at each quantitative site during the quantitative sampling (two surveyors for 30 minutes).

Horizontal transects of 50m in length were established at three tidal levels (High, Middle and Low) on each of the two locations where direct impacts from the Project are anticipated (the landing points of the connecting roads on Airport Island).

The locations of the intertidal transects are shown in **Figure 1**. There were ten 0.5m x 0.5m quadrats on each transect. The epifauna within each quadrat were identified and their numbers/coverage percentages were recorded. Species diversity and abundance were reported for evaluating and ranking the ecological values.

(2) Marine Grab Survey

Marine grab samplings for benthic communities were conducted at 9 stations within the BCF reclamation area (see Figure 1) during both wet season and dry season (September and December 2008). Five grab sample replicates of 0.1m2 were collected in each of the sampling stations by van Veen Grab. Collected samples were sieved by 0.5mm mesh sieve and then preserved in 5% buffered seawater formalin. Organisms inside the samples were sorted from the sediments by staining with Rose Bengal and then identified to the lowest practicable taxonomic level. Species diversity, abundance and biomass were reported for evaluating and ranking the ecological values.

(3) Dive Survey

Dive surveys for corals and other hard substrate marine organisms were conducted in September 2008. The dive surveys concentrated on shallow coastal waters that would be subject to direct loss of marine habitats or indirect water quality impacts, including both natural and artificial coastlines at the northeast of Airport Island.

The methodology used in the present survey followed those adopted in the AFCD territorial wide dive survey conducted in 2001-2002 (AFCD 2004). It consisted of a suite of three standardized "nested" survey methods including spot-check dive reconnaissance dives, Rapid Ecological Assessment (REA) and video transects. In the present study, due to the highly turbid water and the low diversity and coverage of marine fauna, video transect was not performed. The spot-check and REA methods were used and were found sufficient for establishing the ecological profile of the study area.

Spot Reconnaissance survey

Spot reconnaissance dives were conducted 17 spot-check dives were conducted and covered: 1) along the coastlines of Northeast Airport Island (8 spots), with focus concentrated on the section opposite to the future BCF reclamation area, ; 2) as well as within the future BCF reclamation area covering the entire proposed reclamation site (9 spots). The locations for spot reconnaissance dives are shown in Figure 1. Visual reconnaissance was made of the area of each bounce dive point, by adopting a circular path.

The purposes of the spot reconnaissance dives are to verify whether corals (including all hard corals, octocorals and black corals) and other marine organisms with conservation importance are present within the areas potentially subject to direct impacts (e.g. the reclamation area) and indirect impacts (e.g. the Airport Island coastlines). As the underwater visibility is low in North Lantau waters, during the reconnaissance dives circular paths at each dive spots were adopted (continuous routes are not suitable under the very low visibility). Besides the biota, the habitat types present within the areas and their approximate proportions/distributions were also recorded. Underwater photographs were taken.

REA survey

Semi-quantitative Rapid Ecological Assessment (REA) survey were conducted at the two major locations where the connecting roads with BCF will land on Airport Island, as well as with hard substrates identified during the spot reconnaissance dives. The REA transect locations are shown in **Figure 1**. The starting points of the REA transects were determined on site in accordance with the site conditions and underwater visibility.

The REA survey at the landing point areas were performed along 100m underwater transects horizontal to the coastlines. Transects perpendicular to the coastline of 50m (limited by the underwater visibility) were also performed. The depth and substrate along the perpendicular transects for REA were recorded at 3m intervals. The benthic cover, taxon abundance, and ecological attributes of the transects were recorded in a swathe of 2m wide, 1m either side of the transects, following the Rapid Ecological Assessment (REA) technique. Video footages and photos were taken during the dive surveys.

The purposes of the REA survey are to quantitatively record the habitat types and ecological values of the area by SCUBA diving and the application of Rapid Ecological Assessment (REA) approach. The REA approach (see Annex A for details) aims at collecting data on the type of substrate and the abundance of marine organisms in particular the occurrence of corals and the extent of the coral distribution from the coastline, for ranking the ecological values. Other parameters to be recorded during the surveys include site condition (e.g. observations regarding the degree of exposure of the sites to wave action), species list of corals and other marine organisms, coral sizes, coral health status, and translocation feasibility of corals.

Table 1 Time schedule of the ecological survey programme

Items	2008					2009	
	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Approval of survey plan	■						
Marine grab		■			■		
Dive survey			■				
Intertidal survey	■			■			
Draft Results						■	
Final Results							■

5 Results

The proposed Project comprises two major elements, reclamation next to the Airport Island and connecting road/access from the HKBCF to Airport Island.

5.1 Intertidal survey

Intertidal survey is to investigate the intertidal habitats and communities. Two types of intertidal habitats were present and surveyed i.e. artificial seawalls immediately landward to the reclamation area, and rocky shore to the north and to the south of the artificial seawalls, which included a small section of sandy shore further southward to the southern rocky shore.

A total of 21 taxa were recorded during the surveys. All were common intertidal organisms in Hong Kong. The survey data were shown in **Annex 2**.

Table 2 List of Intertidal Fauna Recorded during the survey

Common name	Scientific name	Commonness in Hong Kong
Rock oyster	*Saccostrea cucullata*	Common
Green mussel	*Perna viridis*	Common
Bivalve	*Barbatium* sp.	Common
Limpet	*Cellana grata*	Common
False Limpet	*Siphonaria* sp.	Common
Littorid snail	*Echinolittorina trochoides*	Common
Littorid snail	*Echinolittorina radiata*	Common

Common name	**Scientific name**	**Commonness in Hong Kong**
Littorid snail	*Littoraia articulata*	Common
Snail	*Nerita yoldii*	Common
Snail	*Chlorostoma argyrostomum*	Common
Dog whelk	*Thais clavigera*	Common
Dog whelk	*Thais* sp.	Common
Stalked barnacle	*Capitulum mitella*	Common
Barnacle	*Tetraclita squamosa*	Common
Barnacle	*Balanus amphitrite*	Common
Isopod	*Ligia exotica*	Common
Hermit crab	*Clibanarius infraspinatus*	Common
Crab	*Hemigrapsus sanguineus*	Common
Crab	*Gaetice depressus*	Common
Crab	*Ocypode* sp.	Common
Crab	*Parasesarma pictum*	Common

All the intertidal fauna recorded during the survey were very common to intertidal habitats in Hong Kong. The abundance and diversity of intertidal fauna were low on both the artificial seawalls and the rocky shore. The Diversity Index (H') and Evenness Index (J) were shown in the table below. Both the diversity index and evenness index in both wet (August 2008) and dry (November 2008) seasons were low for the northern and southern transect sites.

Table 3 Diversity index and Evenness index at the 2 transect sampling sites

	August 2008	
	North Site	South Site
Diversity index (*H'*)	1.37	1.19
Evenness index (*J*)	0.60	0.52
	November 2008	
	North Site	South Site
Diversity index (*H'*)	1.23	1.14
Evenness index (*J*)	0.59	0.52

5.2 Benthic survey results

A total of 210 benthic organisms were recorded in the wet season survey, while 348 benthic organism were recorded in dry season survey. 80 taxa were recorded, including 8 phyla (Annelida, Arthropoda, Chordata, Coelentarate, Echinodermata, Mollusca, Nemertea and Phoronida), (Table 4). Detailed results of the benthic survey are presented in Annex 3. In both wet and dry seasons, no species of conservation importance was found and none of the species are listed in the IUCN Red List (IUCN 2008).

Table 4. Summary of the macrofauna collected in wet season (September) and dry season (December) 2008.

Phylum	Wet Season (September 2008)			Dry Season (December 2008)		
	Number of species/ families	Total number of individuals	Total biomass (g)	Number of species/ families	Total number of individuals	Total biomass (g)
Annelida	21	70	3.21	30	129	7.45
Arthropoda	10	41	45.228	16	114	25.196
Chordata	3	8	12.53	3	9	14.4
Coelenterata	1	1	0.08	2	2	0.04
Echinodermata	3	11	2.334	2	15	6.67
Mollusca	9	68	200.09	13	69	125.75
Nemertea	1	8	0.58	1	3	0.05
Phoronida	1	3	0.22	1	7	0.13
Total	**49**	**210**	**264.272**	**68**	**348**	**179.686**

Table 5 Species diversity index and species evenness index of the 9 stations

Station	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**	**G7**	**G8**	**G9**
Wet season									
Individual number	30	30	23	27	16	28	29	14	13
Species diversity H'	2.35	2.83	2.69	1.74	2.51	2.53	2.46	2.07	2.35
Species evenness J	0.69	0.83	0.86	0.53	0.91	0.76	0.73	0.78	0.92
Dry season									
Individual number	60	49	30	34	23	39	29	59	26
Species diversity H'	2.90	2.60	2.75	2.57	2.54	2.70	2.76	3.14	2.74
Species evenness J	0.71	0.67	0.81	0.73	0.81	0.74	0.82	0.78	0.84

Error! Not a valid link. ranged from 1.74 to 3.14, while Pielou's Evenness index ranged from 0.53 to 0.92

Infauna diversity in the Study Are is relatively low when compared to other areas in Hong Kong. All the species recorded occur frequently in Hong Kong and no rare species were observed (Shin 2002)

5.3 Dive survey

Spot dive survey

Spot dive surveys were conducted at 17 locations, including 8 stations along the coastlines of Airport Island and 9 stations within the HKBCF reclamation site. All surveyed areas/sites were of turbid waters and thus low visibility. The coordinates of these spot dive sites are shown in the table below.

Table 6 Coordinates of spot dive sites

Point	Latitude(N)	Longitude(E)
S1	22.192	113.563
S2	22.193	113.564
S3	22.192	113.565
S4	22.191	113.565
S5	22.185	113.564
S6	22.184	113.563
S7	22.184	113.562
S8	22.183	113.562
G1	22.191	113.570
G2	22.190	113.571
G3	22.190	113.572
G4	22.190	113.570
G5	22.190	113.571
G6	22.185	113.572
G7	22.185	113.565
G8	22.185	113.570
G9	22.184	113.572

Spot dive Site S1 to S8 were located on the coastline of Airport Island, from the northeast corner of Airport Island (S1), to the eastern shore of Airport Island southward to the airport runway signal light (S8).

Spot Dive Site S1, S3, S4, S5, and S6 were artificial seawalls, either vertical seawall (S3 and S5) or sloping seawalls (S1, S4, S6).

Sloping seawalls are composed of irregular boulders and maintained the same gradient till they reached the seabed. Gorgonian coral Echinomuricea sp. was found on the surface of the boulders, though the coverage percentage was low (<5%). One species of ahermatypic coral Balanophyllia sp. was also found on boulders at S4, but at a even lower coverage (<1%). Other epifauna on the boulders included Perna viridis and Thais sp.. Beyond the seawalls, the seabed turned into muddy substrates, and no epifauna was found.

The epifauna on vertical seawalls were of a even lower percentages/abundance than that on sloping seawalls. Very limited gorgonian coral Echinomuricea sp. colonized on the crevices of the seawall blocks.

S2 and S7, and S8 were natural coastlines. Boulders (of much smaller sizes than those of sloping seawalls) covered the seabed in the nearshore, and scattered on sandy substrate further offshore. No hard or soft coral was found on these boulders.

G1 to G9 were inside the HKBCF reclamation site. The seabed within the reclamation site was generally in very low gradient. The water depth of these sites was similar, about 5-6m. All these 9 sites were of sandy/muddy substrate. The water was turbid and the visibility in these 9 sites (offshore to the coastline) was lower than the sites near the coastline. No epifauna or any coral was found on these locations with sandy substrate.

Dive REA survey

REA dive survey was conducted at S4 and S6, both are sloping seawalls and are potentially subject to direct impacts from the HKBCF project.

Table 7 The profile of REA Transects

	S4		S6	
Distance (m)	**Depth (m C.D.)**	**Substratum**	**Depth (m C.D.)**	**Substratum**
0	-0.5	Boulders	-0.5	Boulders
3	-1.2	Boulders	-1.2	Boulders
6	-2.5	Boulders	-2.5	Boulders
9	-3	Boulders	-3	Boulders
12	-4	Boulders	-4	Boulders
15	-5	Boulders	-5	Sandy/muddy
18	-5	Boulders	-5	Sandy/muddy
21	-5	Boulders	-5	Sandy/muddy
24	-5	Sandy/muddy	-5	Sandy/muddy
27	-5	Sandy/muddy	-5	Sandy/muddy
30	-5	Sandy/muddy	-5	Sandy/muddy
33	-5.5	Sandy/muddy	-5	Sandy/muddy
36	-5.5	Sandy/muddy	-5	Sandy/muddy
39	-5	Sandy/muddy	-5.5	Sandy/muddy
42	-5	Sandy/muddy	-5.5	Sandy/muddy
45	-5.5	Sandy/muddy	-5.5	Sandy/muddy
48	-5	Sandy/muddy	-5.5	Sandy/muddy

The results of the REA survey were shown in the table below:

Table 8 List of Marine Species Recorded by the REA survey within the Project Area

REA criteria	S4	S6
Substratum		
Bedrock/Continuous pavement	0	0
boulders	6	6
Rubble	0	0
Cobbles	0	0
Sand with gravel	0	0
Mud	0	0
Ecological attributes		
Hard coral	1	0
Dead standing corals	0	0
Soft corals	1	1
Sea anemone beds	0	0
Macroalgae	0	0

A total of 8 species of marine organisms were recorded in the area, while only one species of ahermatypic coral of very low coverage was found. Selected photos of the coral species were shown in **Photo Plate**. All the species recorded are common to dominant in Hong Kong, of no special conservation importance.

Table 9 List of marine coral species recorded within the Project area

Scientific name	Commonness in Hong Kong
Perna viridis	Very common
Balanophyllia sp.	Common
Echinomuricea sp.	Very common
Balanus amphitrite	Very common
Chlorostoma sp.	Very common
Thais sp.	Very common
Hermit crab	Very common
Crassostrea cucullata	Very common

END

Annex 1

Rapid Ecological Assessment

Rapid Ecological Assessment involves 'semi-quantitative' swim-surveys allowing for assessment and classification of survey areas. The field data are collected by divers experienced in the underwater identification of sessile benthic taxa, swimming along coral communities or identified sections of coastline on SCUBA.

REA surveys provide information on the assessment of relative cover of coral and other major benthic groups, as well as an inventory of sessile benthic taxa used to define community types.

Five ecological and six substratum attributes shall be assessed on site and/or by reviewing video footages. Each of the attributes (**Table A1-1**) should be assigned to one of the seven standard ranked categories (from zero to six, representing percentage cover from none to over 76%)(**Table A1-2**).

An inventory of benthic taxa shall be complied for transect. Taxa shall be identified in situ to the following levels:

1) Hard corals to species level where possible;
2) Soft corals, anemones and macroalgae to genus level where possible; and
3) Other benthos to genus level where possible or phylum with growth form.

Each taxon in the inventory shall also be ranked to one of the six categories (**Table A1-3**) in terms of abundance (from 0 to 5, representing from absent to dominant) in the community.

Table A1-1 Ecological and Substratum attributes used in REA

Ecological attributes
Hard coral
Dead standing corals
Soft corals
Sea anemone beds
Macroalgae
Substratum
Bedrock/Continuous pavement
boulders
Rubble
Cobbles
Sand with gravel
Mud

Table A1-2 Ranking of Ecological and substratum attributes

Rank	**Percentage cover (%)**
0	None recorded
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

Table A1-3 Ranking of Benthos abundance

Rank	**Abundance**
0	Absent
1	Sparse
2	Uncommon
3	Common
4	Abundant
5	Dominant

End of Annex 1

Annex 2
Intertidal survey results

S4 (North Site) – August 2008

High level										
Quadrat	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Echinolittorina radiata	2	6		6	11		3			11
Echinolittorina trochoides	11		9	4	3			2		
Littoraria articulata										
Capitulum mitella		35					36			
Middle Level										
Quadrat	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Saccostrea cucullata	23	6	13	9	35	16	36	12		21
Perna viridis										
Cellana grata		3			1		1	1		1
Siphonaria sp.						2				1
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulate										
Nerita yoldii										
Thais clavigera		1		3	2			1		
Thais sp.										
Capitulum mitella				15		3			2	
Teraclita squamosa	6	14	11	2	2		31	2		4
Balanus amphitrite										
Low Level										
Quadrat	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Saccostrea cucullata	9	31	51	34	16	14	5	31	45	35
Perna viridis				1				2		2
Cellana grata		5		3				3		
Siphonaria sp.										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Nerita yoldii				2						
Thais clavigera		2	2		1	3		5	1	11
Thais sp.										
Capitulum mitella							37			
Teraclita squamosa	80	18		25	66	12	41	74	39	90
Balanus amphitrite										

S6 (South Site) – August 2008

High level										
Quadrat	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
	-	-	-	-	-	-	-	-	-	-
Middle Level										
Quadrat	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Saccostrea cucullata	5	7	10	80	90	5	15	90	60	80
Perna viridis								6		
Cellana grata							8	30	25	60
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata							22			
Nerita								1		
Thais clavigera								11		
Thais sp.										
Capitulum mitella										
Teraclita squamosa	4						2			
Balanus amphitrite										
Low Level										
Quadrat	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Saccostrea cucullata	9	26	11					1	1	3
Perna viridis									6	
Cellana grata									5	
Siphonaria sp.			1							
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Nerita yoldii										
Thais clavigera	8			5			2	15		2
Thais sp.									2	
Capitulum mitella										
Teraclita squamosa										
Balanus amphitrite	70	40	40	70	90	95	70	70	60	80

S4 (North Site) – November 2008

High level										
Quadrat	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Echinolittorina radiata		4		14	7				1	10
Echinolittorina trochoides				9	3			1		
Littoraria articulata										
Capitulum mitella					41					
Middle Level										
Quadrat	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Saccostrea cucullata	13	8	15	20	29	1	36		2	18
Perna viridis										
Cellana grata				2				1		1
Siphonaria sp.										1
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Nerita yoldii										
Thais clavigera			2		1			1		
Thais sp.										
Capitulum mitella		11				1				
Teraclita squamosa	18	4		4		1	26	1	3	1
Balanus amphitrite										
Low Level										
Quadrat	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Saccostrea cucullata	12	27	80	33	13	18	21	23	30	40
Perna viridis										
Cellana grata			7							
Siphonaria sp.										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Nerita yoldii										
Thais clavigera			3	2			2	1	3	10
Thais sp.										
Capitulum mitella		22								
Teraclita squamosa	60	23		13	53	28	35	70	42	80
Balanus amphitrite										

S6 (South Site) – November 2008

High level										
Quadrat	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
	-	-	-	-	-	-	-	-	-	-
Middle Level										
Quadrat	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Saccostrea cucullata	3	8	60	6	9	61	28	67	71	74
Perna viridis								2	2	
Cellana grata					3		4	14	26	31
Siphonaria sp.										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata									3	6
Nerita yoldii									2	
Thais clavigera								5	5	
Thais sp.										
Capitulum mitella										
Teraclita squamosa	6			2			3			
Balanus amphitrite										
Low Level										
Quadrat	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Saccostrea cucullata		11	23	9			5		6	
Perna viridis									6	
Cellana grata			2				3			
Siphonaria sp.										
Echinolittorina radiata										
Echinolittorina trochoides										
Littoraria articulata										
Nerita yoldii										
Thais clavigera		5	5	6					8	4
Thais sp.				1		2				
Capitulum mitella										
Teraclita squamosa										
Balanus amphitrite	70	51	20	85	55	85	65	80	50	70

End of Annex 2

Annex 3

Results of Benthic Garb Survey

Results of Dry Season Benthic Grab Survey

		1A		1B		1C		1D		1E		2A		2B		2C		2D		2E		3A		3B		3C		3D		3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	COELENTERATA																														
	Actiniaria																														
1	Actinian																														
2	*Virgularia* sp.																														
	NEMERTEA																														
3	Nemertean																	1	0.01												
	ANNELIDA																														
	Polychaeta																														
4	*Aglaophamus dibranchis*																														
5	*Asychis* sp.																														
6	*Australaugeneria* sp.																														
7	*Bhawania goodei*																														
8	*Chloeia parva*	1	0.13	1	0.17																									1	0.1
9	*Ceratonereis* sp.																														
10	*Cossurella dimorpha*																														
11	*Diopatra variabilis*					1	0.09																								
12	*Eteone longa*									1	0.01																				
13	*Eunice indica*			1	0.02	4	0.13	3	0.1	6	0.16																				
14	*Glycera convoluta*																														
15	*Glycera rouxi*							1	0.01					1	0.03	1	0.04											1	0.03		
16	*Harmothoe imbricata*							1	0.01	1	0.01																				
17	*Heteromastus filiformis*																														
18	*Laonice cirrata*							1	0.01							1	0.02														
19	*Leocrates chinensis*																														
20	*Lepidasthenia microlepis*																														

		1A		1B		1C		1D		1E		2A		2B		2C		2D		2E		3A		3B		3C		3D		3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
21	*Linopherus hirsuta*											1	0.02			1	0.03														
22	*Loimia medusa*																														
23	*Lumbrineris latreilli*																							1	0.01						
24	*Lumbrineris meteorana*																														
25	*Lumbrineris nagae*	1	0.06									1	0.06									1	0.09								
26	*Malacoceros indicus*																							1	0.01						
27	Maldanidae																					1	0.01								
28	*Mediomastus californiensis*									1	0.01									2	0.03										
29	*Nectoneanthes multignatha*																														
30	*Nephtys polybranchia*			1	0.01									1	0.01			1	0.01	1	0.01	1	0.01			1	0.01				
31	*Notomastus latericeus*																					1	0.01			2	0.04				
32	*Ophelina grandis*																									1	0.17				
33	*Paraprionospio pinnata*											1	0.02					1	0.01												
34	*Pilargis* sp.															1	0.07														
35	*Poecilochaetus serpens*																			1	0.03							1	0.02		
36	*Prionospio malmgreni*									1	0.01																				
37	*Sigambra hanaokai*																														
38	*Sthenolepis japonica*							2	0.02																						
39	*Terebellides stroemi*																					1	0.01					1	0.12		
40	*Tharyx marioni*																														
	MOLLUSCA																														
	Bivalvia																														
41	*Anadara granosa*																														
42	*Corbula* sp.																														
43	*Donax* sp.							1	6					2	2.32	1	2.83							1	2.06						
44	*Dosinia* sp.																														
45	*Gafrarium* sp.																	1	1												
46	*Gari hosoyai*																														
47	*Nuculana* sp.																	1	0.11												

		1A		1B		1C		1D		1E		2A		2B		2C		2D		2E		3A		3B		3C		3D		3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
48	*Paphia undulata*					2	0.44					2	2.77	2	11.6	5	11	6	10	1	0.31			3	6					1	2.26
49	*Placamen* sp.																														
50	*Sinonovacula constricta*																														
51	*Solen* sp.									1	0.12																			1	0.3
52	*Yoldia* sp.																														
	Gastropoda																														
	Columbellidae																														
53	*Alia* sp.																														
54	*Nassarius* sp.1							1	0.2																						
55	*Nassarius* sp.2																														
	Terridae																														
56	*Territella bacillum*					1	0.07	2	12					1	0.08																
	ARTHROPODA																														
	Crustacea																														
	Amphipoda																														
57	*Ampelisca* sp.									1	0.01																				
58	*Gammarus* sp.																														
59	Photidae	1	0.01	1	0.01			1	0.02													1	0.01								
60	Pleustidae																														
	Decapoda																														
61	*Alpheus* sp.							3	0.28	1	0.1																				
62	*Callianassa* sp.																														
63	*Charybdis affinis*									2	0.2	1	1.4																		
64	Hippolytidae																														
65	*Macrophthalmus latreillei?*																									1	0.62				
66	Mantis shrimp																														
67	*Metapenaeus* sp.																	1	1.7												
68	*Neoxenophthalmus obscurus*	1	0.2							1	0.12	2	0.9	1	0.08											2	0.19	2	0.2	1	0.25
69	*Polyonyx* sp.																														

		1A		1B		1C		1D		1E		2A		2B		2C		2D		2E		3A		3B		3C		3D		3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
70	*Portunus* sp.																														
71	*Upogebia* sp.							1	0.03	3	0.22																				
72	*Typhlocarcinus nudus*					1	1.3			2	0.19																				
73	*Philyra olivacea*													1	0.31																
	PHORONIDA																														
74	*Phoronis australis*													1	0.02																
	ECHINODERMATA																														
	Holothuroidea																														
75	*Acaudina molpadioides*																														
76	*Protankyra bidentata*																														
	Ophiuroidea																														
77	Amphiuridae	2	0.26					1	0.07	1	0.03					1	0.01			2	0.16	1	0.04								
	Vertebrata																														
	Osteichthyes																														
78	*Odontamblyopus rubicundus*															1	3.1											1	0.07		
79	Gobiidae fish																														
80	Osteichthian (Fish)							1	0.15																						
	Replicates	6	0.66	4	0.21	9	2.03	19	18.9	22	1.2	8	5.17	10	14.5	12	17.1	12	12.8	7	0.54	7	0.18	6	8.08	7	1.03	6	0.44	4	2.91
	Stations									60	23									49	50.1									30	12.6
		348	180																												

		4A		4B		4C		4D		4E		5A		5B		5C		5D		5E		6A		6B		6C		6D		6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	COELENTERATA																														
	Actiniaria																														
1	Actinian																							1	0.02						
2	*Virgularia* sp.																														
	NEMERTEA																														
3	Nemertean																														

		4A		4B		4C		4D		4E		5A		5B		5C		5D		5E		6A		6B		6C		6D		6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	ANNELIDA																														
	Polychaeta																														
4	*Aglaophamus dibranchis*																									1	0.02				
5	*Asychis* sp.																														
6	*Australaugeneria* sp.																														
7	*Bhawania goodei*																														
8	*Chloeia parva*																														
9	*Ceratonereis* sp.																														
10	*Cossurella dimorpha*																														
11	*Diopatra variabilis*	1	1.99	1	0.59																										
12	*Eteone longa*																														
13	*Eunice indica*																														
14	*Glycera convoluta*																														
15	*Glycera rouxi*																														
16	*Harmothoe imbricata*																														
17	*Heteromastus filiformis*																														
18	*Laonice cirrata*															1	0.01													1	0.01
19	*Leocrates chinensis*																														
20	*Lepidasthenia microlepis*																														
21	*Linopherus hirsuta*															1	0.01									1	0.03				
22	*Loimia medusa*							2	0.11															1	0.78						
23	*Lumbrineris latreilli*																									1	0.02	1	0.01		
24	*Lumbrineris meteorana*																														
25	*Lumbrineris nagae*																							1	0.06	2	0.28	1	0.08		
26	*Malacoceros indicus*																														
27	Maldanidae																														
28	*Mediomastus californiensis*							1	0.01			2	0.01																		
29	*Nectoneanthes multignatha*																														
30	*Nephtys polybranchia*					1	0.02	1	0.01					1	0.01							1	0.01	1	0.04	1	0.01			1	0.01

		4A		4B		4C		4D		4E		5A		5B		5C		5D		5E		6A		6B		6C		6D		6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
31	*Notomastus latericeus*											1	0.01																		
32	*Ophelina grandis*			1	0.12																	1	0.01								
33	*Paraprionospio pinnata*																					2	0.02			1	0.01				
34	*Pilargis* sp.																														
35	*Poecilochaetus serpens*													1	0.01																
36	*Prionospio malmgreni*																														
37	*Sigambra hanaokai*																														
38	*Sthenolepis japonica*																														
39	*Terebellides stroemi*																														
40	*Tharyx marioni*																														
	MOLLUSCA																														
	Bivalvia																														
41	*Anadara granosa*																									1	0.17				
42	*Corbula* sp.																														
43	*Donax* sp.			1	3.62									2	4.29																
44	*Dosinia* sp.																														
45	*Gafrarium* sp.																														
46	*Gari hosoyai*																														
47	*Nuculana* sp.																														
48	*Paphia undulata*	1	0.03					1	0.54					2	4.48	2	0.96			1	3.09										
49	*Placamen* sp.																														
50	*Sinonovacula constricta*																														
51	*Solen* sp.											1	0.37	1	0.41									1	0.21						
52	*Yoldia* sp.																									1	0.11				
	Gastropoda																														
	Columbellidae																														
53	*Alia* sp.																														
54	*Nassarius* sp.1																														
55	*Nassarius* sp.2																														
	Terridae																														

		4A		4B		4C		4D		4E		5A		5B		5C		5D		5E		6A		6B		6C		6D		6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
56	*Territella bacillum*			1	0.13	2	0.58	1	0.12							1	0.5			1	0.05										
	ARTHROPODA																														
	Crustacea																														
	Amphipoda																														
57	*Ampelisca* sp.																														
58	*Gammarus* sp.																														
59	Photidae																									1	0.01	1	0.01		
60	Pleustidae											1	0.01											6	0.02	1	0.01				
	Decapoda																														
61	*Alpheus* sp.																													1	0.01
62	*Callianassa* sp.																														
63	*Charybdis affinis*																														
64	Hippolytidae					1	0.12																								
65	*Macrophthalmus latreillei?*																														
66	Mantis shrimp																														
67	*Metapenaeus* sp.					1	0.26	1	0.13																						
68	*Neoxenophthalmus obscurus*			2	0.17					1	0.17							1	0.15					1	0.06						
69	*Polyonyx* sp.													1	0.7																
70	*Portunus* sp.																														
71	*Upogebia* sp.			1	0.03																										
72	*Typhlocarcinus nudus*			5	1.83	2	0.43	1	0.6									1	0.26			1	0.23					2	1.23	1	0.7
73	*Philyra olivacea*																														
	PHORONIDA																														
74	*Phoronis australis*			1	0.03																										
	ECHINODERMATA																														
	Holothuroidea																														
75	*Acaudina molpadioides*																														
76	*Protankyra bidentata*			1	5.45																										
	Ophiuroidea																														

		4A		4B		4C		4D		4E		5A		5B		5C		5D		5E		6A		6B		6C		6D		6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
77	Amphiuridae											1	0.03																		
	Vertebrata																														
	Osteichthyes																														
78	*Odontamblyopus rubicundus*	1	4																											2	0.22
79	Gobiidae fish			1	2.6																										
80	Osteichthian (Fish)																														
	Replicates	3	6.02	15	14.6	7	1.41	8	1.52	1	0.17	6	0.43	8	9.9	5	1.48	2	0.41	2	3.14	5	0.27	12	1.19	11	0.67	5	1.33	6	0.95
	Stations									34	23.7									23	15.4									39	4.41

		7A		7B		7C		7D		7E		8A		8B		8C		8D		8E		9A		9B		9C		9D		9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	COELENTERATA																														
	Actiniaria																														
1	Actinian																														
2	*Virgularia* sp.																									1	0.02				
	NEMERTEA																														
3	Nemertean	1	0.02											1	0.02																
	ANNELIDA																														
	Polychaeta																														
4	*Aglaophamus dibranchis*																														
5	*Asychis* sp.																														
6	*Australaugeneria* sp.																														
7	*Bhawania goodei*			1	0.01																										
8	*Chloeia parva*																														
9	*Ceratonereis* sp.																											1	0.01		
10	*Cossurella dimorpha*																														
11	*Diopatra variabilis*											1	0.02																	1	0.09
12	*Eteone longa*																														

		7A		7B		7C		7D		7E		8A		8B		8C		8D		8E		9A		9B		9C		9D		9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
13	*Eunice indica*											1	0.01															2	0.03		
14	*Glycera convoluta*											1	0.01																	1	0.08
15	*Glycera rouxi*													1	0.02																
16	*Harmothoe imbricata*																														
17	*Heteromastus filiformis*											2	0.01																		
18	*Laonice cirrata*									1	0.16			1	0.01																
19	*Leocrates chinensis*											1	0.01							1	0.04										
20	*Lepidasthenia microlepis*																														
21	*Linopherus hirsuta*																														
22	*Loimia medusa*			1	0.17							4	0.04													1	0.19				
23	*Lumbrineris latreilli*					1	0.01																								
24	*Lumbrineris meteorana*																														
25	*Lumbrineris nagae*					1	0.05			1	0.03																				
26	*Malacoceros indicus*																														
27	Maldanidae																														
28	*Mediomastus californiensis*																														
29	*Nectoneanthes multignatha*																														
30	*Nephtys polybranchia*					1	0.02	1	0.01			1	0.01	1	0.01	1	0.01			1	0.01									1	0.01
31	*Notomastus latericeus*																														
32	*Ophelina grandis*											1	0.02																		
33	*Paraprionospio pinnata*																			1	0.01										
34	*Pilargis* sp.																														
35	*Poecilochaetus serpens*													1	0.01																
36	*Prionospio malmgreni*																	1	0.01							1	0.01				
37	*Sigambra hanaokai*																														
38	*Sthenolepis japonica*																														
39	*Terebellides stroemi*																														
40	*Tharyx marioni*																	1	0.01												
	MOLLUSCA																														

		7A		7B		7C		7D		7E		8A		8B		8C		8D		8E		9A		9B		9C		9D		9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	Bivalvia																														
41	*Anadara granosa*							1	0.35																						
42	*Corbula* sp.																							1	0.04						
43	*Donax* sp.									1	1.47																				
44	*Dosinia* sp.																														
45	*Gafrarium* sp.																														
46	*Gari hosoyai*											1	0.11																		
47	*Nuculana* sp.																														
48	*Paphia undulata*																														
49	*Placamen* sp.											1	0.02																		
50	*Sinonovacula constricta*																														
51	*Solen* sp.	1	0.07							1	0.14																				
52	*Yoldia* sp.																														
	Gastropoda																														
	Columbellidae																														
53	*Alia* sp.					1	0.05																								
54	*Nassarius* sp.1																														
55	*Nassarius* sp.2																														
	Terridae																														
56	*Territella bacillum*			1	1.16									1	0.07	1	0.13					1	31								
	ARTHROPODA																														
	Crustacea																														
	Amphipoda																														
57	*Ampelisca* sp.			1	0.01									1	0.01			3	0.01							1	0.01				
58	*Gammarus* sp.											1	0.01																		
59	Photidae									1	0.01							1	0.01												
60	Pleustidae					6	0.01					2	0.02	1	0.01			2	0.01												
	Decapoda																														
61	*Alpheus* sp.											9	0.24													4	0.27	1	0.01	1	0.02
62	*Callianassa* sp.																							1	0.01						

		7A		7B		7C		7D		7E		8A		8B		8C		8D		8E		9A		9B		9C		9D		9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
63	*Charybdis affinis*			1	0.47																										
64	Hippolytidae																														
65	*Macrophthalmus latreillei?*											1	6.5	1	0.06																
66	Mantis shrimp																														
67	*Metapenaeus* sp.																														
68	*Neoxenophthalmus obscurus*													1	0.07							1	0.11								
69	*Polyonyx* sp.																														
70	*Portunus* sp.																									1	0.44				
71	*Upogebia* sp.													1	0.03																
72	*Typhlocarcinus nudus*	2	0.62											1	0.06											1	0.5				
73	*Philyra olivacea*																					1	0.18								
	PHORONIDA																														
74	*Phoronis australis*													1	0.01	1	0.03			2	0.02			1	0.02						
	ECHINODERMATA																														
	Holothuroidea																														
75	*Acaudina molpadioides*																														
76	*Protankyra bidentata*			1	0.48																										
	Ophiuroidea																														
77	Amphiuridae			1	0.05					1	0.05											1	0.02					1	0.02		
	Vertebrata																														
	Osteichthyes																														
78	*Odontamblyopus rubicundus*																	1	4.2												
79	Gobiidae fish																														
80	Osteichthian (Fish)											1	0.06																		
	Replicates	4	0.71	7	2.35	10	0.14	2	0.36	6	1.86	28	7.09	13	0.39	3	0.17	9	4.25	5	0.08	4	31.3	3	0.07	10	1.43	5	0.07	4	0.2
	Stations									29	5.42									58	12									26	33.1

Results of Wet Season Benthic Grab Survey

		W1A		W1B		W1C		W1D		W1E		W2A		W2B		W2C		W2D		W2E		W3A		W3B		W3C		W3D		W3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	COELENTERATA																														
	Actiniaria																														
1	Actinian																														
2	*Virgularia* sp.																													1	0.08
	NEMERTEA																														
3	Nemertean	1	0.01									1	0.02													1	0.01	1	0.02		
	ANNELIDA																														
	Polychaeta																														
4	*Aglaophamus dibranchis*	2	0.03							1	0.01											1	0.02								
5	*Asychis* sp.																									1	0.01	1	0.01		
6	*Australaugeneria* sp.																														
7	*Bhawania goodei*																														
8	*Chloeia parva*																			1	0.14										
9	*Ceratonereis* sp.																														
10	*Cossurella dimorpha*	1	0.01																												
11	*Diopatra variabilis*																			1	0.05										
12	*Eteone longa*																														
13	*Eunice indica*																														
14	*Glycera convoluta*																														
15	*Glycera rouxi*																					1	0.03								
16	*Harmothoe imbricata*																														
17	*Heteromastus filiformis*			1	0.01							1	0.01			1	0.01														
18	*Laonice cirrata*																														
19	*Leocrates chinensis*													1	0.02																
20	*Lepidasthenia microlepis*																														
21	*Linopherus hirsuta*							1	0.01	1	0.02																				
22	*Loimia medusa*					1	0.05																			1	0.4				

		W1A		W1B		W1C		W1D		W1E		W2A		W2B		W2C		W2D		W2E		W3A		W3B		W3C		W3D		W3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
23	*Lumbrineris latreilli*																														
24	*Lumbrineris meteorana*	1	0.01																												
25	*Lumbrineris nagae*															1	0.13														
26	*Malacoceros indicus*																														
27	Maldanidae																														
28	*Mediomastus californiensis*	1	0.01			1	0.01							1	0.01			3	0.02			1	0.01								
29	*Nectoneanthes multignatha*																														
30	*Nephtys polybranchia*																														
31	*Notomastus latericeus*	1	0.01																												
32	*Ophelina grandis*																														
33	*Paraprionospio pinnata*																														
34	*Pilargis* sp.																														
35	*Poecilochaetus serpens*							1	0.01																	1	0.01	1	0.01		
36	*Prionospio malmgreni*																														
37	*Sigambra hanaokai*															1	0.01														
38	*Sthenolepis japonica*																														
39	*Terebellides stroemi*																														
40	*Tharyx marioni*																														
	MOLLUSCA																														
	Bivalvia																														
41	*Anadara granosa*																														
42	*Corbula* sp.																														
43	*Donax* sp.	1	4	2	18	1	0.02											2	0.52	1	0.53							1	0.38		
44	*Dosinia* sp.																														
45	*Gafrarium* sp.																														
46	*Gari hosoyai*																														
47	*Nuculana* sp.																														
48	*Paphia undulata*	4	9	1	6	1	6.81			3	19									1	0.72	2	2.21								
49	*Placamen* sp.																														

		W1A		W1B		W1C		W1D		W1E		W2A		W2B		W2C		W2D		W2E		W3A		W3B		W3C		W3D		W3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
50	*Sinonovacula constricta*																														
51	*Solen* sp.			1	0.05									1	0.04							1	0.08					2	0.1		
52	*Yoldia* sp.																														
	Gastropoda																														
	Columbellidae																														
53	*Alia* sp.																														
54	*Nassarius* sp.1																														
55	*Nassarius* sp.2																							1	0.1						
	Terridae																														
56	*Territella bacillum*																														
	ARTHROPODA																														
	Crustacea																														
	Amphipoda																														
57	*Ampelisca* sp.																														
58	*Gammarus* sp.																														
59	Photidae																														
60	Pleustidae											2	0.02					2	0.01												
	Decapoda																														
61	*Alpheus* sp.																					2	0.14								
62	*Callianassa* sp.															1	0.02														
63	*Charybdis affinis*																														
64	Hippolytidae																														
65	*Macrophthalmus latreillei?*											1	0.03																		
66	Mantis shrimp																														
67	*Metapenaeus* sp.																														
68	*Neoxenophthalmus obscurus*							1	0.08					2	0.12											1	0.17				
69	*Polyonyx* sp.													1	0.03																
70	*Portunus* sp.																														
71	*Upogebia* sp.																														

		W1A		W1B		W1C		W1D		W1E		W2A		W2B		W2C		W2D		W2E		W3A		W3B		W3C		W3D		W3E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
72	*Typhlocarcinus nudus*																			1	0.17	1	0.39								
73	*Philyra olivacea*																														
	PHORONIDA																														
74	*Phoronis australis*													1	0.15									1	0.02						
	ECHINODERMATA																														
	Holothuroidea																														
75	*Acaudina molpadioides*															1	0.16														
76	*Protankyra bidentata*																														
	Ophiuroidea																														
77	Amphiuridae									1	0.01							1	0.05												
	Vertebrata																														
	Osteichthyes																														
78	*Odontamblyopus rubicundus*																														
79	Gobiidae fish																														
80	Osteichthian (Fish)																														
	Replicates	12	13.1	5	24.1	4	6.89	3	0.1	6	19	5	0.08	7	0.37	5	0.33	8	0.6	5	1.61	9	2.89	2	0.12	5	0.6	6	0.52	1	0.08
	Stations									30	63.2									30	2.99									23	4.2
		210	264																												

		W4A		W4B		W4C		W4D		W4E		W5A		W5B		W5C		W5D		W5E		W6A		W6B		W6C		W6D		W6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	COELENTERATA																														
	Actiniaria																														
1	Actinian																														
2	*Virgularia* sp.																														
	NEMERTEA																														
3	Nemertean			1	0.01	1	0.45																								
	ANNELIDA																														
	Polychaeta																														
4	*Aglaophamus dibranchis*	1	0.01	1	0.01	1	0.02	1	0.01	2	0.02	2	0.02											1	0.01						
5	*Asychis* sp.																														
6	*Australaugeneria* sp.																														
7	*Bhawania goodei*																														
8	*Chloeia parva*									1	0.9																				
9	*Ceratonereis* sp.																														
10	*Cossurella dimorpha*																														
11	*Diopatra variabilis*																														
12	*Eteone longa*																														
13	*Eunice indica*																														
14	*Glycera convoluta*																														
15	*Glycera rouxi*																														
16	*Harmothoe imbricata*																														
17	*Heteromastus filiformis*					1	0.01																								
18	*Laonice cirrata*																					1	0.01								
19	*Leocrates chinensis*																														
20	*Lepidasthenia microlepis*																									1	0.06				
21	*Linopherus hirsuta*																														
22	*Loimia medusa*											1	0.17																		
23	*Lumbrineris latreilli*											1	0.01																		

		W4A		W4B		W4C		W4D		W4E		W5A		W5B		W5C		W5D		W5E		W6A		W6B		W6C		W6D		W6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
24	*Lumbrineris meteorana*													1	0.01																
25	*Lumbrineris nagae*																														
26	*Malacoceros indicus*																														
27	Maldanidae																														
28	*Mediomastus californiensis*							1	0.01																						
29	*Nectoneanthes multignatha*																														
30	*Nephtys polybranchia*																														
31	*Notomastus latericeus*																														
32	*Ophelina grandis*																			1	0.02										
33	*Paraprionospio pinnata*																														
34	*Pilargis* sp.																														
35	*Poecilochaetus serpens*																														
36	*Prionospio malmgreni*																														
37	*Sigambra hanaokai*																														
38	*Sthenolepis japonica*																														
39	*Terebellides stroemi*																														
40	*Tharyx marioni*																														
	MOLLUSCA																														
	Bivalvia																														
41	*Anadara granosa*																					1	0.11								
42	*Corbula* sp.																														
43	*Donax* sp.									1	0.4											2	0.35	1	0.25						
44	*Dosinia* sp.																														
45	*Gafrarium* sp.																														
46	*Gari hosoyai*																														
47	*Nuculana* sp.																														
48	*Paphia undulata*	3	21	1	5	5	31	2	11	1	5.5											1	0.38	2	0.52	1	0.22				
49	*Placamen* sp.																														
50	*Sinonovacula constricta*																														

		W4A		W4B		W4C		W4D		W4E		W5A		W5B		W5C		W5D		W5E		W6A		W6B		W6C		W6D		W6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
51	*Solen* sp.													1	0.45							1	0.04	1	0.03						
52	*Yoldia* sp.																														
	Gastropoda																														
	Columbellidae																														
53	*Alia* sp.																														
54	*Nassarius* sp.1							1	0.2																						
55	*Nassarius* sp.2																														
	Terridae																														
56	*Territella bacillum*																														
	ARTHROPODA																														
	Crustacea																														
	Amphipoda																														
57	*Ampelisca* sp.																														
58	*Gammarus* sp.																														
59	Photidae																														
60	Pleustidae																														
	Decapoda																														
61	*Alpheus* sp.																					1	0.03								
62	*Callianassa* sp.																														
63	*Charybdis affinis*																											1	0.6		
64	Hippolytidae																														
65	*Macrophthalmus latreillei?*			1	10																										
66	Mantis shrimp											1	4.5																		
67	*Metapenaeus* sp.																														
68	*Neoxenophthalmus obscurus*																													2	0.33
69	*Polyonyx* sp.																														
70	*Portunus* sp.																														
71	*Upogebia* sp.																														
72	*Typhlocarcinus nudus*													1	0.27			1	0.4			1	0.03	1	0.09	2	0.28			1	0.09

		W4A		W4B		W4C		W4D		W4E		W5A		W5B		W5C		W5D		W5E		W6A		W6B		W6C		W6D		W6E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
73	*Philyra olivacea*																													1	0.29
	PHORONIDA																														
74	*Phoronis australis*													1	0.05																
	ECHINODERMATA																														
	Holothuroidea																														
75	*Acaudina molpadioides*																														
76	*Protankyra bidentata*																			1	0.54					2	0.21				
	Ophiuroidea																														
77	Amphiuridae																			1	0.05									2	0.12
	Vertebrata																														
	Osteichthyes																														
78	*Odontamblyopus rubicundus*					1	5							2	3.09							1	0.02								
79	Gobiidae fish																														
80	Osteichthian (Fish)													1	0.01																
	Replicates	4	21	4	15	9	36.5	5	11.2	5	6.82	5	4.7	7	3.88	0	0	1	0.4	3	0.61	9	0.97	6	0.9	6	0.77	1	0.6	6	0.84
	Stations									27	90.5									16	9.59									28	4.08

		W7A		W7B		W7C		W7D		W7E		W8A		W8B		W8C		W8D		W8E		W9A		W9B		W9C		W9D		W9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	COELENTERATA																														
	Actiniaria																														
1	Actinian																														
2	*Virgularia* sp.																														
	NEMERTEA																														
3	Nemertean									1	0.03																			1	0.03
	ANNELIDA																														
	Polychaeta																														
4	*Aglaophamus dibranchis*	2	0.02	1	0.03																										

		W7A		W7B		W7C		W7D		W7E		W8A		W8B		W8C		W8D		W8E		W9A		W9B		W9C		W9D		W9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
5	*Asychis* sp.																														
6	*Australaugeneria* sp.	1	0.01																												
7	*Bhawania goodei*																														
8	*Chloeia parva*																														
9	*Ceratonereis* sp.																														
10	*Cossurella dimorpha*																														
11	*Diopatra variabilis*																														
12	*Eteone longa*																														
13	*Eunice indica*																														
14	*Glycera convoluta*																														
15	*Glycera rouxi*																														
16	*Harmothoe imbricata*																														
17	*Heteromastus filiformis*							1	0.01																						
18	*Laonice cirrata*																														
19	*Leocrates chinensis*																														
20	*Lepidasthenia microlepis*																														
21	*Linopherus hirsuta*																														
22	*Loimia medusa*					1	0.08																								
23	*Lumbrineris latreilli*																														
24	*Lumbrineris meteorana*							1	0.01			1	0.01											1	0.02						
25	*Lumbrineris nagae*							1	0.21			1	0.02																		
26	*Malacoceros indicus*																														
27	Maldanidae																														
28	*Mediomastus californiensis*	1	0.01			4	0.04	1	0.01							1	0.01														
29	*Nectoneanthes multignatha*																														
30	*Nephtys polybranchia*																														
31	*Notomastus latericeus*															1	0.03														
32	*Ophelina grandis*																													1	0.3
33	*Paraprionospio pinnata*																														

		W7A		W7B		W7C		W7D		W7E		W8A		W8B		W8C		W8D		W8E		W9A		W9B		W9C		W9D		W9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
34	*Pilargis* sp.																														
35	*Poecilochaetus serpens*																														
36	*Prionospio malmgreni*																														
37	*Sigambra hanaokai*																														
38	*Sthenolepis japonica*																														
39	*Terebellides stroemi*																														
40	*Tharyx marioni*																														
	MOLLUSCA																														
	Bivalvia																														
41	*Anadara granosa*																					1	8								
42	*Corbula* sp.																														
43	*Donax* sp.																														
44	*Dosinia* sp.	1	1.07																												
45	*Gafrarium* sp.																														
46	*Gari hosoyai*																														
47	*Nuculana* sp.																														
48	*Paphia undulata*	2	15			4	11																								
49	*Placamen* sp.																														
50	*Sinonovacula constricta*																									1	0.36				
51	*Solen* sp.																									1	0.11	1	0.08		
52	*Yoldia* sp.																														
	Gastropoda																														
	Columbellidae																														
53	*Alia* sp.																														
54	*Nassarius* sp.1																														
55	*Nassarius* sp.2																														
	Terridae																														
56	*Territella bacillum*	1	6.5			1	4.46							1	1.77	1	1.7	1	2.94									1	3.1		
	ARTHROPODA																														
	Crustacea																														

		W7A		W7B		W7C		W7D		W7E		W8A		W8B		W8C		W8D		W8E		W9A		W9B		W9C		W9D		W9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	Amphipoda																														
57	*Ampelisca* sp.																														
58	*Gammarus* sp.																														
59	Photidae																														
60	Pleustidae									1	0.01																				
	Decapoda																														
61	*Alpheus* sp.																			3	1.6										
62	*Callianassa* sp.																														
63	*Charybdis affinis*																			1	22										
64	Hippolytidae																														
65	*Macrophthalmus latreillei?*																														
66	Mantis shrimp																														
67	*Metapenaeus* sp.																														
68	*Neoxenophthalmus obscurus*	1	0.03																							1	0.1				
69	*Polyonyx* sp.																														
70	*Portunus* sp.																														
71	*Upogebia* sp.																														
72	*Typhlocarcinus nudus*					1	1.5							1	0.46					1	0.7			1	0.4	1	0.32				
73	*Philyra olivacea*																														
	PHORONIDA																														
74	*Phoronis australis*																														
	ECHINODERMATA																														
	Holothuroidea																														
75	*Acaudina molpadioides*					1	0.6																								
76	*Protankyra bidentata*																													1	0.59
	Ophiuroidea																														
77	Amphiuridae																														
	Vertebrata																														
	Osteichthyes																														

		W7A		W7B		W7C		W7D		W7E		W8A		W8B		W8C		W8D		W8E		W9A		W9B		W9C		W9D		W9E	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
78	*Odontamblyopus rubicundus*																	1	1.9												
79	Gobiidae fish	1	2.5																												
80	Osteichthian (Fish)																									1	0.01				
	Replicates	10	25.1	1	0.03	12	17.7	4	0.24	2	0.04	2	0.03	2	2.24	3	1.74	2	4.84	5	24.3	1	8	2	0.42	5	0.9	2	3.18	3	0.92
	Stations									29	43.1									14	33.1									13	13.4

Figure 1 Sampling locations at and near the HKBCF for the Marine Ecological Study

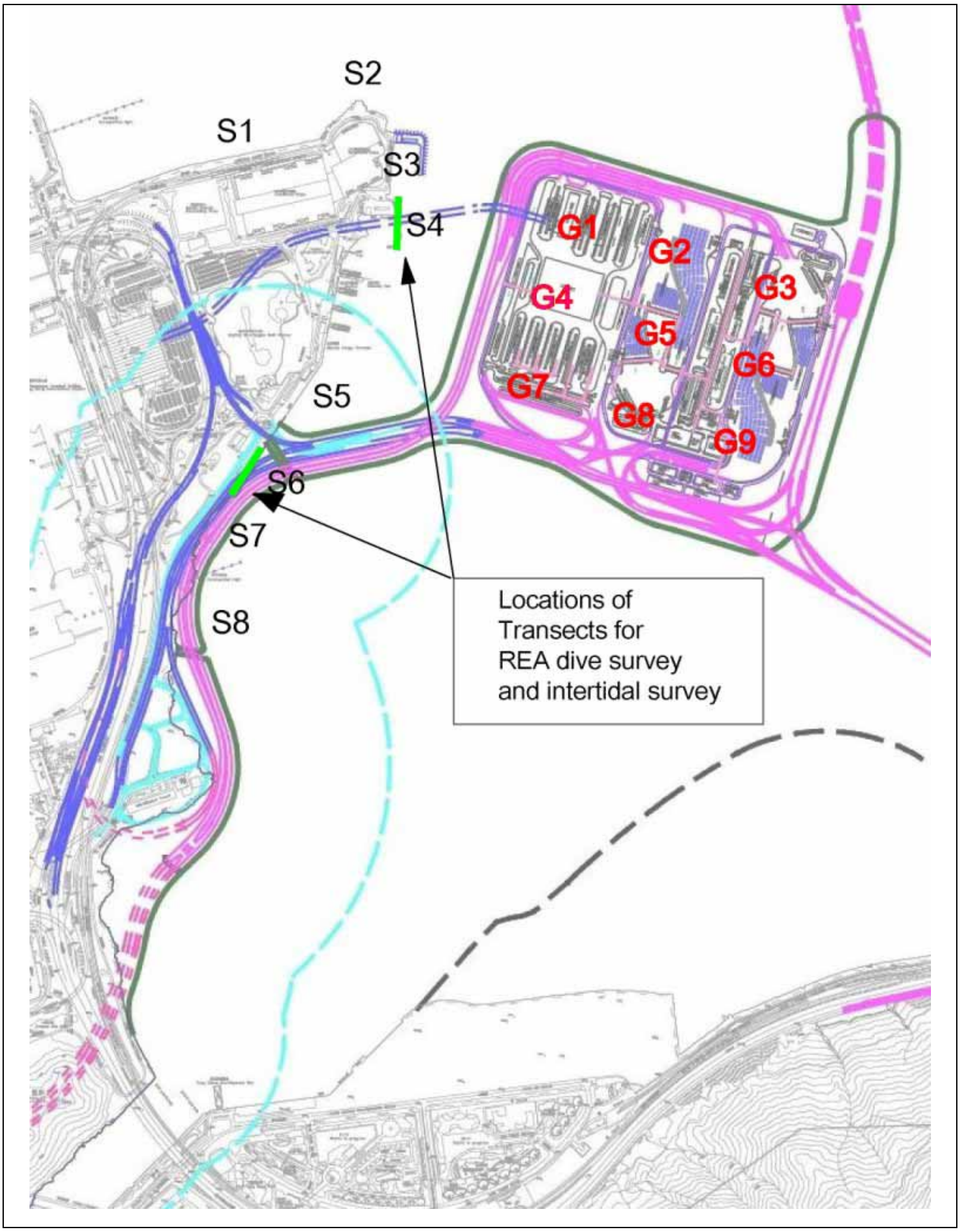


Figure 2 ABC plot for the wet season benthic survey in G1 to G9 stations

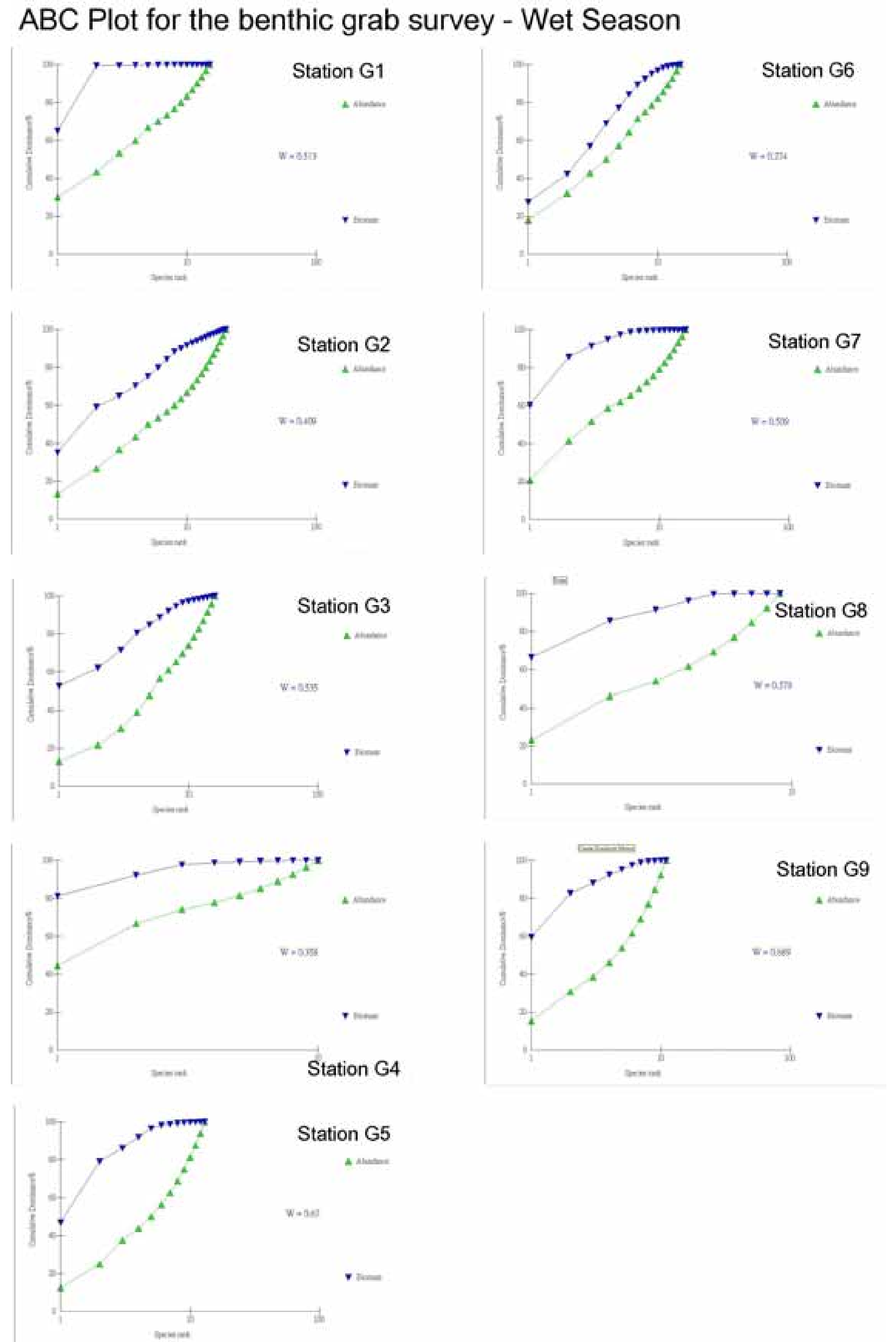


Figure 3 ABC plot for the dry season benthic survey in G1 to G9 stations

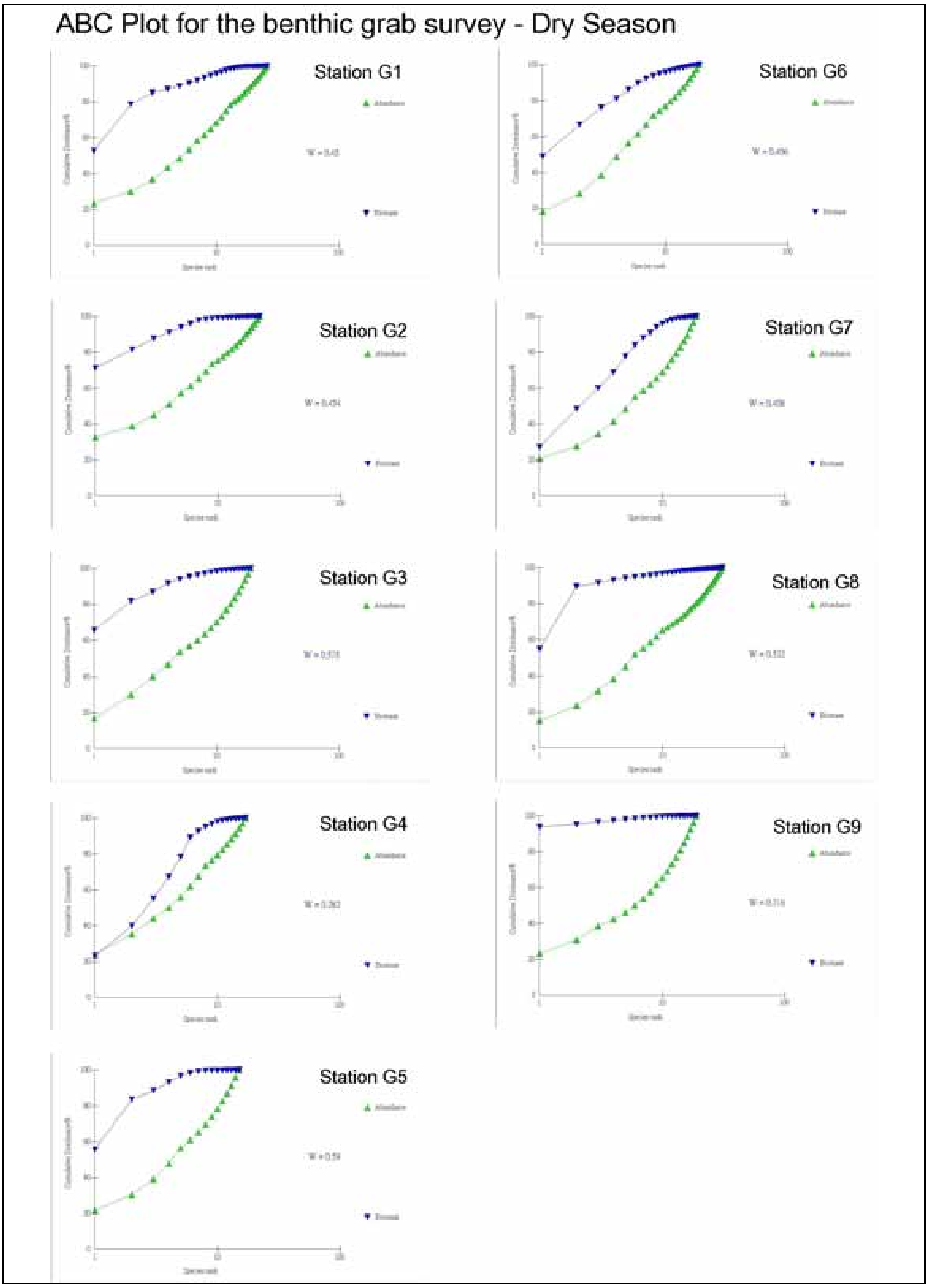
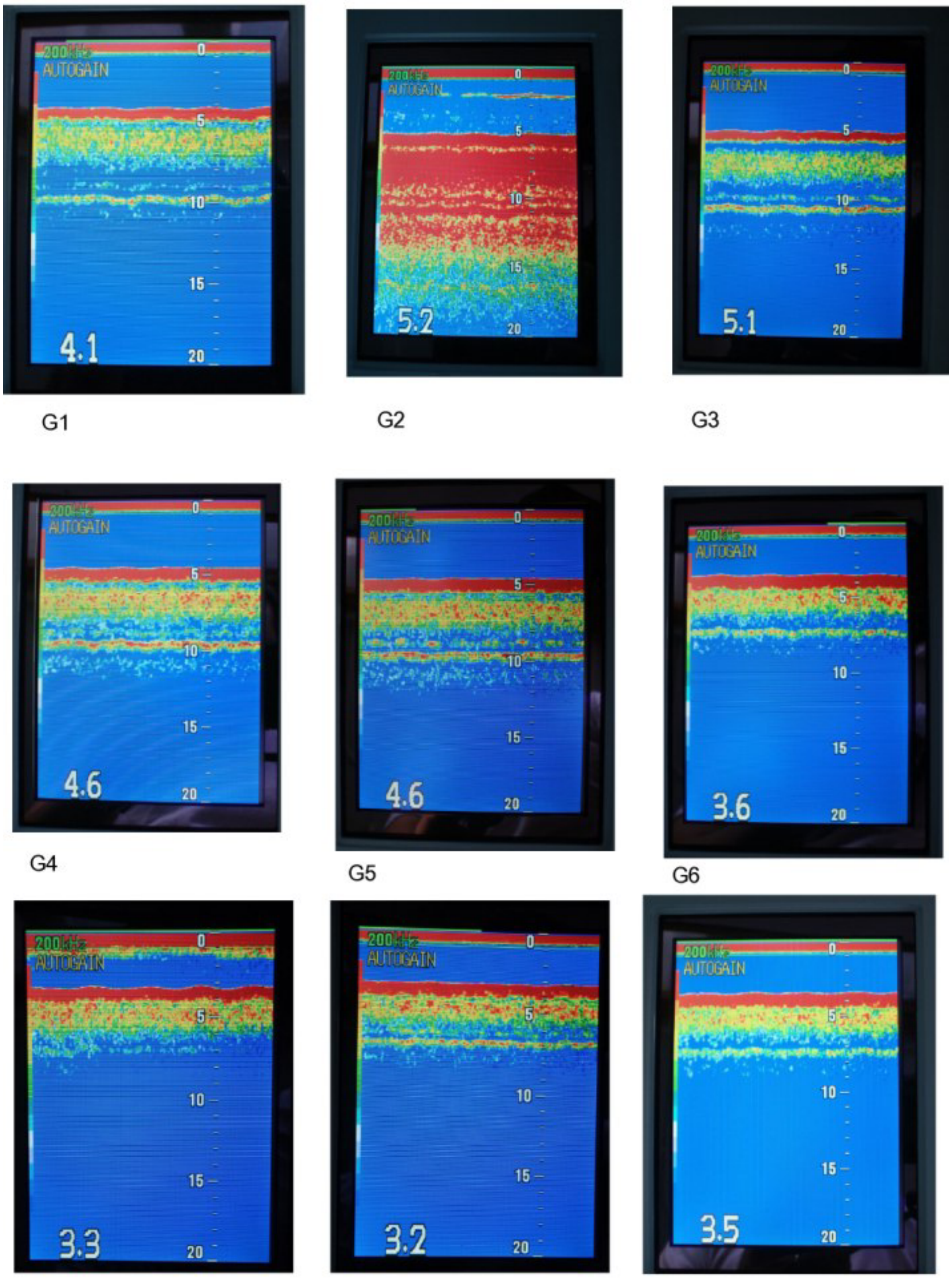


Figure 4 **Seabed profile in G1 to G9 stations as shown on sonic device**

Seabed conditions in grabsampling sites as shown in Echo Device



G1 G2 G3

G4 G5 G6

G7 G8 G9

Figure 5 Photos of dive survey

Photos of dive survey

Sloping seawall

Vertical seawall

Boulders on sloping seawall

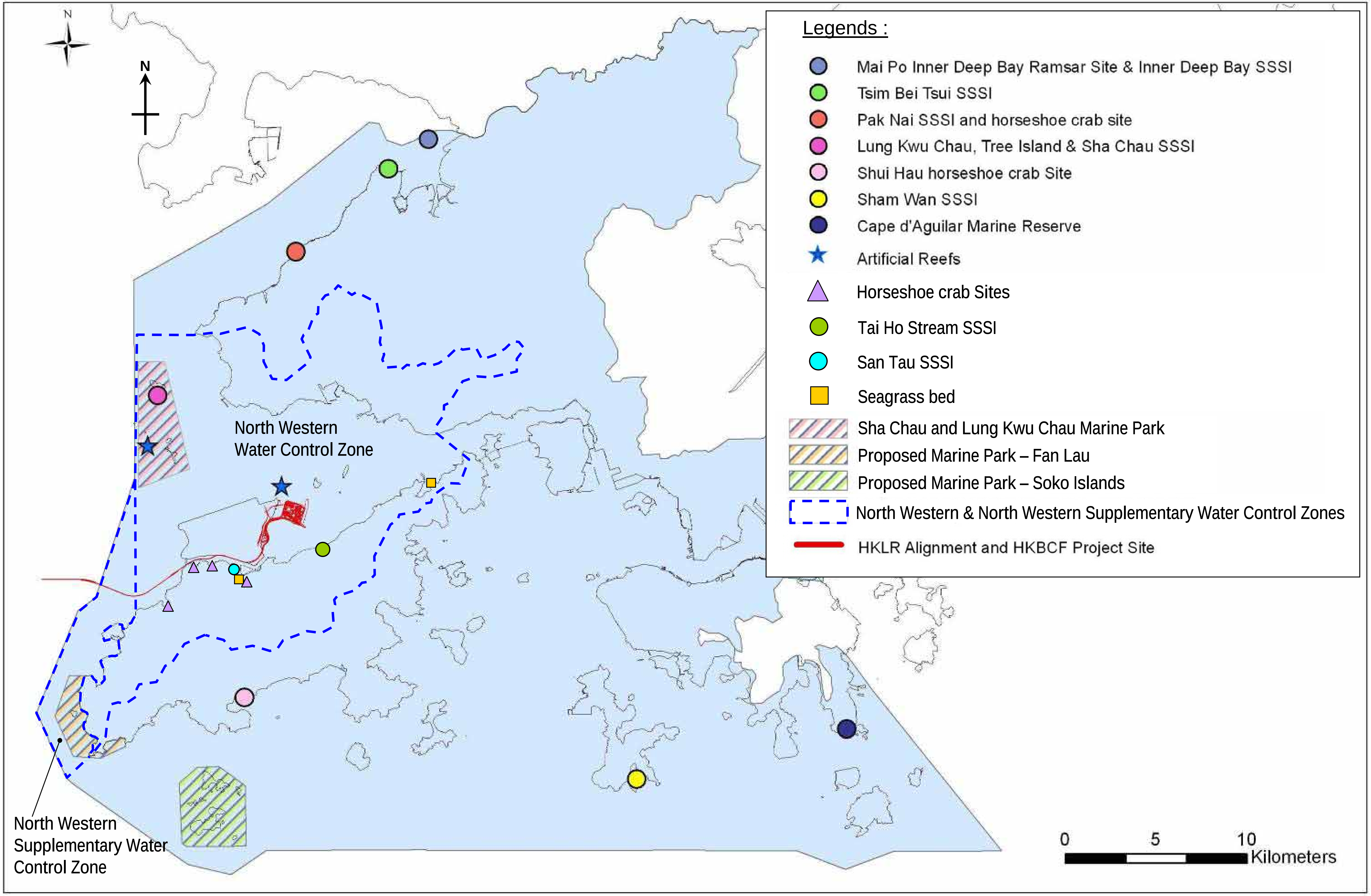
Runway signal light

Echinomuricea sp.

Perna viridis

Thais snail

Barnacle



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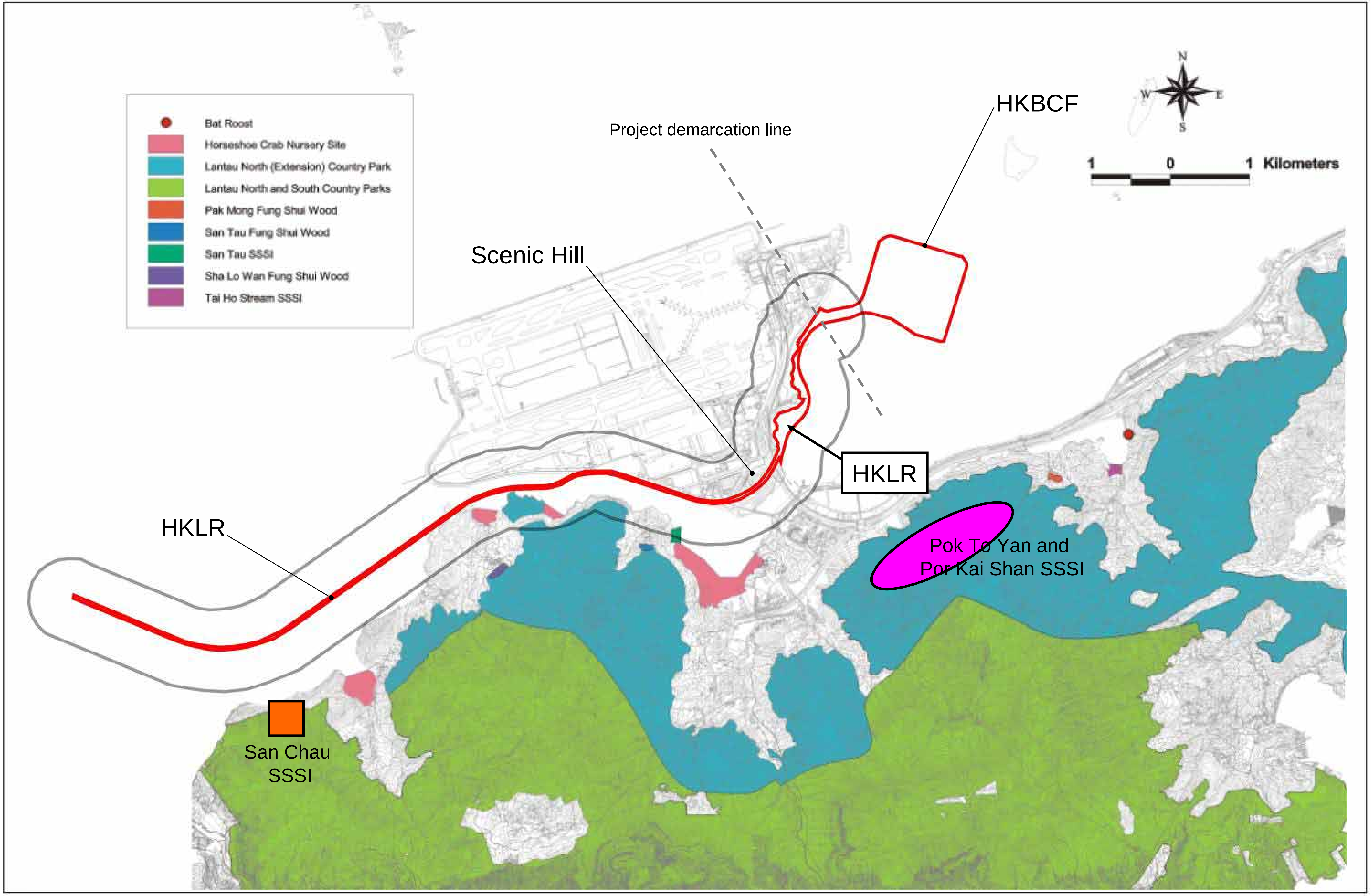
Drawing Title

Marine Ecological Assessment Area and Marine Ecological Sensitive Receivers

Drawing No.

Figure 10.1



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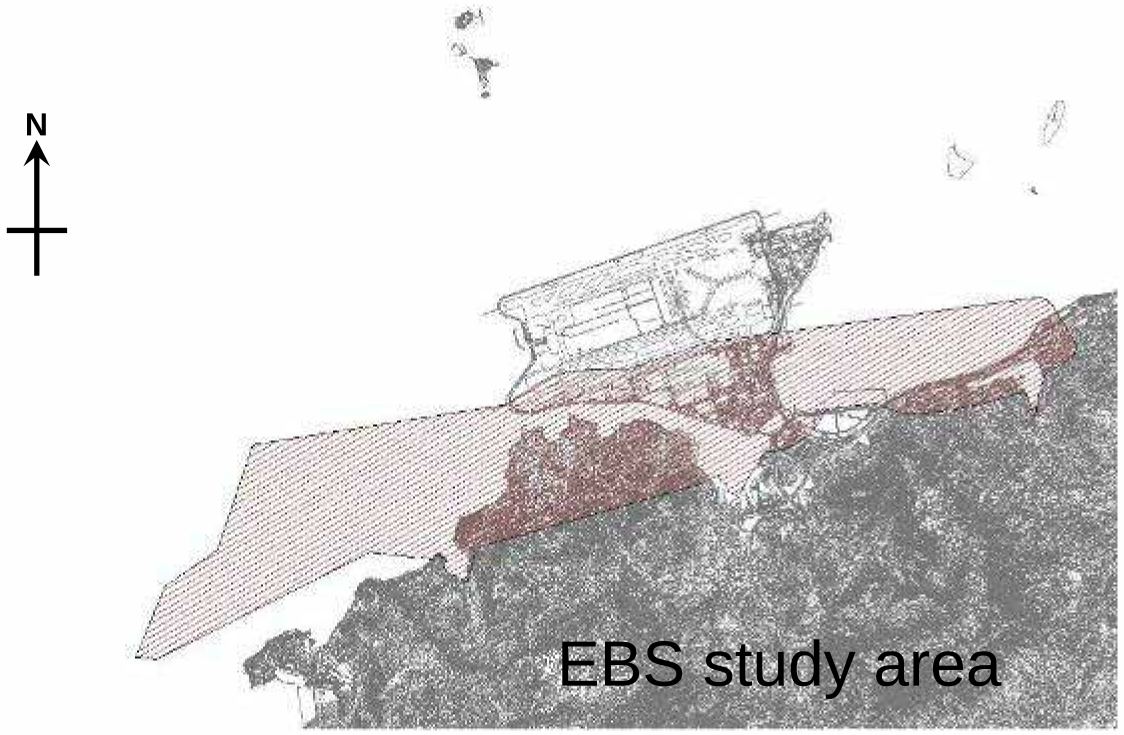
Drawing Title

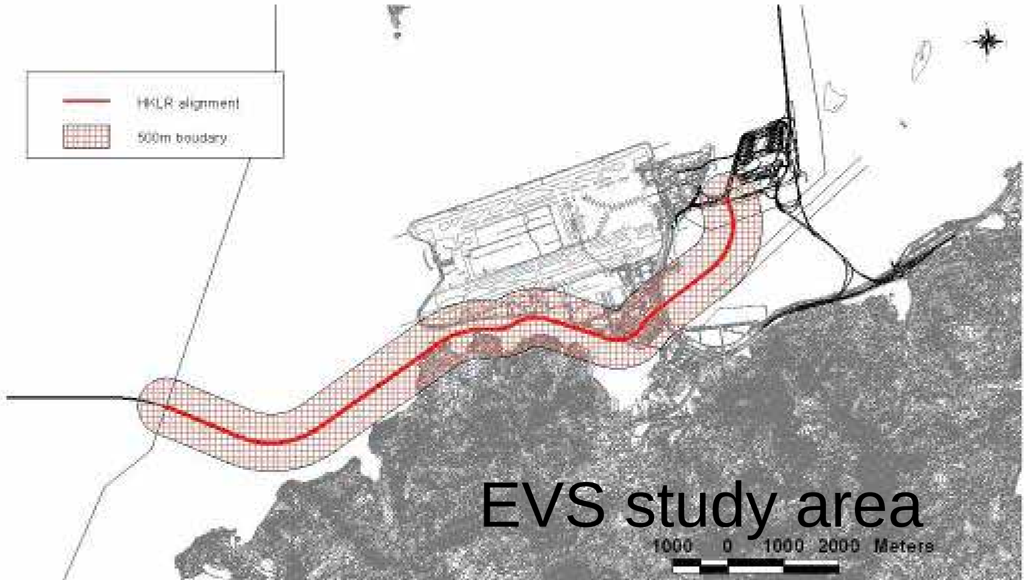
Terrestrial Ecological Assessment Area and Sites of Conservation Importance for Terrestrial and Intertidal Ecology

Drawing No.

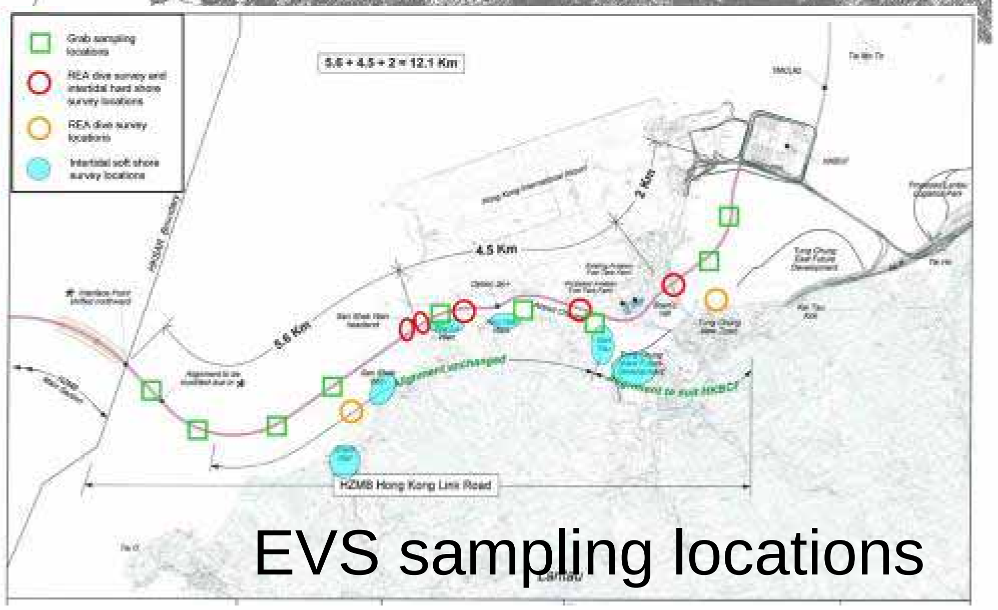
Figure 10.2



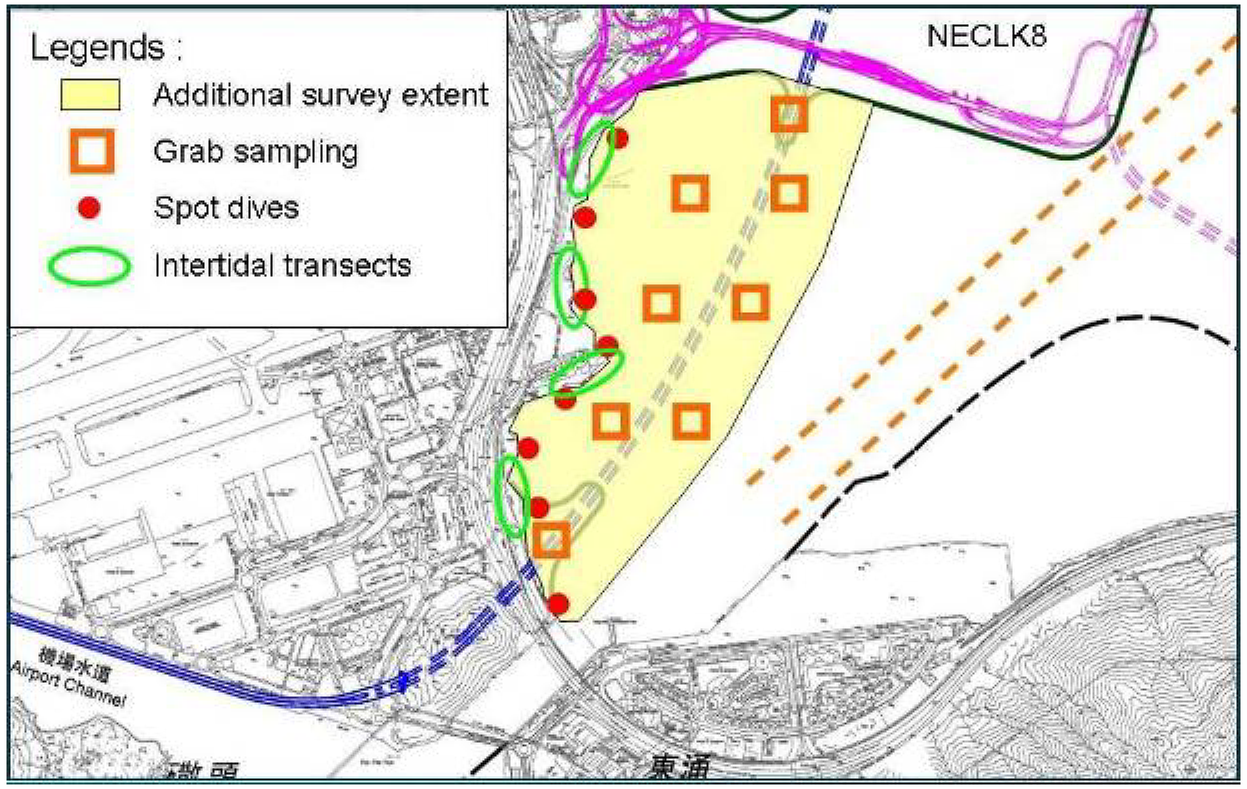
EBS study area



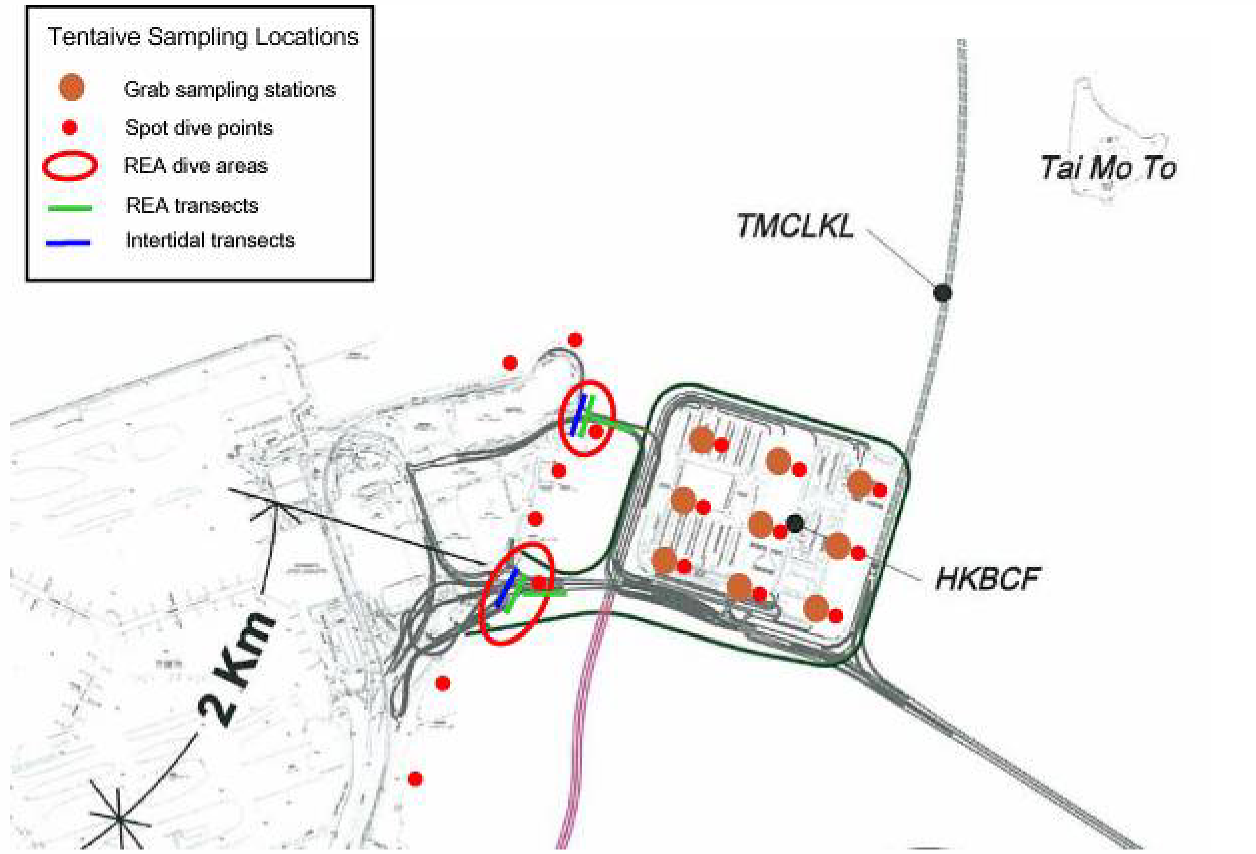
EVS study area



EVS sampling locations



MSS sampling locations



HKBCF sampling locations

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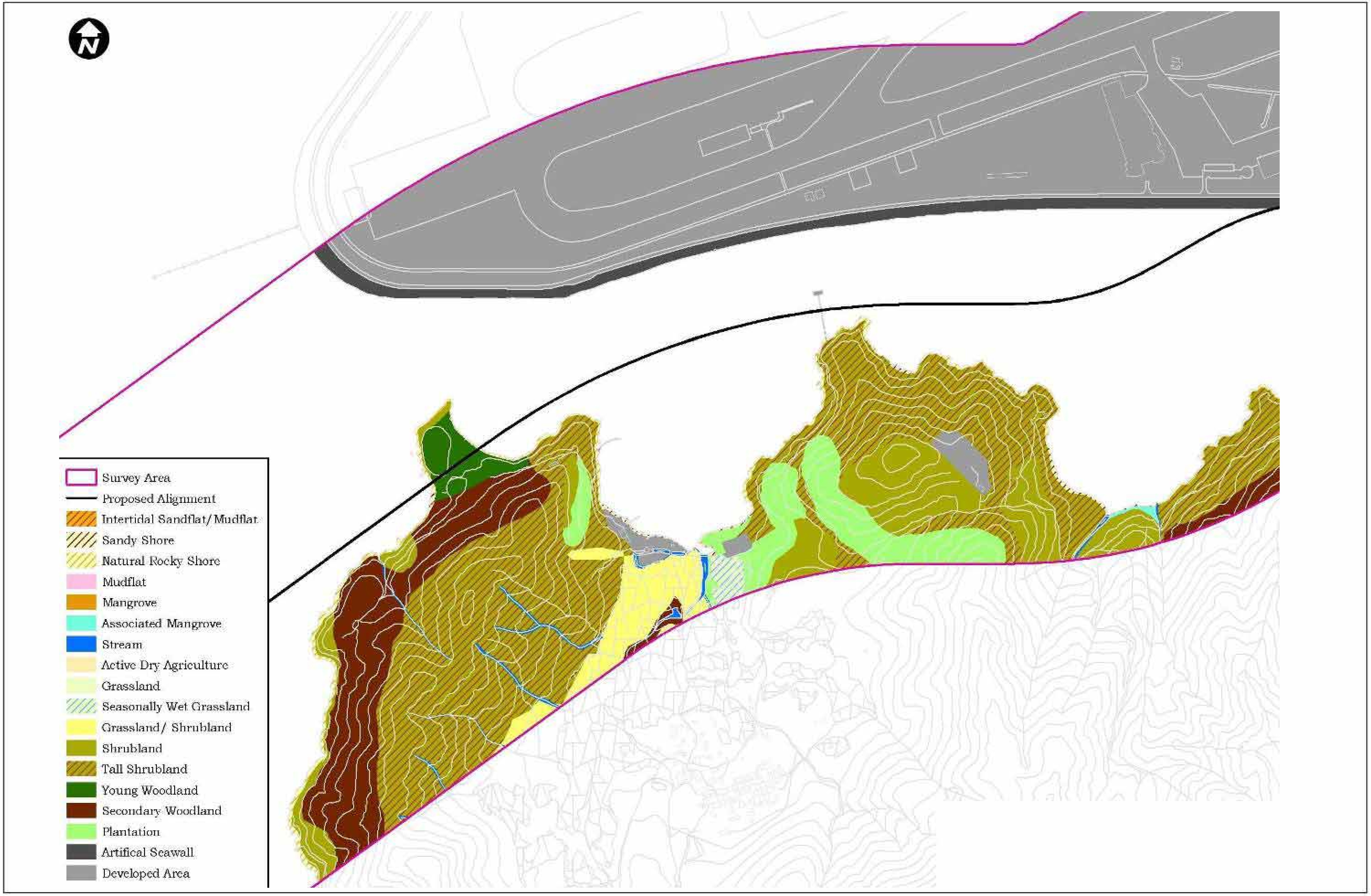
Drawing Title

Survey Coverage and Sampling Locations in the Various Survey Programmes under HKLR and HKBCF

Drawing No.

Figure 10.3



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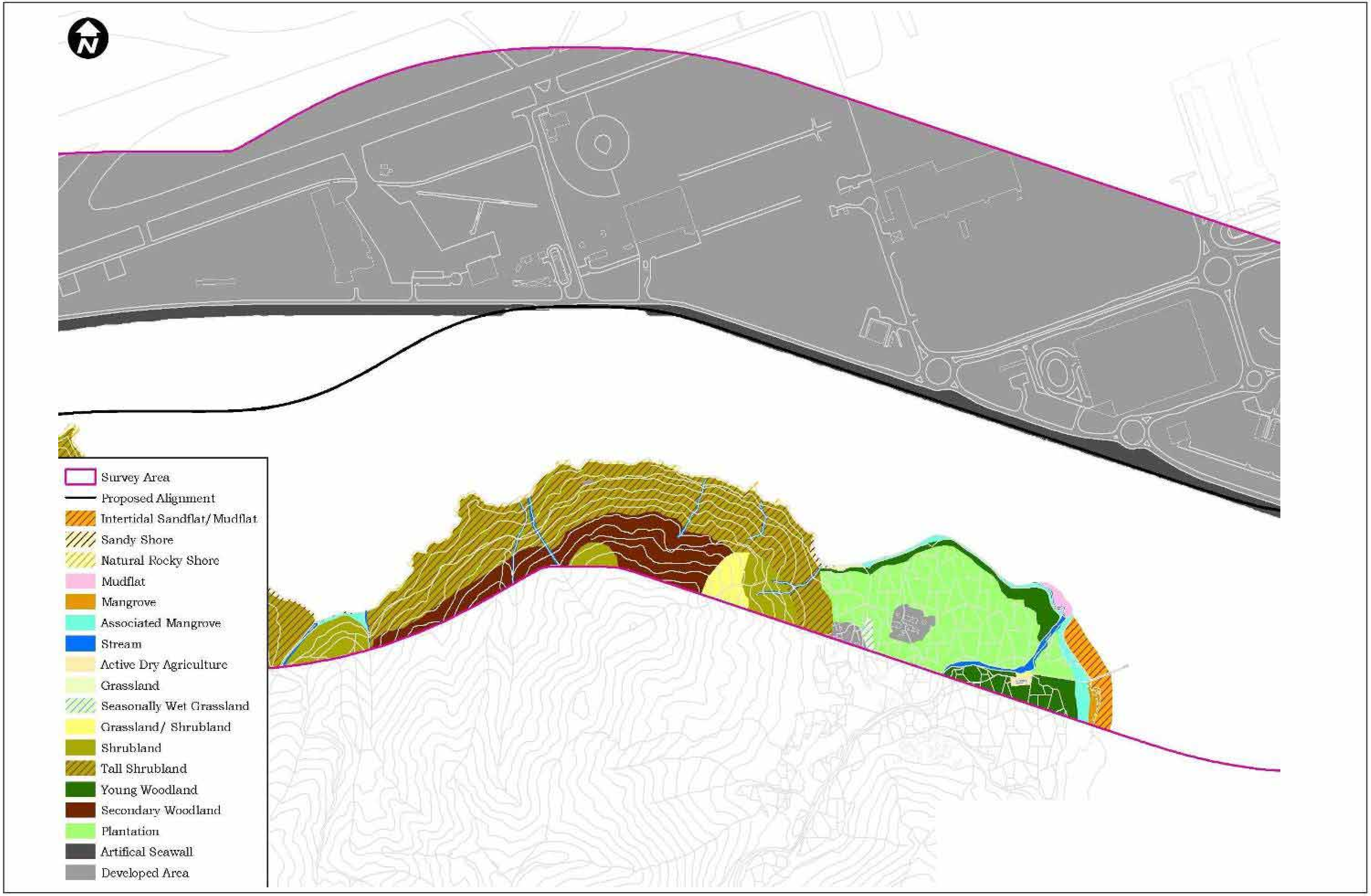
Drawing Title

Habitat Map for Terrestrial Ecological Assessment Area of HKLR (Airport Channel and North Lantau)

Drawing No.

Figure 10.4a



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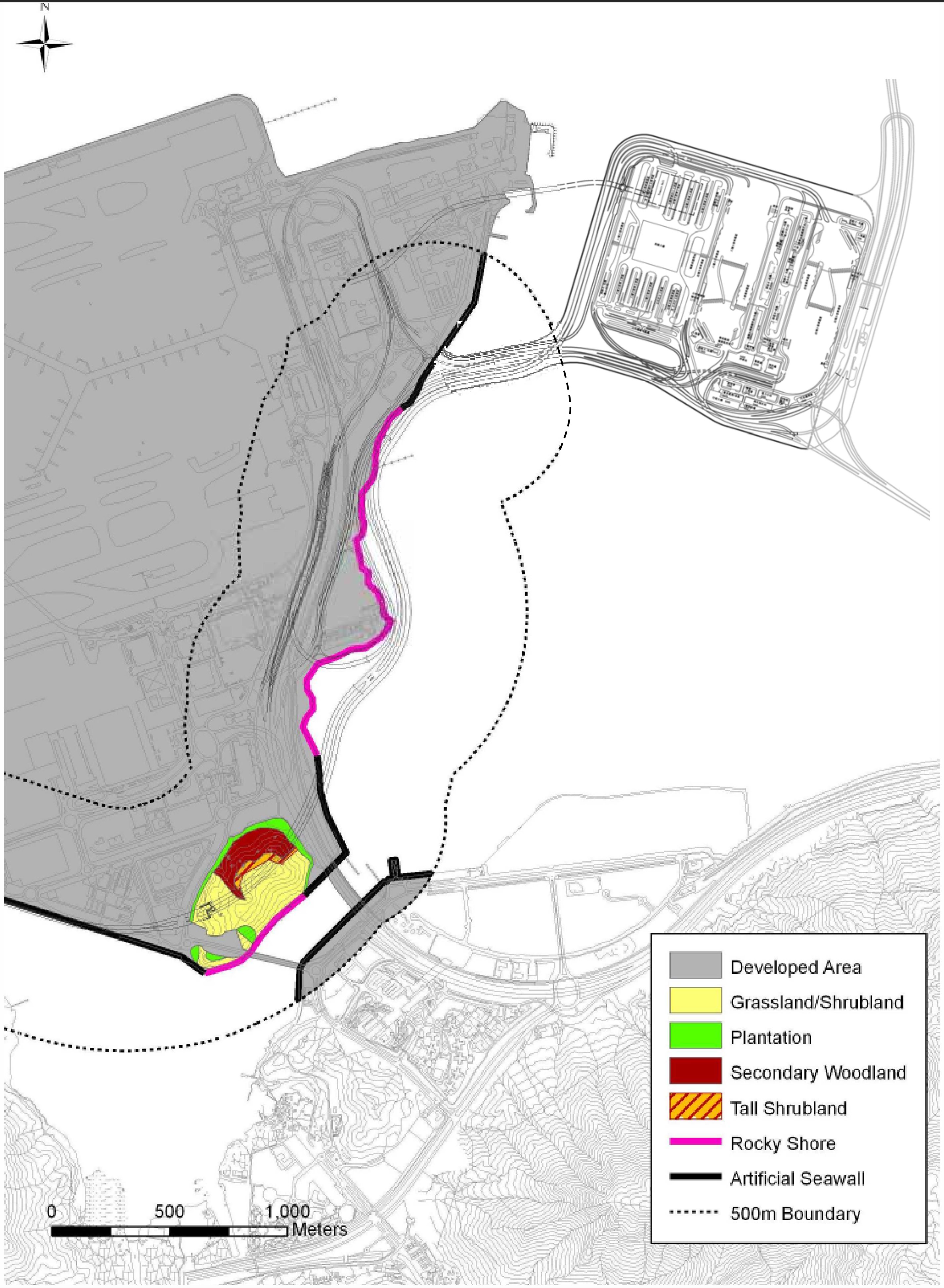
Drawing Title
Habitat Map for Terrestrial Ecological Assessment Area of HKLR (Airport Channel and North Lantau)

Drawing No.
Figure 10.4b



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Drawing Title

Habitat Map for Terrestrial Ecological Assessment Area of HKLR (Airport Island)

Drawing No.

Figure 10.4c


Grassland


Plantation


Stream


Rocky Shore at Sha Lo Wan


Tall Shrubland


Active Dry Agriculture


Sandy Shore


Rocky Shore on Airport Island


Young Woodland


Developed Area


Mudflat


Artificial Seawall on Airport Island


Secondary Woodland


Mangrove


Marine Waters

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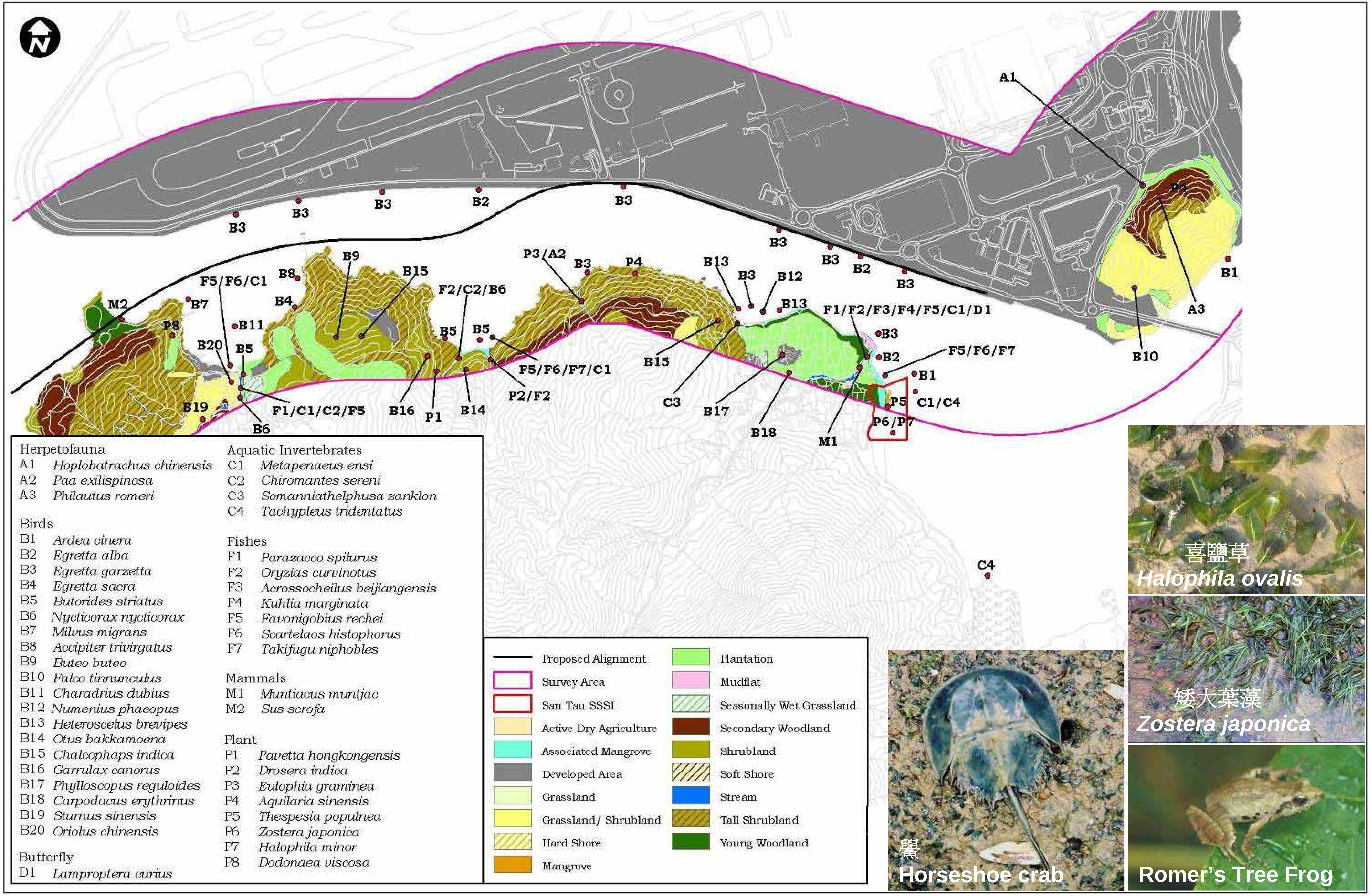

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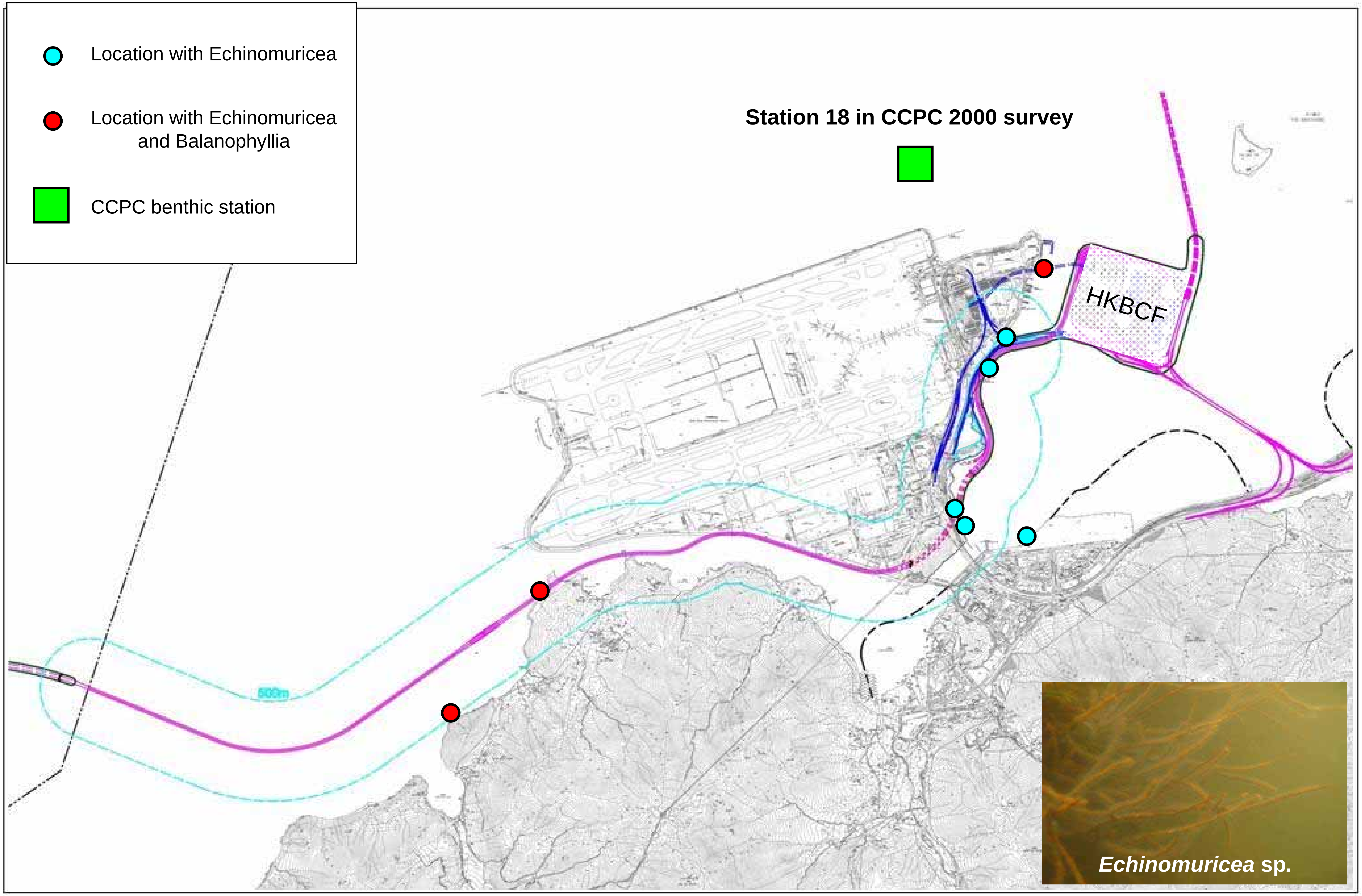
Drawing Title

Locations of Species of Conservation Importance within Terrestrial Ecological Assessment Area of HKLR (Airport Channel and North Lantau)

Drawing No.

Figure 10.6



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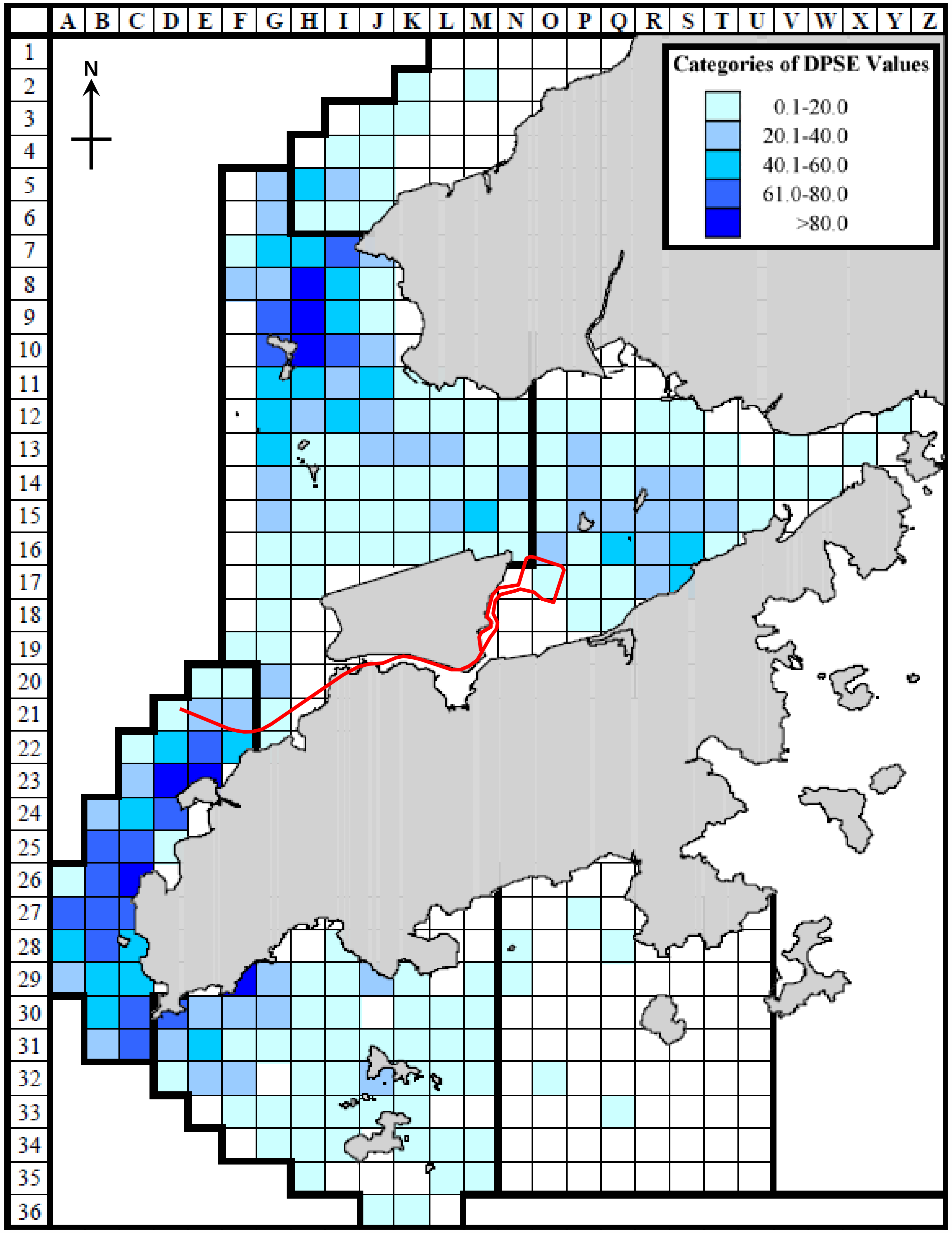
Drawing Title

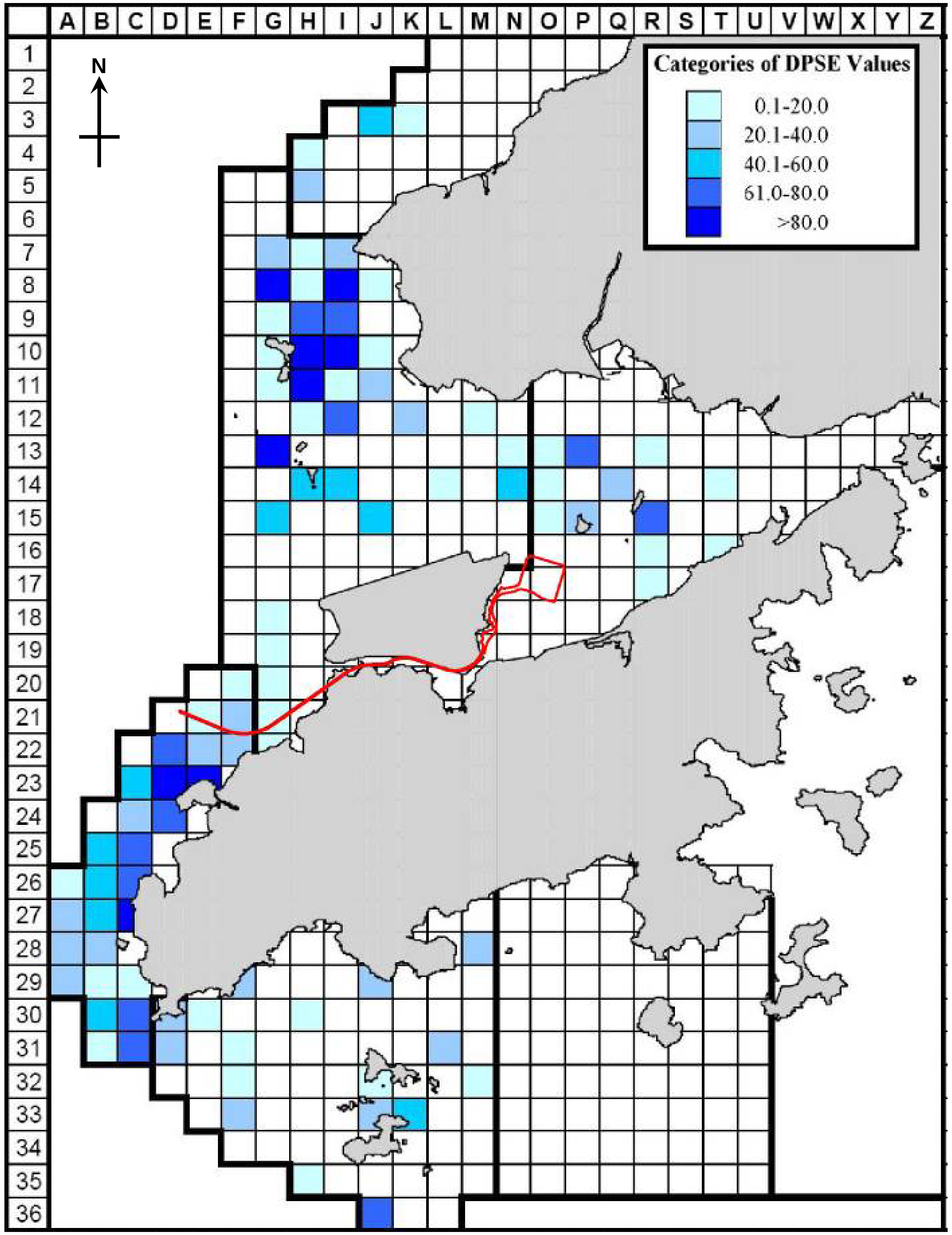
Locations with gorgonian Echinomuricea and ahermatypic coral Balanophyllia and the CCPC benthic sampling station 18

Drawing No.

Figure 10.7



Chinese White Dolphin DPSE 2002-2008



Chinese White Dolphin DPSE 2008-2009

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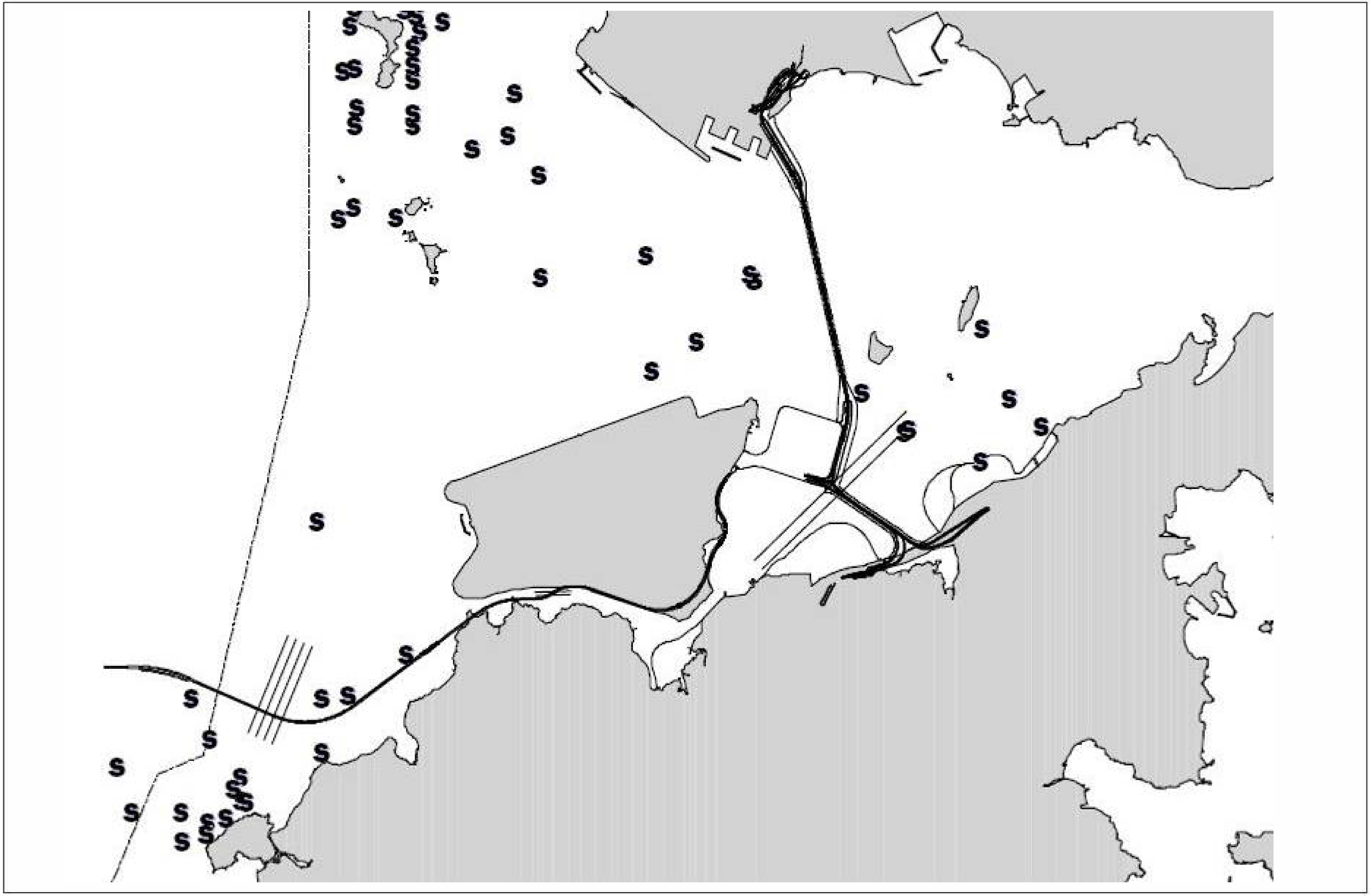
Drawing Title

Chinese White Dolphin DPSE 2002-2009 and the HKBCF & HKLR Project Sites

Drawing No.

Figure 10.8



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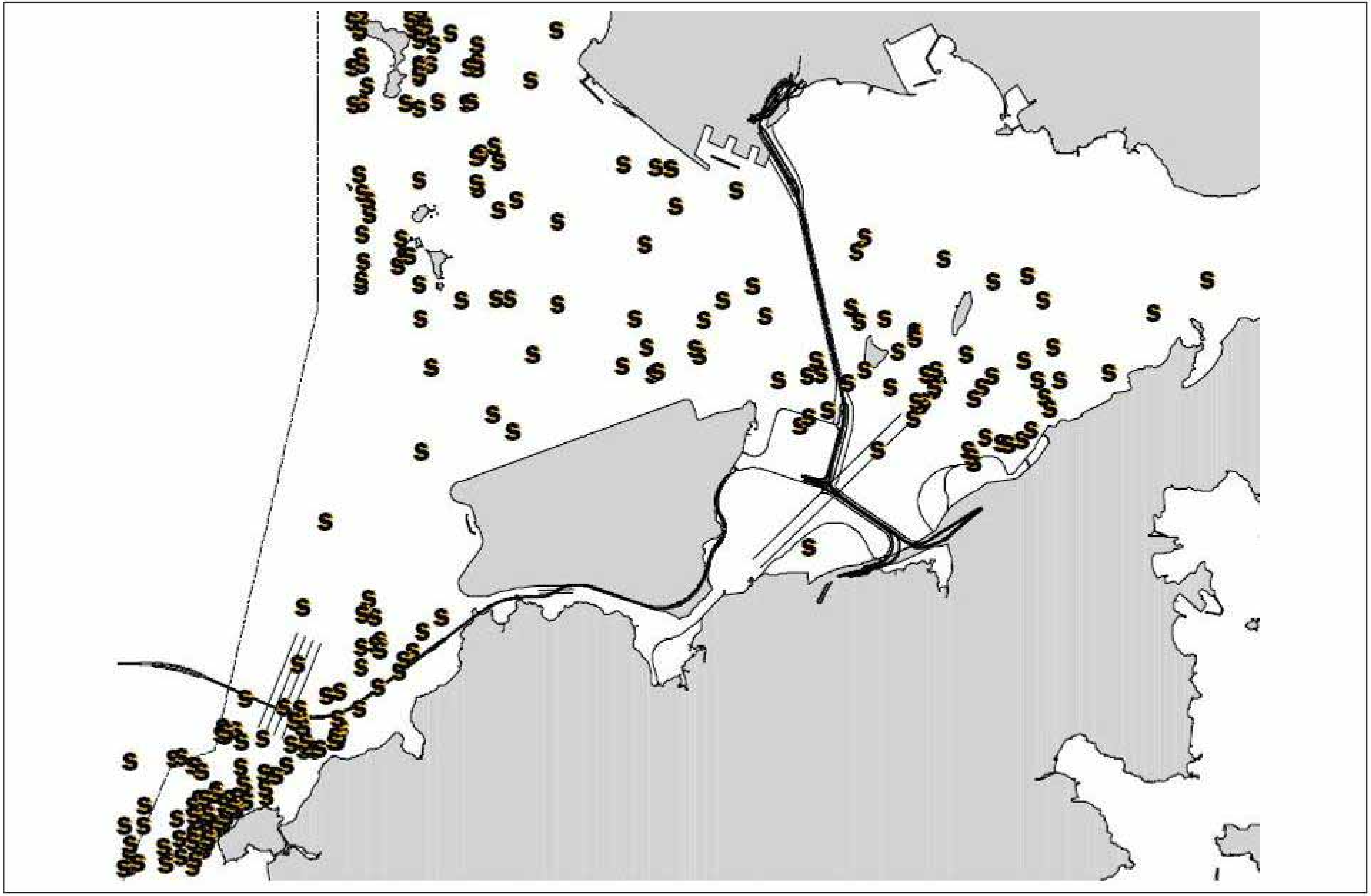

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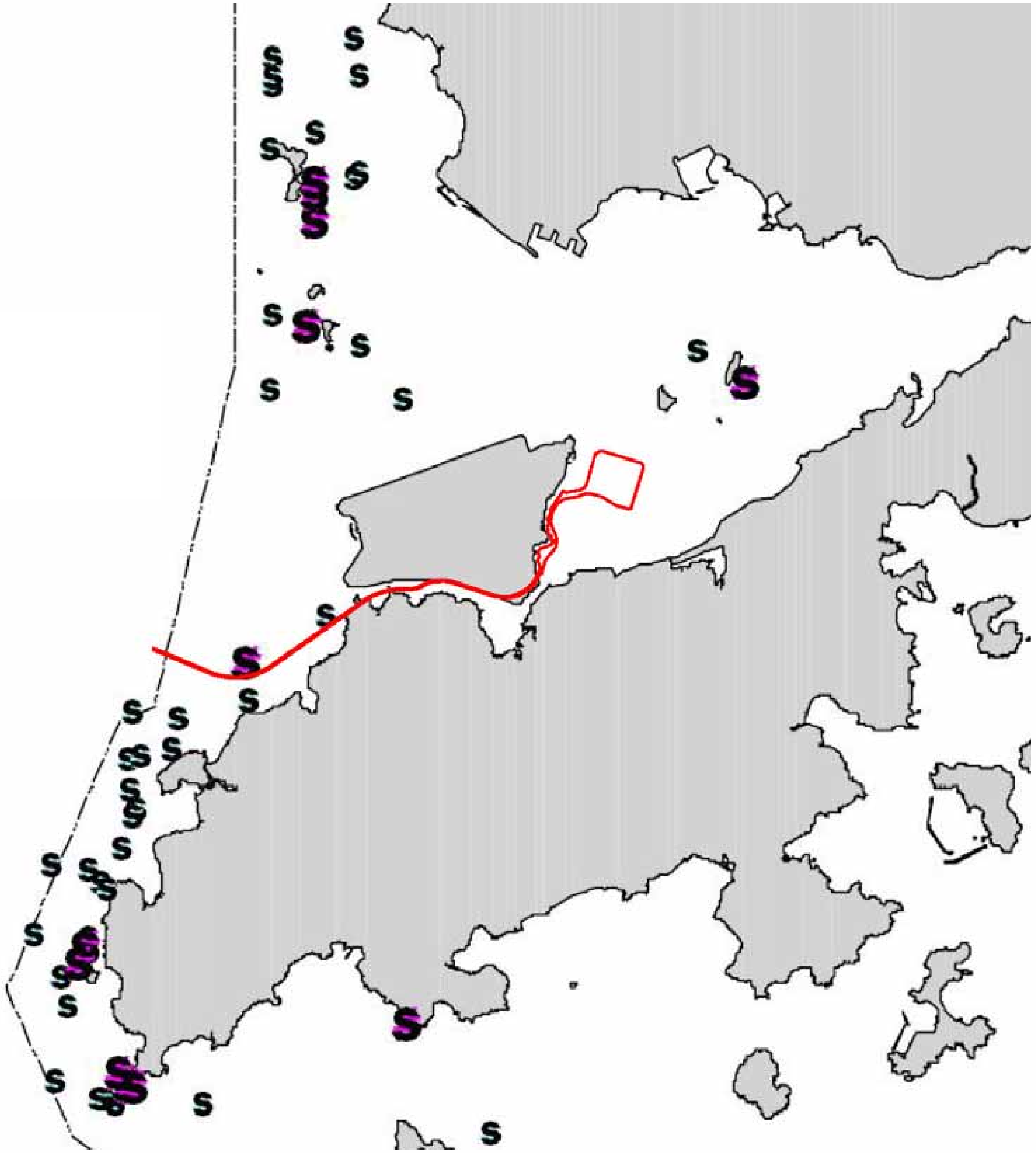
Drawing Title

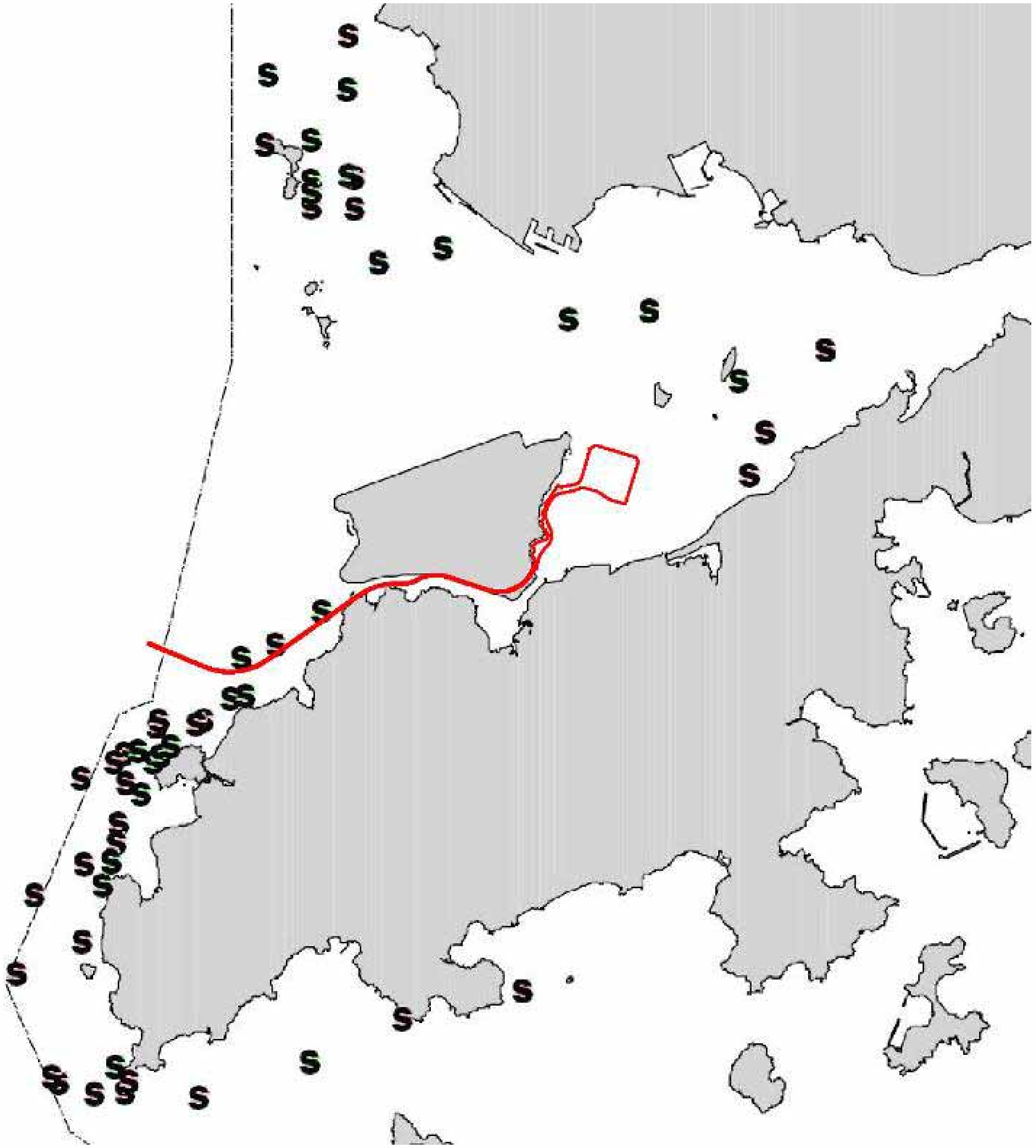
Chinese White Dolphin Unspotted Juvenile Sightings 2002-2008 and the HKBCF and HKLR Project Sites

Drawing No.

Figure 10.10



Chinese White Dolphin Juvenile and Calf Sightings 2008-2009



Chinese White Dolphin Feeding and Socializing Activities 2008-2009

s Sightings of UJ
s Sightings of UC

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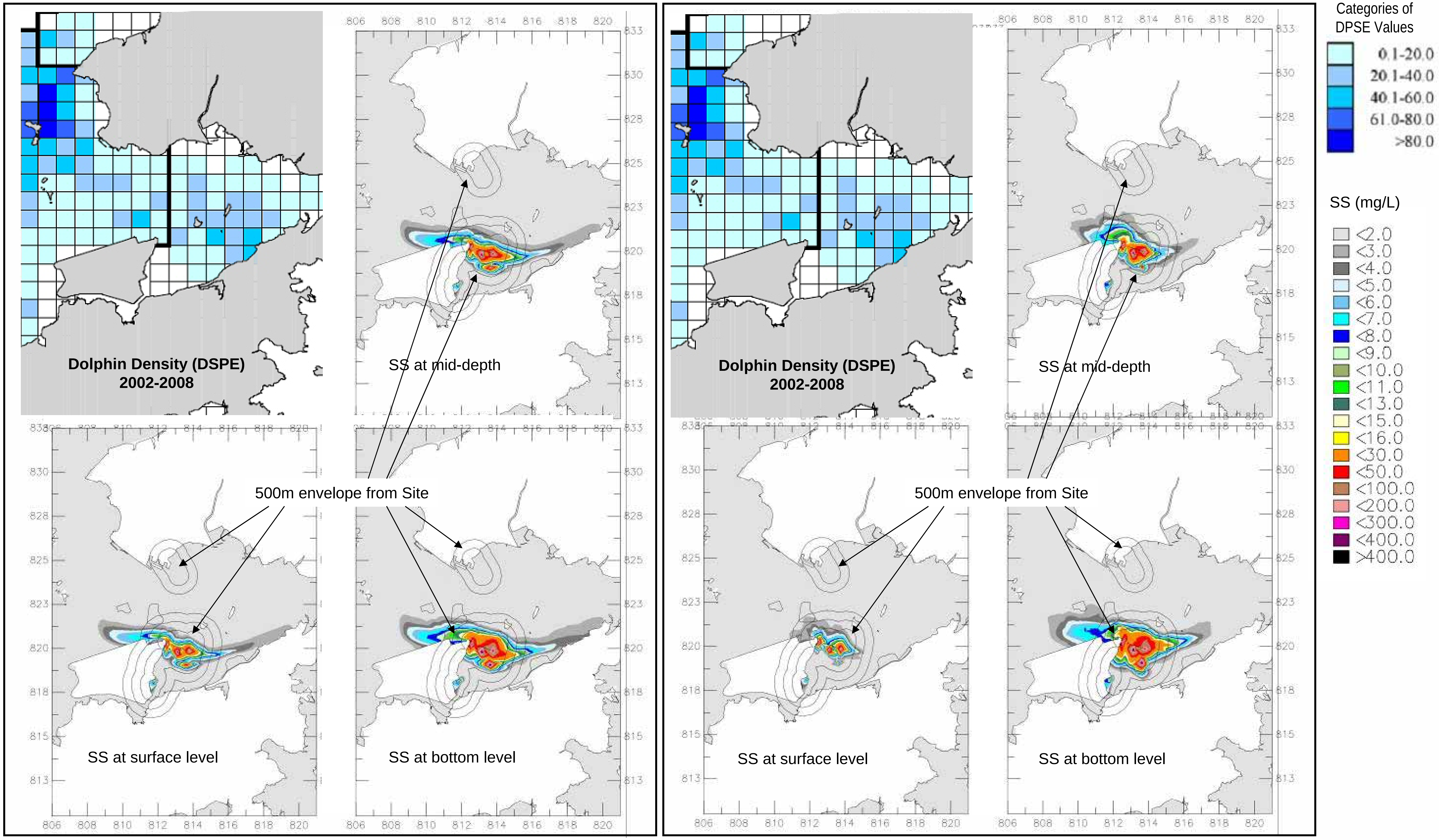
Drawing Title
Chinese White Dolphin Juvenile/Calf Sightings and Feeding/Socializing Activities 2008-2009 and the HKBCF & HKLR Project Sites

Drawing No.
Figure 10.11



A) Dry Season, After mitigation with (1+1) silt curtain system

B) Wet Season, After mitigation with (1+1) silt curtain system

Note: The contour shows the predicted highest SS concentration over the whole simulation period and such a level may only be predicted for a very short period of time.

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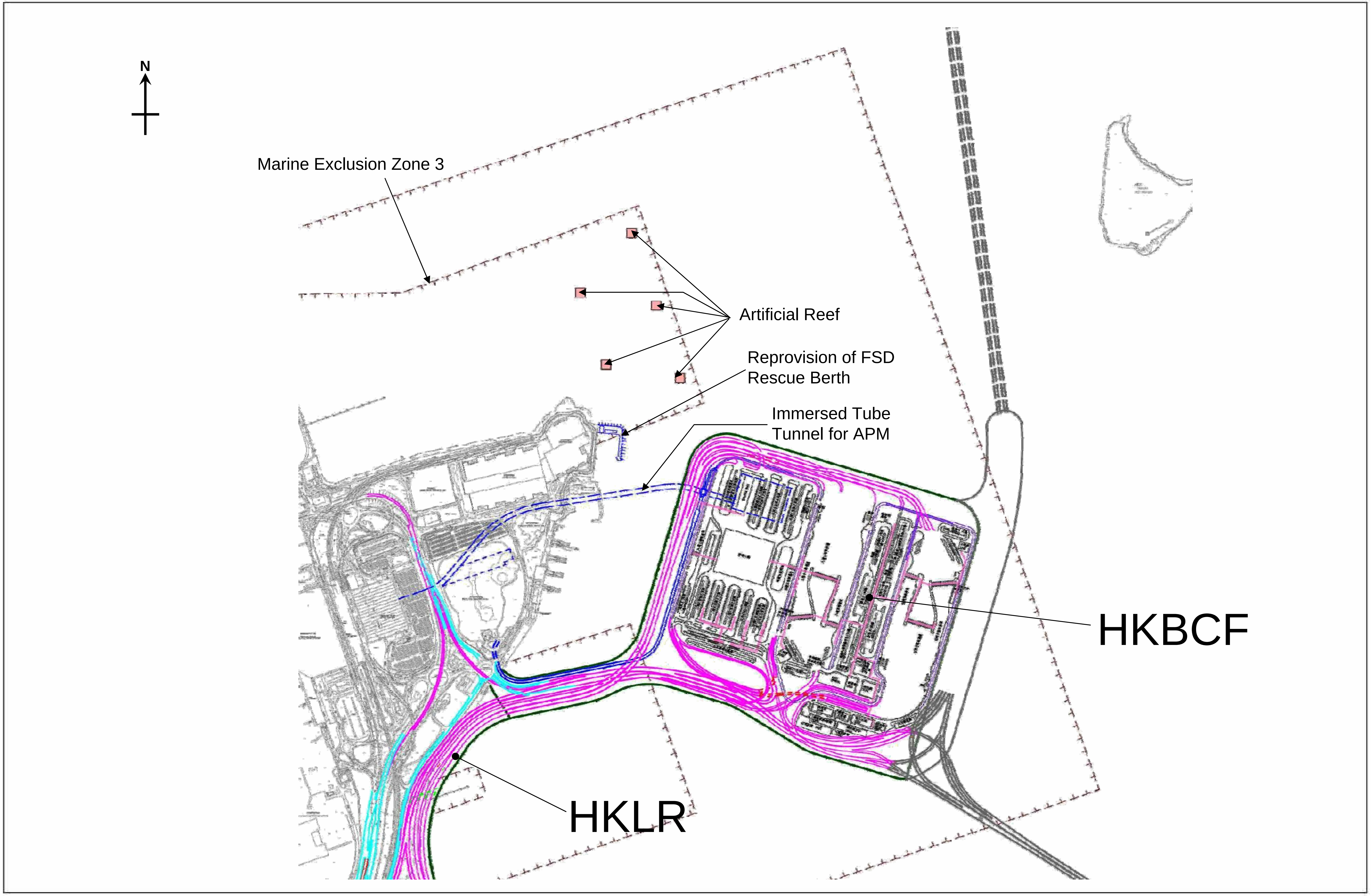
Drawing Title

2011 Dry & Wet Season Predicted Maximum Sediment Plumes and CWD density distribution in North Lantau Waters (Mitigated Scenario)

Drawing No.

Figure 10.12



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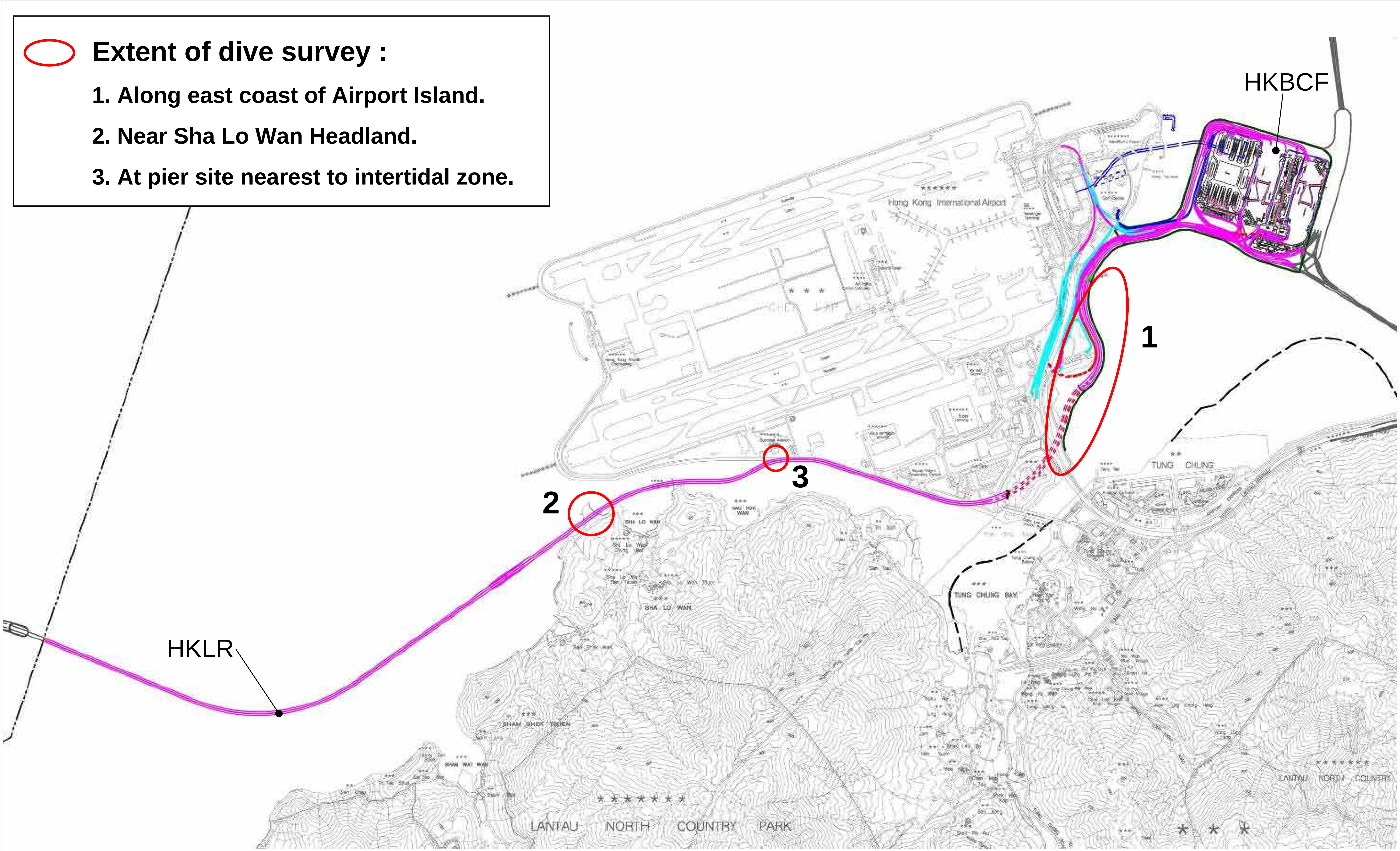
Drawing Title

Artificial Reefs in Airport Marine Exclusion Zone 3 and the HKBCF & HKLR Project Sites

Drawing No.

Figure 10.13



Note : Pre-construction dive survey for about 2-3 weeks will be conducted, prior to marine construction works in these three locations, to identify any coral colonies suitable for translocation, taking into account the conservation value, the health status and the translocation feasibility.

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