6 ECOLOGICAL IMPACT

6.1 Introduction

6.1.1 This chapter presents the ecological baseline resource within the assessment area, and the results of assessment of the potential ecological impacts resulting from the construction and operation of the TKO-LT Tunnel. Baseline conditions for ecological components of the terrestrial and marine environment were evaluated based on information from available literature and field surveys conducted for the purposes of this EIA. Measures required to mitigate any identified adverse impacts are recommended, where appropriate, and residual impacts assessed.

6.2 Environmental Legislation, Standards and Criteria

6.2.1 This assessment makes reference to the following HKSAR Government ordinances, regulations, standards, guidelines, and documents when identifying ecological importance of habitats and species, evaluating and assessing potential impacts of the Project on the ecological resources:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) – aims to avoid, minimize and control the adverse effects on the environment by designated projects through the application of the environmental impacts of assessment process and the environmental permit system.

- Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) Annex 8 – recommends the criteria that can be used for evaluating habitat and ecological impact.

- EIAO-TM Annex 16 – sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts.

- EIAO Guidance Note No. 3/2010 – provides guiding principles on the approach to assess the recommended environmental mitigation measures in EIA reports.

- EIAO Guidance Note No. 6/2010 – clarifies the requirement of ecological assessments under the EIAO.

- EIAO Guidance Note No. 7/2010 – provides general guidelines for conducting ecological baseline surveys in order to fulfill requirements stipulated in the EIAO-TM.

- EIAO Guidance Note No. 10/2010 – introduces some general methodologies for terrestrial and freshwater ecological baseline surveys.

- EIAO Guidance Note No. 11/2010 – introduces some general methodologies for marine ecological baseline surveys.

- Country Parks Ordinance (Cap. 208) – provides for the designation and management of

country parks and special areas. Country parks are designated for the purpose of nature conservation, countryside recreation and outdoor education. Special Areas are created mainly for the purpose of nature conservation.

- The Forests and Countryside Ordinance (Cap. 96) – prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. Related subsidiary Regulations prohibit the selling or possession of listed restricted and protected plant species. The list of protected species in Hong Kong that comes under the Forestry Regulations was last amended on 11 June 1993 under the Forestry (Amendment) Regulation 1993 made under Section 3 of the Forests and Countryside Ordinance.

- Wild Animals Protection Ordinance (Cap. 170) – designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury destruction and removal. All birds and most mammals, including marine cetaceans, are protected under this Ordinance. The Second Schedule of the Ordinance, which lists all the animals protected, was last revised in June 1997.

- Town Planning Ordinance (Cap. 131) – provides for the designation of Coastal Protection Areas, Sites of Special Scientific Interest (SSSIs), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment.

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

- The Marine Parks Ordinance (Cap. 476) and Subsidiary Legislation – allows for designation, control and management of marine parks and marine reserves through regulation of activities therein to protect, conserve and enhance the marine environment for the purposes of nature conservation, education, scientific research and recreation. The Ordinance came into effect on 1 June 1995.

- The Protection of the Harbour Ordinance (Cap. 531) – based on a presumption against reclamation, the harbour is to be protected and preserved as a special public asset and a natural heritage of Hong Kong people.

- The Water Pollution Control Ordinance (Cap. 358) – aims to control water pollution in waters of Hong Kong. Water control zones are designated with individual water quality objective to promote the conservation and best use of those waters in the public interest. The most updated water quality objectives for the Victoria Harbour Water Control Zone were revised in June 1997.

6.2.2 This section also makes reference to the following international conventions and nearby national regulations:

- The IUCN Red List of Threatened Species provides taxonomic, conservation status and

distribution information on taxa that have been evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction. The IUCN Red List also includes information on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme.

- The PRC National Protection Lists of Important Wild Animals and Plants – lists detailed Category I and Category II key protected animals and plant species under Mainland Chinese Legislation. The list was last updated in November 2002.

6.3 Assessment Methodology

Assessment Area

6.3.1 In accordance with Clause 3.4.5.2 of the EIA Study Brief, the assessment area for the purpose of terrestrial ecological assessment included areas within 500 m from the site boundary of the land based works areas and other areas likely to be impacted by the Project (**Figure 6.1** refers).

6.3.2 The marine ecology assessment area covered the Junk Bay Water Control Zone (WCZ), the Eastern Buffer WCZ and Victoria Harbour WCZ, as designated under the Water Pollution Control Ordinance and other areas likely to be impacted by the Project (**Figure 6.2** refers). After referring to the Water Quality Impact Assessment, potential adverse impact on marine water quality is predicted to be localized within the works area. Therefore, impact assessment for marine ecology in WCZs outside of the impacted area would be based mostly on desktop literature review while marine ecological surveys were confined to be within and adjacent to Junk Bay.

Literature Review

6.3.3 The ecological characteristics of the assessment area were identified through a comprehensive review of the relevant literature. This review collated ecological information from various reports and publications that included:

- Agriculture, Fisheries and Conservation Department, 2002. *Consultancy Study on Marine Benthic Communities in Hong Kong*. Prepared by Centre for Coastal Pollution and Conservation, City U Professional Services Limited for Agriculture, Fisheries and Conservation Department, HK SAR Government. (*Consultancy Study on Marine Benthic Communities in Hong Kong*)
- Agriculture, Fisheries and Conservation Department, 2004. *Ecological Status and Revised Species Records of Hong Kong's Scleractinian Corals.* Prepared by Oceanway Corporation Ltd. for Agriculture, Fisheries and Conservation Department, HK SAR Government. (*AFCD Hard Coral Survey Report*)
- ASB Biodiesel HK Ltd., 2008. *Approved EIA Report. Development of a Biodiesel Plant at Tseung Kwan O Industrial Estate*. Prepared by ERM for ASB Biodiesel HK Ltd.
- Civil Engineering Department, 2001. *Final EIA Report. Tseung Kwan O Development Phase III Road P2 connecting Town Centre and Western Coast Road*. Prepared by Scott Wilson for Civil Engineering Department, HK SAR Government. (*Road P2 Road EIA Report*)
- Civil Engineering and Development Department, 2005. *Approved EIA Report. Further*

Development of Tseung Kwan O, Feasibility Study. Prepared by Maunsell Consultants Asia Ltd. for Civil Engineering and Development Department, HK SAR Government. (*Further Development of TKO EIA Report*)

- Civil Engineering and Development Department, 2007a. *Approved EIA Report. Wan Chai Development Phase II and Central-Wan Chai Bypass*. Prepared by Maunsell Consultants Asia Ltd. for Civil Engineering and Development Department, HK SAR Government. (*WDII & CWB EIA Report*)
- Civil Engineering and Development Department, 2007b. *EM&A Manual. Wan Chai Development Phase II and Central-Wan Chai Bypass.* Prepared by Maunsell Consultants Asia Ltd. for Civil Engineering and Development Department, HK SAR Government. (*WDII & CWB EM&A Manual*)
- Civil Engineering and Development Department, 2007c. *Approved EIA Report. Dredging Works for Proposed Cruise Terminal at Kai Tak.* Prepared by Maunsell Asia Consultants for Civil Engineering and Development Department, HK SAR Government. (*Kai Tak Development EIA Report*)
- Civil Engineering and Development Department, 2009a. *Site Formation for Kai Tak Cruise Terminal Development – Design and Construction: Final Detailed Coral Translocation Plan.* Prepared by Scott Wilson for Civil Engineering and Development Department, HK SAR Government. (*Kai Tak Coral Translocation Plan*)
- Civil Engineering and Development Department, 2009b. *Site Formation for Kai Tak Cruise Terminal Development – Baseline Post-translocation Coral Monitoring Report.* Prepared by Scott Wilson for Civil Engineering and Development Department, HK SAR Government. (*Kai Tak Baseline Post-translocation Coral Monitoring Report*)
- Civil Engineering and Development Department, 2009c. *Wan Chai Development Phase II and Central – Wan Chai Bypass – Baseline Sampling, Field Measurement and Testing Works: Baseline Coral Survey Report.* Prepared by Chung Shun Boring Eng. Co., Ltd. For Civil Engineering and Development Department, HK SAR Government. (*WDII & CWB Baseline Pre-translocation Coral Survey Report*).
- Civil Engineering and Development Department, 2010. *Cross Bay Link, Tseung Kwan O – Investigation – Working Paper on Marine Ecological Impact Assessment.* Prepared by Ove Arup & Partners HK Ltd. for Civil Engineering and Development Department, HK SAR Government. (*Cross Bay Link Marine Ecological Impact Assessment Working Paper*)
- Environmental Protection Department, 2004. *Environmental and Engineering Feasibility Assessment Studies in Relation to the Way Forward of the Harbour Area Treatment Scheme, Working Paper No.3 & 9*. Prepared by CDM for Environmental Protection Department, HK SAR Government. (*HATS EEF Survey Report*)
- Environmental Protection Department, 2007. *Approved EIA Report. South East New Territories (SENT) Landfill Extension*. Prepared by ERM for Environmental Protection Department, HK SAR Government. (*SENT Landfill Extension EIA Report*)
- HK Offshore Wind Ltd., 2009. *Approved EIA Report. Hong Kong Offshore Wind Farm in Southeastern Waters.* Prepared by BMT Asia Pacific Ltd. for HK Offshore Wind Ltd. (*SE Offshore Wind Farm EIA Report*)
- MTR Corporation Ltd., 2009. *Approved EIA Report. Hong Kong Section of Guangzhou - Shenzhen - Hong Kong Express Rail Link*. Prepared by AECOM Asia Co. Ltd. for MTR Corporation Ltd. (*XRL EIA Study*)
- Territory Development Department, 1999a. *Approved EIA Report. Feasibility Study on the Alternative Alignment for the Western Coast Road, Tseung Kwan O*. Prepared by ERM for Territory Development Department, HKSAR Government. (*Western Coast*

Road EIA Report)

- Territory Development Department, 1999b. *Final EIA Report. Feasibility Study for Development at Cha Kwo Ling Kaolin Mine Site.* Prepared by Furgo(HK) Ltd. for Territory Development Department, HKSAR Government. (*Cha Kwo Ling EIA Report*)
- Territory Development Department, 2001a. *Area 131 Further Ecological Study*. Prepared by M2 Environmental Ltd. for Territory Development Department, HKSAR Government. (*Area 131 Further Ecological Study*)
- Territory Development Department, 2001b. *Approved EIA Report. Wanchai Development Phase II Comprehensive Feasibility Study.* Prepared by Maunsell for Territory Development Department, HK SAR Government. (*WDII EIA Study*)
- Territory Development Department, 2001c. *Approved EIA Report. Comprehensive Feasibility Study for the Revised Scheme of South East Kowloon Development EIA Report.* Prepared by Ove Arup and Partners HK Ltd. for Territory Development Department, HK SAR Government. (*SE Kowloon Development EIA Study*)

http://www.epd.gov.hk/eia/notice/report/latest/adv-71-58.htm

Ecological Field Surveys

6.3.4 Based on review of the findings of relevant studies and available information, ecological field surveys were carried out to fill the information gaps identified and verify the information collected, and to fulfill the objectives of the EIA Study according to Clause 3.4.5.4(iii) of the EIA Study Brief (ESB-195/2008).

6.3.5 The ecological surveys were conducted from June to December 2009 covering both wet and dry seasons.

6.3.6 **Table 6.1** summarizes the survey programme. The methodologies adopted for the ecological surveys are described below.

Table 6.1 Ecological Survey Programme

Survey Type	Wet Season					Dry Season		
	Jun 2009	Jul 2009	Aug 2009	Sept 2009	Oct 2009	Nov 2009	Dec 2009	Jan 2013 [2]
Terrestrial Ecological Survey								
Habitat and Vegetation Survey		✓				✓		
Avifauna Survey (Day)		✓		✓		✓		
Avifauna Survey (Night)			✓		✓		✓	
Butterfly and Dragonfly Survey		✓		✓		✓		
Herpetofauna Survey (Day)		✓		✓		✓		

Herpetofauna Survey (Night)			✓		✓			
Terrestrial Mammal Survey (Day)		✓		✓		✓		
Terrestrial Mammal Survey (Night)			✓		✓		✓	
Freshwater Communities Survey	✓			✓			✓	
Habitat Verification Survey								✓
Marine Ecological Survey[1]								
Intertidal Survey	✓					✓		
Benthos Survey	✓					✓		
Dive Survey	✓		✓	✓				✓
Fish Survey	✓			✓			✓	

Note:
1. Based on the best available information, waters within and adjacent to Junk Bay do not appear to be frequently utilized by marine mammals. Considering no direct impact to marine mammals is anticipated, no additional marine mammal survey is deemed necessary.
2. Terrestrial and marine verification surveys were conducted to check the validity of the 2009 survey results.

Terrestrial Ecology

Habitat Mapping and Vegetation Survey

6.3.7 Terrestrial habitats within the assessment area (refer to **Figure 6.1**) were identified, sized and mapped. Ecological characteristics of each habitat type, including size, vegetation type, species present, dominant species found, species diversity and abundance, community structure, seasonal patterns and inter-dependence of the habitats and species, and presence of any features of ecological importance were defined and characterized. Representative photographs of the habitat types and important ecological features identified were taken. A habitat map of suitable scale (1:1000 to 1:5000) showing the types and locations of terrestrial habitats within the assessment area was prepared with reference to aerial photographs. The habitat map was then checked during ground truthing.

6.3.8 Vegetation surveys were conducted by direct observation to record diversity and dominance of plant species present in different habitat types. The location(s) of any plant species of conservation interest were recorded. Identification of flora species and status in Hong Kong were made with reference to Flora of Hong Kong – Vol. 1 – 4 (Hong Kong Herbarium and South China Botanical Gardens, 2007; 2008; 2009; 2011) and Corlett *et al*. (2000).

Avifauna Survey

The presence and abundance of avifauna species at various habitats was recorded visually and aurally. Avifauna within the assessment area were surveyed quantitatively using the transect count method (refer to **Figure 6.3**). Daytime avifauna surveys were started in the early morning at the period of peak bird activity. Night surveys were also conducted to record nocturnal avifauna. The location(s) of any avifauna species of conservation interest encountered were recorded, along with notable behaviour (e.g. breeding behaviour such as

nesting and presence of recently fledged juveniles, roosting, and feeding activities). Ornithological nomenclature in this study follows the Hong Kong Bird Watching Society List of Hong Kong Birds (2012).

Dragonfly and Butterfly Survey

6.3.9 Dragonflies, damselflies and butterflies within the assessment area were surveyed, focusing on suitable habitats such as ponds, watercourses, etc. Relative abundance of dragonfly and butterfly encountered was recorded. Nomenclature of dragonfly and damselfly follows Tam *et al.* (2011), and nomenclature of butterfly follows Lo (2005).

Herpetofauna Survey

6.3.10 Herpetofauna within the assessment area were surveyed qualitatively. Potential microhabitats (e.g. leaf litter, underneath rotten logs) were searched. All reptiles and amphibians sighted were recorded.

6.3.11 Amphibian surveys were conducted whenever possible on evening following or during periods of rainfall, focusing on areas suitable for amphibians. Records of the calling amphibians formed the bulk of the data collected, but this were also supplemented when possible by visual observation of eggs, tadpoles and adult frogs and toads.

6.3.12 During reptile surveys, careful searches of appropriate microhabitats and refugia were undertaken. All reptiles observed were identified. In addition to active searching, observations of exposed, basking or foraging reptiles were also recorded.

6.3.13 Nomenclature of amphibian follows Chan *et al*. (2005), and reptile follows Karsen *et al*. (1998).

Mammal Survey

6.3.14 Surveys were conducted in areas which may potentially be utilized by terrestrial mammals within the assessment area during day and night time. The surveys focused on searching for field signs such as droppings, footprints, diggings or burrows left by larger terrestrial mammals. Mammal identification was made as accurate as possible from the field signs encountered. In addition, any mammal directly observed was identified. Nomenclature of mammal follows Shek (2006).

Freshwater Communities Survey

6.3.15 Freshwater fish and macroinvertebrate communities were surveyed via active searching and direct observation at stream sections within the assessment area. The sampling locations of the freshwater communities surveys are shown in **Figure 6.3**. Boulders within the stream were turned over to locate any aquatic animals beneath. Hand nets were used to collect organisms along the streams. Any organisms encountered were recorded and identified to the lowest possible taxon level.

Marine Ecology

Intertidal Survey

6.3.16 Surveys on intertidal communities were conducted at the five survey locations, T1 to T5 (**Figure 6.5**) covering the rocky and sandy shore, and artificial seawall by line-transect method, in order to establish an ecological profile of the intertidal habitats located at, and in

the vicinity to the Project site.

6.3.17 At each survey location, a qualitative or walk-through survey was conducted to determine the intertidal flora and fauna present and their occurrence in the survey locations. The average sampling effort for walk-through survey included active searching by 3 surveyors for approximately 30 minutes at each survey location.

6.3.18 Following the qualitative walk-through survey, line-transect surveys were conducted to provide more detailed, quantitative information. At each of the five sampling points, a line transect was deployed perpendicular to the shoreline from high water mark to low water mark during the low tide period (tide level below 1 m). Along each transect, standard ecological sampling quadrats (dimensions 0.5 m x 0.5 m) were laid at 1 m intervals. Quadrats were laid at 0.5 m interval at T1 in view of the short transect length to obtain representative sample size of quadrats. Intertidal epifauna and flora within each quadrant were identified and enumerated. In general, mobile fauna were counted in terms of abundance per unit area. Sessile organisms such as barnacles, oysters and algae were estimated in terms of percentage cover per fixed area. Representative photographs of intertidal habitat and flora / fauna species identified were taken.

6.3.19 At the survey location on sandy shore (T4), three core samples using a 1000 cm^3 hand core sampler were also taken from each tide level (i.e. low tide, mid tide and high tide) and collected infauna was sieved, counted and identified to the lowest taxonomic level.

Dive Survey

6.3.20 Spot check dives, covering the proposed maximum extent of the possible reclamation, were conducted along Chiu Keng Wan in June 2009 to provide information on the presence of corals within the Project Area. Subtidal substrata (hard substratum seabed and seawall, etc.) along the proposed spot-check dive area (**Figure 6.6** refers) were surveyed for presence of any coral communities, including hard corals (order Scleractinia), octocorals (sub-class Octocorallia) and black corals (order Antipatharia).

6.3.21 Based on the results from spot-check dive surveys, a more detailed Rapid Ecological Assessment (REA) was carried out with reference to DeVantier *et al.* (1998) (see **Appendix 6.1** for details) in August and September 2009. A total of 23 100 m REA transects were surveyed and the locations of transects are shown in **Figure 6.7**. For each REA transect, the locations (GPS) of dive routes, distance surveyed, number of colonies, sizes, species coverage, abundance, condition, translocation feasibility, and the conservation status of coral species were recorded and representative photographs were taken.

Benthos Survey

6.3.22 To survey marine soft bottom benthic fauna, grab samples of seabed sediment were carried out at four sampling sites within and in the vicinity of the proposed reclamation area (**Figure 6.8** refers). At each of the sampling sites, three replicates of grab samples were collected using a van Veen grab. Each sample covered over 0.1 m^2 of seabed substrate. Samples were then sieved through 0.5 mm sieves and stained with Rose Bengal. All collected organisms (including species/taxa of conservation interest e.g. amphioxus, if any) were counted, weighed, and identified to the lowest practicable taxon.

6.3.23 Abundance, biomass, species diversity *H'* and evenness *J* were calculated for pooled data, using the following formulae:

$H' = -\sum (Ni / N) \ln (Ni / N)$; 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.

Fish Survey

6.3.24 Surveys on the fish communities at the coastal intertidal, marine and estuarine and freshwater subtidal habitats were conducted. Fish sampling methodologies included direct field observation, active searching, net casting and cage-trapping depending on the substratum and water depth of the sampling sites (Yamasaki and Tachihara, 2005; 朱育文, 2001).

6.3.25 At the intertidal and shallow estuarine area (< 1.5 m C.D.), fish community was surveyed by direct field observation and active searching with the aid of hand nets to collect qualitative information on the fish community. The sampling effort spent in direct field observation and active searching within intertidal and estuarine included active searching by three surveyors for three hours at the survey locations.

6.3.26 Fish communities from marine and estuarine subtidal habitats with a depth greater than 1.5 m C.D. were sampled by net casting and cage-trapping at four sampling locations (**Figure 6.9** refers) to obtain quantitative data on fish diversity and abundance. At each sampling location, three replicates of net casting were undertaken. Five fish cages were deployed to subtidal habitat of each sampling location for 2 hours.

6.3.27 In view of the diadromous behavior of some fish species, fish communities in the freshwater stream habitat were also surveyed via active searching and direct observation during stream surveys. Hand nets were used to collect fish encountered along the streams.

6.3.28 All fish sampled were quantified (e.g. in terms of relative abundance and species richness) and identified to the lowest taxonomic level whenever possible, and then returned to their natural habitat after identification. Representative photographs of fish identified were also taken.

Verification Surveys

6.3.29 Additionally, a habitat verification survey was conducted in January 2013 to obtain the most up-to-date habitats conditions within the assessment area where direct and indirect impacts are likely to occur. As such, terrestrial habitats within the vicinity of the proposed above-ground works including the tunnel portals at Cha Kwo Ling and TKO, areas near Road P2 reclamation and the proposed access road to the temporary barging point at TKO were updated.

6.3.30 As part of the verification surveys undertaken in January 2013, a spot check dive was conducted at TKO to obtain updated conditions of coral communities to check the validity of the 2009 survey results. Coastal areas with major proposed marine works covering the reclamation of Road P2 all the way to the TKO temporary barging point were surveyed.

6.4 Description of the Environment

Area of Conservation Interest

6.4.1 There are no areas of recognized conservation interest (such as Country Parks, Sites of Special Scientific Interest, Coastal Protection Areas or Conservation Areas) within or in the vicinity of the terrestrial ecological assessment area. The closest Conservation Area (CA) at

Mang Kung Uk is located 1 km east from the assessment boundary at Tseung Kwan O Sheung Tak Estate.

6.4.2 Outside of the marine ecological assessment area, there are several marine areas of recognized or potential conservation interest including two designated Sites of Special Scientific Interest (SSSIs) at Shek O Headland and Hok Tsui, a Marine Reserve at Hok Tsui and a potential Marine Park at Clear Water Bay. The locations of these marine sites of conservation interest are shown in **Figure 6.2**.

6.4.3 The Cape d' Aguilar (Hok Tsui) Marine Reserve is located about 10 km south of Junk Bay and comprises a sea area of about 18 hectares. This Reserve was established in July 1996 and has been a designated SSSI since July 1990. It is also recognized as Hong Kong's only no-take Marine Protected Area (MPA). This area supports diverse marine life including corals dominated by *Platygyra sinensis*, *Favites abdita* and *Goniastrea aspera* (Clark, 1997 and 1998), as well as some subtidal macrofaunal assemblages that are unique to the Reserve (Morton & Harper, 1997; Morton, 1998; Morton 2003).

6.4.4 The Shek O Headland SSSI, designated in February 1998, is located about 8 km south of Junk Bay. This exposed rocky shore habitat was designated as SSSI because it is among the areas with the richest assemblages of macroalgae (seaweed) in Hong Kong.

6.4.5 The waters around coastal areas of north Clear Water Bay and Shelter Island were proposed as a potential marine park/reserve in the *Study on South East New Territories Development Strategy Review*. Although the area has not been designated as Marine Park, it is still considered as an area of conservation interest given its potential conservation value. This proposed marine park is approximately 8 km away from the Junk Bay.

Terrestrial Habitat and Vegetation

Literature Review

6.4.6 Previously, a number of surveys had been conducted within and in vicinity of the assessment area (TDD, 1999; CED, 2001; CEDD, 2005). These surveys identified similar habitat types within the assessment area of the Project and its vicinity as the identified habitats in the recent survey.

6.4.7 Five habitat types including, shrubland, grassland, woodland, plantation and disturbed/urbanized areas were identified from the Cha Kwo Ling area during the ecological surveys conducted in 1999 under the *Development at Cha Kwo Ling Kaolin Mine Site EIA Study* (TDD, 1999). One orchid species of conservation interest, the Ladies Tresses Orchid (*Spiranthes sinensis*), was recorded on the upper hydroseeded slopes of the former Sai Tso Wan Landfill (TDD, 1999). Ladies Tresses Orchid is a locally common orchid species, found growing in a variety of habitat types including grassland and boggy areas. All wild orchid species are protected in Hong Kong under the Forests and Countryside Ordinance (Cap. 96).

6.4.8 Habitat and vegetation surveys covering the Tseung Kwan O (TKO) Chinese Permanent Cemetery and north-western coastline of Junk Bay were conducted under the *Road P2 EIA Study* (CED, 2001). The surveys recorded four habitat types including, grassland/shrubland mosaic, woodland, disturbed areas, and stream habitats. The surveys also recorded two flora species of conservation interest, the Chinese New Year Flower (*Enkianthus quinqueflorus*), and Yellow-eye Grass (*Xyris indica*) within the grassland/shrubland mosaic habitat. Chinese New Year Flower is locally common but protected under the Forests and Countryside Ordinance (Cap. 96), while Yellow-eye Grass has a restricted distribution in Hong Kong.

6.4.9 The surveys under the *Further Development of Tseung Kwan O EIA Study* covered part of the current assessment area of the Project and identified nine habitat types including, mixed woodland, disturbed woodland, grassland/shrubland mosaic, village/orchard, orchard, plantation, wasteland/developed areas, disturbed grassland and stream habitats (CEDD, 2005). One flora species of conservation interest, the Small Persimmon (*Diospyros vaccinioides*), was recorded from the grassland/shrubland mosaic during the field surveys. Although locally common, this species is listed as critically endangered in the IUCN Red Data List (IUCN, 2012).

Recent Survey Results

6.4.10 Recent surveys recorded a total of seven habitat types within the assessment area, comprising: Mixed Woodland, Disturbed Woodland, Grassland/Shrubland Mosaic, Village/Orchard, Plantation, Stream, and Wasteland/Developed Area. The results of habitat surveys conducted for this Study generally resembled the habitat condition reported during previous surveys of the assessment areas (**Sections 6.4.6 to 6.4.9** refer).

6.4.11 Habitat maps of the assessment area are presented in **Figures 6.4** and **Figure 6.4a to 6.4e**. Representative photographs of habitats are given in **Appendix 6.1**. Photographs of plant species of conservation interest are given in **Appendix 6.2**. Flora species recorded in the assessment areas is listed in **Appendix 6.3**. **Table 6.2** summarizes the size of each habitat type within the assessment area. Further descriptions of habitat types recorded in the assessment areas are given in the following sections.

6.4.12 During the habitat verification survey in January 2013, there were no major changes in the habitats at areas of above-ground works at Cha Kwo Ling, while two changes were observed at TKO when compared to the 2009 baseline survey results. At the northern coast of TKO, east of Ocean Shore Phase 1, the reclaimed peninsula lying had been reduced in size by approximately 0.4 ha when compared to the 2009 findings. Secondly, the size of the developed areas of TKO Chinese Permanent Cemetery had increased as two former patches of plantations of approximately 0.3 ha, have been transformed into developed areas. These two plantation patches were formerly located east of the currently existing plantation patch surrounding the retention ponds within the TKO Chinese Permanent Cemetery. The ecological value of developed area/wasteland is very low and for plantation is low, therefore these transformations do not significantly impact the conclusion drawn from the previous assessment as they are not associated with any areas of high ecological value or areas with records of species of conservation interest. The conclusions drawn before the verification surveys are still valid.

Table 6.2 Habitats Recorded within the Assessment Area

Habitat	Area (Hectare)	% of Total Assessment Area
Mixed Woodland	2.8	<1%
Disturbed Woodland	10.5	2%
Grassland/Shrubland Mosaic	94.0	20%
Village/Orchard	4.1	1%
Plantation	62.5	14%

Habitat	Area (Hectare)	% of Total Assessment Area
Pond/Stream	Pond: 1.0 Stream: 0.1 (Length: 851 m)	Pond: <1% Stream: <1%
Wasteland / Developed Area	283.5	61%
Natural Rocky Shore	2.0	<1%
Sandy Shore	0.3	<0.1%
Artificial Seawall	1.3	<1%
Total	**462.1**	**100%**

Mixed Woodland

6.4.13 The mixed woodland habitat covered an area of 2.8 ha (making up less than 1% of the total assessment area) was identified south of the residential blocks of Ocean Shore. This habitat type was dominated by common and widespread native pioneer tree species (*Macaranga tanarius, Mallotus paniculatus, Sapium discolor, Ficus hispida* and *Schefflera heptaphylla*). Other vegetation recorded from mixed woodland included common tree species (*Celtis sinensis* and *Araucaria heterophylla*), climber (*Dalbergia benthamii*), shrubs (*Manihot esculenta* and *Phyllanthus cochinchinensis*) and herbs (*Pteris ensiformis* and *Scaevola taccada*). Fruit trees and amenity planting were also recorded. No rare flora or species of conservation interest was recorded within this habitat during the recent surveys.

Disturbed Woodland

6.4.14 Occupying a total area of 10.5 ha (approximately 2% of the assessment area), disturbed woodland habitat was recorded from a hillside slope between Kwong Tin Estate and Lei Yue Mun Road (**Figure 6.4a** to **6.4c** refers). The disturbed woodland is covered with dense vegetation dominated by common trees (*Ficus microcarpa, Macaranga tanarius* and *Leucaena leucocephala*) and fruit tree (particularly, *Musa x paradisiaca*). This habitat was surrounded mostly by developed area with evidence of human disturbance such as the presence of abandoned village huts and scattered agricultural plots. The floral diversity was relatively low without any records of flora species of conservation interest.
Grassland/Shrubland Mosaic

6.4.15 Grassland/shrubland mosaic was the most dominant natural habitat type, covering an area of 94 ha, making up of approximately 20% of the total assessment area. This habitat covered most of Chiu Keng Wan Shan and the back-shore slopes along the coast of Chiu Keng Wan (**Figures 6.4c** to **6.4e** refer). At Cha Kwo Ling area, a small area of grassland/shrubland mosaic was also recorded from the hillside slope northeast of Cha Kwo Ling Tsuen (**Figures 6.4a** and **6.4b**). Although this habitat type was fragmented by developed area, the flora species recorded were generally similar among different areas. The vegetation cover and species complexity of grassland/shrubland mosaic was relatively lower on hilltops and exposed slopes on the windward sides. Vegetation tended to grow taller with denser canopy cover within stream valleys and the shoreward side. Representative vegetation recorded within grassland/shrubland mosaic habitat included young individuals of pioneer trees (*Macaranga tanarius, Litsea glutinosa* and *Bridelia tomentosa*), shrubs (*Rhodomyrtus tomentosa, Lantana camara* and *Rhaphiolepis indica*), ferns (*Dicranopteris pedata*), grasses (*Hedyotis acutangula* and *Neyraudia reynaudiana*) and herbs (*Bidens alba* and *Ageratum conyzoides*).

6.4.16 Bamboo Orchid (*Arundina graminifolia*) was the only flora species of conservation interest found within the assessment area. It was recorded from the slope-side of grassland/shrubland mosaic behind the TKO Chinese Permanent Cemetery. This species is locally very common but it is listed under both Forests and Countryside Ordinance (Cap. 96); and Protection of Endangered Species of Animals and Plants (Cap. 586). Refer to **Figure 6.4e** for its location.

Village/Orchard

6.4.17 Village/orchard habitat is mainly located at Cha Kwo Ling Tsuen (**Figure 6.4a** and **6.4b** refer) and the slope below the TKO Chinese Permanent Cemetery (**Figure 6.4d** refers) within the assessment area. This habitat type enveloped a total of 4.1 ha, making up approximately 1% of the assessment area. Village/orchard was characterized by village residential housing interspersed with scattered orchard plantings dominated by *Dimocarpus longan* . Other vegetation recorded within this habitat included trees (*Antirhea chinensis* and *Schefflera heptaphylla*), shrubs (*Bougainvillea spectabilis* and *Pueraria phaseoloides*), and herbs (*Alocasia odora*). No rare plant or species of conservation interest were recorded from village/orchard habitat within the assessment area.

Plantation

6.4.18 Plantation habitat within the assessment area mainly consisted of road-side tree planting and plantings on the engineered slopes, making up a total of 62.5 ha (14%) of the assessment area. Plantation with highest tree density was recorded around the Sai Tso Wan Recreation Ground built on the closed Sai Tso Wan Landfill (**Figure 6.4a** refers). Other significant plantation habitats were identified on both sides of O King Road (**Figure 6.4c** refers). In general, the plantation habitat was dominated by exotic tree species typically planted in the plantation habitat elsewhere in Hong Kong, including *Acacia confusa, Acacia auriculiformis, Eucalyptus* spp., *Casuarina equisetifolia,* and *Celtis sinensis*. Occasional records of native pioneer tree species such as *Macaranga tanarius* and *Schefflera heptaphylla* also comprised this habitat. No plant species of conservation interest were recorded from the plantation habitats.

Pond/Stream

6.4.19 Several concrete water retention ponds were recorded within the TKO Chinese Permanent Cemetery (**Figure 6.4e** refers). These ponds served as a flood prevention measure to store the surface runoff from the Cemetery. They were surrounded by plantation habitat.

6.4.20 A seasonal ephemeral pond was identified within the previously abandoned quarry site northeast to Cha Kwo Ling Tsuen (**Figure 6.4a** refers). The water level of the pond varied seasonally, dried-up conditions were recorded during dry season surveys (November to December 2009).

6.4.21 Four streams (Stream 1 to 4, **Figure 6.3** refers), with a total length of 782 m, were recorded within the assessment area.

6.4.22 A semi-natural stream (Stream 1) with bedrock and large boulder based substratum was identified running between the Kwong Tin Estate and Lei Yue Mun Road (**Figure 6.4a** refers) and discharging to an underground storm-water drain at the west of Lei Yue Mun Road. The embankments of the stream were made of natural boulders and glass bottles set in mortar, and earthen banks. The water quality of the stream appeared to be fair with freshwater fauna present (**Section 6.4.54** and **Appendix 6.4** refers) during surveys in the wet season (June and

September 2009). The stream was observed to be polluted with white precipitated-substance, apparently discharged from Kwong Tin Estate, during a night survey in October 2009. No freshwater fauna was recorded in the subsequent freshwater communities surveys (December 2009).

6.4.23 Three natural streams (Stream 2, 3 and 4) with bedrock streambed were identified on the western coast of Chiu Keng Wan (**Figure 6.4e** refers). Stream 4 located on a steep and exposed slope with sparse vegetation cover was the smallest (<1 m in width). The tributaries of this stream were intermittent in nature and were found to be mostly dry during the surveys. Upstream is modified with concrete which drained into the natural stream and then discharge into the Junk Bay through an intertidal rock pool.

6.4.24 Stream 2 originated from water retention ponds within the TKO Chinese Permanent Cemetery. The upper reaches were modified into concrete channel and the lower reaches were mostly natural, approximately 1 – 2 m wide, with the existence of some shallow riffles and deep pools. This natural stream discharged into a rocky shore at the southern region of Chiu Keng Wan.

6.4.25 The upper reaches of Stream 3 is made up of drainage ditches which then flowed into the natural stream and eventually discharged into a sandy shore along the coast. The characteristics of the natural portions are similar to that of Stream 2, approximately 1 – 2 m wide with shallow riffles and deep pools.

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6.4.26 Water quality of both Stream 2 and 3 were poor with trash observed within the stream during the surveys. Both streams were shaded by dense canopy of *Dimocarpus longan*, *Musa* x *paradisiaca*, and *Macaranga tanarius* from the adjacent village/orchard habitat. Other riparian vegetation recorded along the banks of the streams included trees (*Ficus hispida*) and shrubs (*Sterculia lanceolata* and *Hedychium coronarium*) and herbs (*Sesbania cannabinai*).

Wasteland / Developed Area

6.4.27 Wasteland / Developed Area include urbanized area, the TKO Chinese Permanent Cemetery, roads, recreational parks, recently reclaimed land and wasteland. This habitat type is the dominant habitat within the assessment area accounting for 283.5 ha (about 61% of the assessment area). These areas are considered to be of low ecological value due to high levels of anthropogenic disturbance. Flora communities in this habitat were generally low in diversity and dominated by common and widespread species such as *Ficus microcarpa, Delonix regia*, and *Spathodea campanulata*. No plant species of conservation interest were recorded from this habitat within the assessment areas.

Fauna

Avifauna

Literature Review

6.4.28 Avifauna surveys were conducted in previous studies, including *Cha Kwo Ling EIA Study* (TDD, 1999), *Road P2 EIA Study* (CED, 2001), *Further Development of TKO EIA Study* (CEDD, 2005). Up to 46 avifauna species within and in the vicinity of the assessment area were recorded. The avifaunal assemblage was mainly dominated by common and widespread species occurring in urban and disturbed habitats. Commonly recorded species included Black-collared Starling (*Sturnus nigricollis*), Red-whiskered Bulbul (*Pycnonotus jocosus*) and Eurasian Tree Sparrow (*Passer montanus*).

6.4.29 Among avifauna previously recorded, 12 species were considered of conservation interest. Bird species of conservation interest recorded in previous studies are summarized in **Table 6.3**.

Table 6.3 Avifauna of Conservation Interest Previously Recorded from the Assessment Area and its Vicinity

Common Name[1]	Distribution in HK	Level of Concern[2]	Protection Status in China[3]	*CKL EIA*[4]	*Road P2 EIA*[5]	*TKO EIA*[6]
Pacific Reef Egret	Uncommon	(LC)	Class II			√
Eastern Cattle Egret	Common	(LC)	-			√
Chinese Pond Heron	Common	PRC (RC)	-			√
Black Kite[7]	Common	(RC)	Class II	√	√	√
White-bellied Sea Eagle[7]	Uncommon	(RC)	Class II	√		
Eastern Buzzard[7]	Common	-	Class II	√		√
Peregrine Falcon[7]	Scarce	(LC)	Class II			√
Greater Coucal	Common	-	Class II	√		√
Eurasian Eagle Owl	Scarce	RC	Class II		√	
Grey Bush Chat	Scarce	LC	-			√
Black-naped Oriole	Scarce	LC	-			√
Collared Crow	Uncommon	LC	-			√
	Number of Species of Conservation Interest			**4**	**2**	**10**

Notes:
1. All wild birds are Protected under Wild Animal Protection Ordinance (Cap. 170)
2. Fellowes *et al.* (2002); RC=Regional Concern; LC=Local Concern; PRC=Potential Regional Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
3. List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
4. CKL EIA = Development at Cha Kwo Ling Kaolin Mine Site EIA Study (TDD, 1999);
5. Road P2 EIA = Road P2 EIA Study (CED, 2001) ;
6. TKO EIA = Further Development of Tseung Kwan O EIA Study (CEDD, 2005);
7. Protected under Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).

Recent Survey Results

6.4.30 A total of 53 avifaunal species were recorded within the assessment area during the recent surveys. Relatively high species diversity and abundance of avifauna were recorded from grassland/shrubland mosaic habitat than the other habitat types. In general, the bird communities recorded were dominated by species typical of disturbed habitats in Hong Kong such as Red-whiskered Bulbul, Eurasian Tree Sparrow and Japanese White-eye (*Zosterops japonica*). A full list of avifaunal species recorded within the assessment area is given in **Appendix 6.4**. Out of the total number of species recorded, 10 species are considered to be of conservation interest (refer to **Table 6.4**). Photographic records of avifauna species of conservation interest are provided in **Appendix 6.2**.

Table 6.4 Avifauna Species of Conservation Interest Recorded within the Assessment Area during the Recent Surveys

Common Name[1]	Scientific Name	Distribution in Hong Kong	Level of Concern [2]	Protection Status in China[3]
Little Egret	*Egretta garzetta*	Common	PRC (RC)	-
Pacific Reef Egret	*Egretta sacra*	Uncommon	(LC)	Class II
Chinese Pond Heron	*Ardeola bacchus*	Common	PRC (RC)	-
Black Kite[4]	*Milvus migrans*	Common	(RC)	Class II
Eastern Buzzard[4]	*Buteo buteo*	Common	-	Class II
Grey-tailed Tattler	*Heteroscelus brevipes*	Common	LC	-
Sanderling	*Calidris alba*	Uncommon	LC	-
Greater Coucal	*Centropus sinensis*	Common	-	Class II
Zitting Cisticola	*Cisticola juncidis*	Common	LC	-
Collared Crow	*Corvus torquatus*	Uncommon	LC	-

Notes:
1. All wild birds are Protected under Wild Animal Protection Ordinance (Cap. 170)
2. Fellowes *et al.* (2002); RC=Regional Concern; LC=Local Concern; PRC=Potential Regional Concern. Letter in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
3. List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
4. Protected under Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)

Ardeids

6.4.31 Four species of ardeids, including Little Egret (*Egretta garzetta*), Pacific Reef Egret (*Egretta sacra*), Chinese Pond Heron (*Ardeola bacclus*) and Black-crowned Night Heron (*Nycticorax nycticorax*) were recorded from the assessment area during recent surveys. Of which, Little Egret, Pacific Reef Egret and Chinese Pond Heron are considered to be species of conservation interest under this study. The large, secure populations of Little Egret and Chinese Pond Heron in Hong Kong are considered important in a regional context (Fellowes *et al*., 2002). In spite of their decline numbers in Hong Kong, the local population is still large enough to be of regional significance (Carey *et al*., 2001). The nearest egretry, Ocean Park Egretry, is located 10 km south-west of the assessment area.

6.4.32 The local populations of Little Egret, Chinese Pond Heron and Black-crowned Night Heron mainly concentrate at areas of Deep Bay and Starling Inlet, where extensive of wetland habitats (e.g. intertidal mudflats and fishponds) are available for feeding (HKBWS, 2009). These three species recorded from the assessment area during the current survey were of low abundance, and thus considered as a minor population in the local context.

6.4.33 Three records of Pacific Reef Egret (*Egretta sacra*) were found at the coastal rocky shore habitat at Chiu Keng Wan. Unlike the above three ardeids species, Pacific Reef Egret displays exceptional affinity to rocky and sandy shores along the coastlines (Wong *et al*., 2009). Previous breeding bird surveys reported in Carey *et al.* (2001) also showed concentrations of Pacific Reef Egret at the Clearwater Bay (which is about 3 km away from the assessment area).

6.4.34 Since no breeding behavior of Black-crowned Night Heron was recorded within or in vicinity of the assessment area, this species was not regarded as of conservation interest under the current studies.

Raptors

6.4.35 Records of Black Kite (*Milvus migrans*) were recorded at various habitats within the assessment area throughout the survey period. Flocks of up to 30 individuals soaring over the TKO Chinese Permanent Cemetery were frequently observed. Although Black Kites were observed perching on trees/poles close to the Chinese Permanent Cemetery, no breeding activity (e.g. nesting) was recorded during the surveys. The species is considered to be of conservation interest in Hong Kong due to the restricted number of nesting and roosting sites (Fellowes *et al*., 2002). It is also a Category II protected species under Mainland Chinese Legislation.

6.4.36 White-bellied Sea-eagle (*Haliaeetus leucogaster*) and Eastern Buzzard (*Buteo japonicus*) were observed in-flight over the assessment area. Although these species are not considered to be of conservation interest in this study due to the fact that they were not seen utilizing the assessment area, it should be noted that they are under class II protection under Mainland Chinese Legislation.

Waders

6.4.37 Two waders of conservation interest, Grey-tailed Tattler (*Heteroscelus brevipes*) and Sanderling (*Calidris alba*), were recorded from the rocky shore at Chiu Keng Wan. Both waders are passage migrants usually recorded from the intertidal mudflat habitats in the Deep Bay area. Grey-tailed Tattler is a common passage migrant with small numbers distributed in the coastline localities throughout Hong Kong (Carey *et al*., 2001). Sanderling is locally uncommon and is mostly recorded at coastal areas at Tai Long Wan and Sai Kung (Carey *et al*., 2001). They are both considered to be of local concern by Fellowes *et al*. (2002).

Other Birds

6.4.38 Records of Greater Coucal (*Centropus sinensis*) were made from disturbed woodland, grassland/shrubland mosaic and plantation habitats within the assessment area. This species is common and widespread in Hong Kong, but is a Category II protected species in Mainland China.

6.4.39 Individuals of Zitting Cisticola (*Cisticola juncidis*) were recorded from the grassland/shrubland mosaic habitat within the assessment area during the surveys. Zitting Cisticola is a relatively common winter visitor and passage migrant to Hong Kong, with a small breeding population restricted to the Northern New Territories (Carey *et al*., 2001). This species is widespread in open areas of tall grass, and is also abundant at places such as Long Valley and areas with fishponds/filled fishponds (ibid). Fellowes *et al*. (2002) considers it as a species of local conservation concern, given its restricted local distribution.

6.4.40 Records of Collared Crows (*Corvus torquatus*) were made from the grassland/shrubland mosaic and wasteland/developed area at the TKO Chinese Permanent Cemetery. This species has a restricted and declining local population (Carey *et al.*, 2001), and are considered to be of local conservation concern by Fellowes *et al.* (2002). They are also recorded from widespread coastal habitats, including occasional reports from relatively disturbed areas (Carey *et al*., 2001).

6.4.41 No avifauna species displayed evidence of breeding during the recent surveys.

Butterfly and Dragonfly

Literature Review

6.4.42 Low diversity of butterfly (three to four species) and dragonfly (three species) were recorded from the assessment area during the surveys for the *Development at Cha Kwo Ling Kaolin Mine Site EIA Study* and *Road P2 EIA Study* (TDD, 1999; CED, 2001). A more extensive ecological field surveys for *Further Development of Tseung Kwan O EIA Study* recorded 11 dragonfly and 33 butterfly species from the assessment area (CEDD, 2005). All the recorded species are common and widespread in Hong Kong, none are rare or species of conservation interest.

Recent Survey Results

6.4.43 Recent field surveys recorded 52 butterfly species, of which one is of conservation interest. Large Branded Swift was recorded in the grassland/shrubland mosaic near the coast of Chiu Keng Wan. This species is very rare in Hong Kong. The majority of the remaining recorded species were common or very common. Butterfly species diversity and abundance was the highest at grassland/shrubland mosaic. A full list of butterfly species recorded within the assessment area is presented in **Appendix 6.4**.

6.4.44 Nineteen dragonfly species were observed within the assessment area. All of the recorded species are abundant and common Hong Kong. Dragonfly diversity and abundance was the highest at pond/stream habitats. None of the recorded dragonfly is of conservation interest. A full list of dragonfly species recorded within the assessment area is presented in **Appendix 6.4**.

Herpetofauna

Literature Review

6.4.45 All amphibians recorded from the assessment area during the previous surveys (TDD, 1999; CED, 2001; CEDD, 2005) are common and widespread in Hong Kong.

6.4.46 Two reptile species of conservation interest, Chinese Cobra (*Naja atra*) and Common Rat Snake (*Ptyas mucosus*), were recorded from the assessment area at the western coast of Junk Bay during the field surveys for the *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005). Chinese Cobra was recorded approximately 700 m away from the Project Boundary of LT Tunnel, while Common Rat Snake was found adjacent to the current Project Boundary. Fellowes *et al*. (2002) considers the relatively large and secure population of both these species that occur in Hong Kong as of potential regional concern due to the declining regional and global populations of the species.

Recent Survey Results

6.4.47 Six amphibian and eight reptile species were recorded within the assessment area during the recent surveys. All the herpetofauna species are common and widespread in Hong Kong, none of them are of conservation interest. A full list of herpetofauna species recorded within the assessment area is presented in **Appendix 6.4**.

Terrestrial Mammals

Literature Review

6.4.48 Direct observations of two mammal species of conservation interest, Japanese Pipistrelle (*Pipistrellus abramus*) and Pallas's Squirrel (*Callosciurus erythraeus styan*) were made from the assessment area during the surveys for the *Further Development of Tseung Kwan O EIA*

Study (CEDD, 2005). Both species are protected under the Wild Animal Protection Ordinance (Cap. 170).

Recent Survey Results

6.4.49 Two mammal species, Japanese Pipistrelle (*Pipistrellus abramus*) and Asian House Rat (*Rattus tanezumi*), were recorded from wasteland/developed area within the assessment area. Both species are locally common and widespread. However, Japanese Pipistrelle is under the protection of the Wild Animal Protection Ordinance (Cap. 170).

Freshwater Communities

Literature Review

6.4.50 The freshwater macroinvetebrate communities previously recorded from the stream and pond habitats within the assessment area generally had low species diversity dominated by common (e.g. *Cardinia* spp.) and pollution tolerant taxon (e.g. *Chironomus* sp.) (CEDD, 2005).

6.4.51 Tadpoles of Gunther's Frog (*Rana guentheri*) were found in the ephemeral ponds at the abandoned quarry behind the Cha Kwo Ling village (TDD, 1999).

6.4.52 A diadromous fish of conservation interest, the Philippine Neon Goby (*Stiphodon atropurpureus*), was recorded from a small freshwater stream running from the TKO Chinese Permanent Cemetery to the west Junk Bay (referred to as Stream 3 in the current study) (CEDD, 2005). This fish is locally uncommon (Lee *et al*., 2004) and has only been recorded from areas of Lantau Island and North-east New Territories (Chan, 2001). It is considered to be of global concern by Fellowes *et al.* (2002) due to its restricted and declining local, regional and global populations.

Recent Survey Results

6.4.53 A total of 32 macroinvertebrates (**Appendix 6.4** refers), three fish species and one tadpole were recorded from the stream habitat within the assessment area during the recent surveys.

6.4.54 Stream 1, which is located between Kwong Tin Estate and Lei Yue Mun Road, was dominated by mayfly nymph (*Liebebiella* sp.) and snail (Planorbidae). Other commonly recorded taxa included snails (Viviparidae and *Physella acuta*), dragonfly nymph (Cordulegasterida) and tadpole of Brown Tree Frog (*Litoria ewingii*). No fish was recorded from this stream. Species diversity was relatively low, and no species of conservation interest w recorded from the stream.

6.4.55 Stream 2, Stream 3 and Stream 4, (**Figure 6.3** refers) located on the western coast of Chiu Keng Wan, were dominated by freshwater shrimps (*Cardinia* sp.). The highest diversity of shrimps was recorded at Stream 2. Other commonly recorded taxa of macroinvertebrate included snail (*Physella acuta*) and mayfly nymph (*Procloeon* sp. and Leptophlebiidae). Fish communities were only recorded in an intertidal rock pool that Stream 4 discharged into, this is where *Mugil cephalus, Siganus canaliculatus* and *Terapon jarbua* were recorded. These fish are marine species and believed to be trapped in the rock pool during low tide period. The previously recorded diadromous fish of conservation interest, Philippine Neon Goby, was not recorded during the recent surveys.

Intertidal Habitat

Literature Review

6.4.56 Intertidal habitat within the assessment area consists of natural rocky shore, sandy shore and artificially modified coastline (i.e. artificial vertical seawall and man-made sloping seawall).

Natural Rocky Shore

Victoria Harbour

6.4.57 The extent of natural rocky shore habitat is very limited within Victoria Harbour. The coastline around Kellet Island is the only natural rocky shore identified within Victoria Harbour. This shoreline line was previously surveyed by TDD (2001a) and CEDD (2007a). The area was subject to high levels of disturbance due to construction and reclamation works in the past. Typical sheltered rocky shore communities with low diversity dominated by periwinkles (*Echinolittorina millegrana*) on upper shore and top shells (*Monodonta australis*) on the lower shore. No rare species or species of conservation interest were recorded during the surveys.

Junk Bay

6.4.58 On the western coast of Junk Bay, the natural rocky shore comprised nearly the entire coastline stretching from Chiu Keng Bay southward to Lei Yue Mun with the occurrence of several intermittent sandy beaches. This coast is the largest remaining natural rocky shore within Junk Bay given that most of it at the inner and east coast of Junk Bay have been lost to reclamation. Elsewhere within the assessment area, natural rocky shore could also be found outside the Victoria Harbour, fringing the east coast of Hong Kong Island, west coast of Fat Tong Chau, and from the Jose House Bay around the Clear Water Bay.

6.4.59 Literature review revealed that the intertidal assemblage inhabiting the natural rocky shore within the assessment area comprised of typical species with community composition similar to other semi-exposed rocky shores in Hong Kong.

6.4.60 An intertidal survey on the natural rocky shore at Fat Tong Chau was undertaken in April 2008 for *Tseung Kwan O Biodiesel Plant EIA Study* (ASB Biodiesel HK Ltd., 2008). Dominant species of the natural rocky shoreline included rock oyster (*Saccostrea cucullata*), periwinkles (*Echinolittorina radiata* and *E. trochoides*), limpets (*Nipponacmea concinna*) and topshell (*Monodonta labio*). All these species are commonly found on natural rocky shores of Hong Kong.

6.4.61 The natural rocky shore at Chiu Keng Wan in the north-western coast of Junk Bay was previously surveyed in March and September 1997 for the *Western Coast Road EIA Study*. Fauna recorded on the rocky shore at Chiu Keng Wan were represented by 27 different species, comprising periwinkles (*Nodolittorina trochoides, Nodolittorina vidua, Nodolittorina radiata, Littoraria articulata* and *Peasiella roepstorffina*), whelks (*Thais clavigera* and *Morula musiva*), topshells (*Chlorostoma argyrostomas* and *Monodonta labio*), turban shells (*Lunella coronate*) and nerites (*Nerita albicilla*), barnacles (*Tetraclita squamosa, Capitelum mitella*), limpets (*Cellana toreuma, Cellana grata, Patelloida pygmaea, Patelloida saccharina*), false limpets (*Siphonaria japonica, Siphonaria sirrius, Siphonaria atra*), chitons (*Acanthopleura japonica, Ischnochiton comptus*), bivalves (*Septifer virgatus; Saccostrea cucullata;* and *Barbatia virescens*), sea anemones (*Anthopleura* sp.) and rock crabs (*Grapsus albolineatus*). Algal cover on the rocky shore was comprised of erect coralline algae (*Corallina sessilis*), red encrusting algae (*Peysonnelia* sp., *Hildenbrandtia prototypus*), brown encrusting algae (*Ralfsia expansa, Endopleura aurea, Hapalospongidion gelatinosum*), green foliose algae (*Ulva fasciata*), brown turf algae (*Hincksia mitchelliae*), red turf algae (*Gelidium pusillum, Gymnogongrus flabelliformis*) and cyanobacteria (*Kyrtuthrix*

maculans).

6.4.62 An intertidal survey on the rocky shore habitat at Chiu Keng Wan was conducted in May 2003 and January 2004 for the *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005). Recorded intertidal assemblage comprised of 33 fauna species and five flora species with a typical vertically stratified zonation on the rocky shore. The high shore was dominated by the periwinkles (*Nodolittorina* spp.), while sea slaters (*Ligia exotica*) were also present. At the mid-shore, assemblages were dominated by limpets (*Cellana toreuma*) and barnacles (*Tetraclita* spp.) and Common Top Shell (*Monodonata labio*). At low shore, rock oysters (*Saccostrea cucullata*) and mussels (*Sepifera virigatus*) dominated. Common Rock Crab (*Grapsus albolineatus*) was occasionally seen close to the water's edge.

Sandy Shore

6.4.63 Sandy shore habitats only comprised of a small area in terms of the total extent of shoreline within the assessment area. The sandy shore habitats within Junk Bay are restricted to two small isolated coves along the natural shores at the western edge of the Junk Bay. There are also small stretches of sandy shore at Lei Yue Mun Point, Fat Tong Chau, Jose House Bay and Tung Lung Chau. Further far-field sandy shores are identified from the Clear Water Bay, Big Wave Bay and Shek O on the east coast of Hong Kong Island.

6.4.64 In general, sandy shores in Hong Kong mostly appear devoid of intertidal life except a few burrowing organisms (e.g. crabs and worms) given the mobile and unstable substratum of sandy shore due to exposure to the constant water movement and wave action (Morton & Morton, 1983; Morton *et al*., 1995).

6.4.65 The sandy shores at Big Wave Bay and Shek O were previously surveyed by Wong (1990) from 1987 to 1988. Dominant species were surf clams, *Donax semigranosus* and *Donax cuneatus*. Other species recorded were mole crabs (*Hippa pacifica*), hermit crabs (*Calcinus herbstii*), ghost crabs (*Ocypode ceratophthalma*), sand crabs (*Matuta lunata*), mysid shrimps (*Archaeomysis* sp.), and isopod (*Excirolana chiltoni*) (Wong, 1990).

6.4.66 The two coves of sandy shores identified at the western coast of Junk Bay were surveyed in 1998 for the *Road P2 EIA Study* (CED, 2001). No macrofaunal invertebrates were recorded from sand core samples collected, except for several burrow openings of ghost crab (*Ocypode* sp.).

6.4.67 In a survey conducted in May and October 2004 for the *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005), similar ecological conditions of the sandy shore persisted and survey results resembled that of the *Road P2 EIA Study*. No living burrowing macrofauna were found, only shell debris was observed scattered on the shore. These shell debris could have been carried onto the shore by water movement and thus would not be considered as direct evidence for intertidal life. Ghost Crab burrows were also recorded on the sandy shore. It was confirmed during night surveys that the burrows were made by nocturnal Large Ghost Crab (*Ocypode ceratophthalma*).

Artificial Seawall

6.4.68 Artificial seawall virtually covers the entire shoreline of Victoria Harbour and most of the Junk Bay shoreline and thus it is the most dominant intertidal habitat within the assessment area. The artificial seawalls were found to support less complex intertidal community with low species diversity than natural rocky shore. Compared with the homogenous nature of the vertical seawalls, artificial rockfills or sloping rubble mound seawall provided a more diverse and abundant intertidal community.

6.4.69 Literature review indicated that the intertidal fauna supported by seawalls and rockfills within Victoria Harbour were largely restricted to encrusting sessile organisms such as bivalves, molluscs, and barnacles (Morton & Morton, 1983). Fauna commonly found included molluscs such as the common neogastropod (*Thais clavigera*) and the pollution tolerant *Perna virdis*, as well as encrusting crustaceans such as barnacles (*Balanus* spp., *Tetraclita squamosa* and *Capitulum mitella*) and ubiquitous mobile isopod (*Ligia exotica*) (Morton & Morton, 1983; Lee, 1985; Lee & Morton, 1985). Flora species present are mostly restricted to algae that are either organic or nutrient enrichment indicators such as *Ulva* spp. and *Cladophora* spp. (Morton & Morton, 1983).

6.4.70 Intertidal surveys on artificial seawall within Victoria Harbour for various projects (e.g. *HATS Dive Survey* (EPD, 2003); *Wan Chai Development Phase II and Central-Wan Chai Bypass EIA Study* (CEDD, 2007); *Kai Tak Development EIA Study* (CEDD, 2008) recorded generally consistent intertidal biotic assemblage with low species diversity. Commonly recorded species from the artificial seawall included a few sessile and encrusting fauna, chiton (*Acanthopleura japonica*), barnacle (*Tetraclita squamosa*), periwinkle (*Echinolittorina radiata*), topshell (*Monodonta labio*), limpets (*Cellana grata*), bivalve (*Saccostrea cucullata*) and barnacles (*Balanus amphitrite*); and mobile fauna, common Sea Slater (*Ligia exotica*) and crabs. Encrusting (*Pseudulvella applanata* and *Hildenbrandia rubra*) and erect (*Ulva* sp. and *Hincksia mitchelliae*) algae were commonly recorded on the surface of artificial seawall as well.

6.4.71 An intertidal survey on the artificial seawall along the coast of TKO Industrial Estate was conducted in April 2008 for the *Tseung Kwan O Biodiesel Plant EIA Study* (ASB Biodiesel HK Ltd., 2008). The artificial seawall exhibited an intertidal community with low diversity of species dominated by rock oyster (*Saccostrea cucullata*), periwinkles (*Echinolittorina radiata* and *E. trochoides*), and limpets (*Nipponacmea concinna* and *Patelloida pygmaea*). Topshell (*Monodonta labio*) and chiton (*Acanthopleura japonica*) were also recorded in low abundances and a few mobile juvenile crustaceans were observed at the mid intertidal zone on the artificial seawall.

Recent Survey Results

6.4.72 In order to update and verify the baseline information on the ecological profile of intertidal habitat at Chiu Keng Wan, particularly the coastline that would likely be impacted by marine works (e.g. dredging or reclamation) of the Project, intertidal surveys were conducted in June and November 2009. The surveys covered five sampling locations including the rocky shore, sandy shore, and artificial seawall spreading along the coastline of Chiu Keng Wan (**Figure 6.5**).

Table 6.5 Locations and Habitat Characteristics of the Sampling Locations for Intertidal Surveys

Sampling Locations	Habitat Type	Habitat Description
T1	Artificial Sloping Seawall	- Located at the northern end of the Survey Area. - Mainly a boulder shore covered by rocks of irregular shape forming a sloping seawall.

Sampling Locations	Habitat Type	Habitat Description
T2	Rocky Shore	- Located near the junction point between modified artificial vertical seawall and natural rocky shore of the Chiu Keng Wan. - A mixture of natural rocky shore and artificial vertical seawall.
T3	Rocky Shore	- A protruding area between two sandy bays. - A steep natural granite rocky shore.
T4	Sandy Shore	- The most southern sandy shore within Chiu Keng Wan. - Mostly sandy in nature with big rocks and boulders at low shore.
T5	Rocky Shore	- Located near a former pier at the southern end of the Survey Area. - Natural granite rocky shore.

6.4.73 **Table 6.5** presents the habitat characteristics of the sampling locations. Photographic records of the intertidal survey are given in **Appendix 6.5**.

6.4.74 A total of 67 taxa of intertidal organisms were recorded during the intertidal surveys. More than 99% of the intertidal organisms encountered during the intertidal surveys were observed on the hard surfaces of the rocky shores and artificial seawalls. The natural rocky intertidal habitat supported higher diversity and abundance of intertidal organisms than the artificial seawalls. The most frequently recorded species included rock oyster (*Saccostrea cucullata*), littorina snails (*Echinolittorina trochoides* and *E. radiata*), limpets (*Patelloida pygmaea* and *P. saccharina*), barnacle (*Tetraclita japonica* and *Balanus amphitrite*), sea anemone (*Spheractis cheungae*), crab (*Hemigrapsus sanguineus*) and algae (*Corallina* spp. and *Pseudulvella applanata*).

6.4.75 No infauna was recorded in the upper 5 cm of sandy substrate and from the core samples in sandy shore (at T4). However, individuals of Ghost Crab (*Ocypode ceratophthalmus*) were observed on the sandy shore during both wet and dry season surveys. A number of Ghost Crab burrow openings were also observed on the sandy shore from the quadrat sampling and walk-through surveys.

6.4.76 Survey results of the intertidal community from wet season surveys exhibited a relatively higher taxa diversity and abundance than the dry season (**Table 6.6** refers). Another noteworthy seasonal change was the significantly higher coverage and diversity of macroalgae during dry season (**Appendix 6.9** refers).

Table 6.6 Number of Taxa and Abundance of Intertidal Species Recorded during the Intertidal Surveys

	Wet Season (June 2009)					Dry Season (November 2009)				
Transect	**T1**	**T2**	**T3**	**T4**	**T5**	**T1**	**T2**	**T3**	**T4**	**T5**
No. of Taxa	24	35	30	0	30	23	27	26	1	23
	Total: 49					Total: 43				
Abundance	121	609	180	0	258	70	427	171	1	363
	Total: 1168					Total: 1032				

6.4.77 **Appendix 6.9** provides a full list of organisms recorded during both the qualitative walk-through and quantitative transect surveys during both wet and dry seasons.

6.4.78 The intertidal community supported by the natural rocky shore and artificial sloping seawall displayed similar vertical zonation patterns with predominance of rock oyster (*Saccostrea cucullata*) at the lower shore during the surveys in both seasons. The upper shore was dominated by periwinkles (*Echinolittorina trochoides* and *E. radiata*). The artificial vertical seawall near T2 was colonized by barnacles (*Tetraclita* spp. and *Balanus amphitrite*), bivalves (*Perna viridis* and *Septifer virgatus*), polychaete tube-worm (*Hydroides* spp.) and ascidians (*Styela plicata*). Other mobile fauna commonly recorded from these habitats included crabs (*Hemigrapsus sanguineus*) and Sea Slater (*Ligia exotica*).

6.4.79 The walk-through survey recorded four species of fish (*Mugil cephalus, Bathygobius fuscus, Takifugu niphobles* and *T. alboplumbeus*) in the intertidal rock pool habitat. (Refer to **Section 6.4.156** to **6.4.161** and **Table 6.12** for details).

6.4.80 Overall, all the organisms recorded during the current intertidal surveys are common and widespread in Hong Kong.

Hard Subtrata Subtidal Habitat

Literature Review

6.4.81 In Hong Kong, there is a gradient in physical conditions from the turbid estuarine waters in the west to the clear and more oceanic waters in the east. Such environmental gradient has given rise to a general gradient in distribution of coral communities in Hong Kong waters. The diversity and coverage of coral communities are generally higher in the eastern waters than the western waters because of a favourable oceanic environment. The eastern waters are free from the influence of estuarine water from the Pearl River. The assessment area encompasses a portion of Hong Kong eastern, south-eastern coastal waters and the Victoria Harbour which belong to the oceanic environment supposedly favourable for coral growth. However, the waters within assessment area, particularly Victoria Harbour and Junk Bay are subject to higher level of anthropogenic influence (e.g. pollution and reclamation) than the eastern waters in Hong Kong.

Hard Coral

6.4.82 In general, the hard coral communities in Hong Kong are categorized into four generic community types (AFCD, 2004):

- Type A *Platygyra* – Favia community: clear shelter waters with low turbidity and

sediment and high salinity;

- Type B *Acropora solitaryensis – Montipora peliformis* community: more exposed areas of moderate to high water clarity and salinity and low sediment; and
- Type C *Psammocora – Schizoporella (bryozoans)* community: harsh water with high turbidity and sediment and low salinity, mainly western water in Hong Kong;
- Type D *Porites deformis – Cyphastrea* community: deeper communities – moderate water clarity and sediment deposition.

The hard coral communities within the assessment area largely belong to communities Types A, B and D.

Octocoral / Soft Coral

6.4.83 Octocorals / soft corals tend to inhabit deep and more turbid water with relatively higher water current where hard coral cover is generally low (Fabricius & Alderslade, 2001). The soft coral communities of Hong Kong are found to be largely restricted to west-southern waters (e.g. Po Toi, Beaufort Island, Hei Ling Chau, Soko Island, Peng Chau etc.). Key indicator species included *Dendronephthya* spp., *Guaiagorgia* spp. and *Stereonephthea* spp. and undescribed species of nephtheid soft coral (AFCD, 2004).

6.4.84 From the HATS Coral Dive Survey (EPD, 2004), the best octocoral diversity and percentage coverage in the assessment area was at Ngan Wan (Cape Collinson) where 14 genera were recorded.

Black Coral

6.4.85 Local literature on distribution and ecology of black coral is scarce. Two genera of black corals, *Antipathes* and *Cirripathes* with three respective species were first recorded from the Sai Kung Peninsula by Zhou and Zhou (1984). Subtidal distribution of these antipatharians lies mainly in depth ranged of -10 m to -20 m C.D.

6.4.86 Other more recent records of black coral in Hong Kong include the occasional sighting at -6 m to -15 m C.D. (Binnie, 1995), and records in extensive communities scale in shallow water along the coastline on both sides of Tolo Channel, particularly towards Mirs Bay (Asiatic Marine, 2002). The dominant *Antipathes* species in Hong Kong has been identified as *Antipathes sp. aff*. A. curvata van Pesch 1914 (HK Offshore Wind Ltd., 2009).

Coral Communities within Assessment Area

6.4.87 A number of dive surveys on the coral communities have previously been conducted within the assessment area. Generally, the hard subtidal habitat within Victoria Harbour supports sparse coverage of hard coral with low species diversity. Coral assemblages with relatively higher ecological value (e.g. higher coverage and species diversity) were fringing the natural coastline on the eastern side (e.g. natural shore near to Clear Water Bay, east coast of Tung Lung Chau, western coast of Junk Bay, Fat Tong Chau, Joss House Bay, and Tathong Channel).

6.4.88 The detailed results of the previous dive surveys at specific localities within the assessment area from the literature are summarized and presented in the following sections:

Victoria Harbour

6.4.89 On the western Victoria Harbour, records of soft coral (*Dendronephthya* sp.) and gorgonians

(*Euplexaura curvata, Echinogorgia complexa* and *Ellisella gracilis*) on the Green Island and Little Green Island on western side of Victoria Harbour were documented on the Green Island Development EIA Study (TDD, 1997). The species recorded are not rare to Hong Kong. These soft coral and gorgonians are more resistant to turbid waters than hard coral since they do not contain zooxanthallae and do not require light for photosynthesis. Therefore they can tolerate the turbid water and spread with wider range of distribution in Hong Kong.

6.4.90 The ecological condition of coral communities within the inner Victoria Harbour are presented in *Wan Chai Development Phase II and Central-Wan Chai Bypass EIA Study* (CEDD, 2007a), *Kai Tak Development EIA Study* (CEDD, 2007c) and *XRL EIA Study* (MTR Corporation Ltd., 2009). The survey results revealed the occurrence of tolerant coral species (e.g. *Oulastrea crispata, Echinomeuricia* spp. and *Balanophyllia* spp.) with low coverage (< 1% to 5%) on the subtidal artificial seawall within the Harbour Area. These species are especially adapted to harsh environment and can be found in many places in Hong Kong.

6.4.91 In summary, the coral assemblages within Victoria Harbour were restricted to low coverage of a few tolerant coral species, reflecting the low carrying capacity of corals within the harbour region. Possible factors include the high water turbidity and lack of natural hard substratum.

Tathong Channel

6.4.92 The hard subtidal habitats fringing along the coastlines on north (Ngan Wan and Joss House Bay) and south (Tung Lung Chau) sides of Tathong Channel were previously investigated in 2003 and 2007 with survey results reported in *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004) and *Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study* (HK Offshore Wind Ltd., 2009), respectively. These areas were found to support relative better growth of coral than that within the Victoria Harbour.

Joss House Bay

6.4.93 Among these coastal communities, a rich coral community was recorded at East Joss House Bay where a community of 23 coral species with 10 – 25% coverage and *Platygyra acuta* being the dominant hard species was recorded. Abundance of octocoral (soft / gorgonian corals) at this location was relatively low (<5%) in the channel (EPD, 2004). The same surveys recorded only low hard coral abundance (<5% hard coral with absence of soft / gorgonian) at West Joss House Bay. A total of eight hard coral species were recorded, of which *Cyphastrea serailia* was the most dominant species (EPD, 2004).

Tung Lung Chau

6.4.94 With similar hard coral cover (10-25%) as the East Joss House Bay, shallow subtidal hard substratum of North Tung Lung Chau only support 7 hard coral species dominated by the genus *Favites*. Only scattered and sparse cover (<5% cover) of octocoral was recorded (EPD, 2004).

6.4.95 Only <1% of hard coral coverage and approximately 5% octocoral coverage were recorded from west coast of Tung Lung Chau (EPD, 2004). Four hard coral (*Porites lutea, Plesiastrea versipora, Turbinaria peltata* and *Favites* sp.) and a soft coral (*Sinularia* sp.) were recorded from the shallow zone. In deep zone, *Dendrophyllia* sp., an ahermaptypic hard coral, *Tubastrea* sp. and a gorgonian, *Euplexaura* were noted.

6.4.96 Early surveys at south Tung Lung Chau revealed only low cover (<5%) of hard corals represented by 4 species as well as low covers of soft corals and gorgonian (<5%) (EPD,

2004). A more recent survey at south Tung Lung Chau reported 5 – 25 % of hard coral cover and about 5% octocoral cover (HK Offshore Wind Ltd., 2009). Eleven species of hard coral *(Plesiastrea versipora, Cyphastrea serailia, Cyphastrea japonica, Favia helianthoides, Favia speciosa, Goniopora djiboutiensis, Goniopora stutchburyi, Porites lutea, Psammocora superficialis, Psammocora haimeana* and *Coscinaraea n.* sp.) and seven genera of octocorals (*Dendronephthya, Euplexaura, Menella, Nephthyigoria, Chironephthya, Muricella* and *Anthogoria*), pulse a number of black coral, *Cirripathes* colonies were recorded from south Tung Lung Chau during the surveys (HK Offshore Wind Ltd., 2009).

Ngan Wan

6.4.97 On the western coast of Tathong Channel, a rich and diverse soft / gorgonian coral community dominated by *Echinomericea* sp. was recorded extending from the shallow into deep region at Ngan Wan (EPD, 2004). The sea-fan, seawhip and soft coral recorded from the shallow waters were markedly larger than that from middle and deep depths and occurred with 25 – 50% of coverage. Octocoral cover from middle and deep regions was 10 – 50%. In the mean time, a hard coral community with sparse cover (<5%) comprising seven species dominated by *Goniopora stutchburyi* was recorded from the shallow water of Ngan Wan (EPD, 2004).

Junk Bay

Fat Tong Chau and nearby Reclaimed Seawall

6.4.98 Fat Tong Chau is located on the eastern side of Junk Bay and has been partially engulfed by reclaimed land. Its remaining natural subtidal habitat had been previously surveyed in 1999, 2003, 2007 and 2008 with findings presented in the *Area 131 Further Ecological Study Report* (TDD, 2001a), *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004), *Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study* (HK Offshore Wind Ltd., 2009) and *Tseung Kwan O Biodiesel Plant EIA study* (ASB Biodiesel HK Ltd., 2008), respectively.

6.4.99 In early February 1999, small Faviid hard corals, some colonies of *Tubastrea* sp., and low abundance of soft corals (*Dendronephthya* sp.) and gorgonians were recorded from Fat Tong Chau by the survey for the *Area 131 Further Ecological Study* (TDD, 2001a).

6.4.100 Subsequent surveys for *Environmental and Engineering Feasibility Assessment Study* in January 2003 recorded three hard coral species (*Porites* sp., *Cyphastrea* sp. and *Acanthastrea echinata*), one soft coral (*Dendronephthya* sp.) and six gorgonian taxa (*Echinomuricea* sp., *Menella* sp., *Guaiagorgia* sp., *Euplexaura* sp., *Anthogorgia* sp and *Echinogorgia* sp.) (EPD, 2004). The percentage of hard coral ranged from 10 to 20% and were restricted mainly to shallow water. Octocoral, however, exhibited a stratified coverage pattern along the water depths (shallow: 10-25% cover; middle: 25-50% cover; deep: <5% cover).

6.4.101 The coastal subtidal area of Fat Tong Chau was surveyed again for the *Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study* (HK Offshore Wind Ltd., 2009) in 2007. The shallow zone (-2m to -4m C.D.) supported very little coral growth, with both hard and octocoral recorded at less than 1% level. An octocoral cover of 35% was recorded in deep zone (-6m to -8m C.D.). The coral community consists of three hard corals (*Goniopora stutchburyi, Leptastrea purpurea* and *Cyphastrea serailia*), one soft coral (*Dendronephthya* sp.) and three gorgonians (*Paraplexaura* sp., *Echinomuricea* sp., *Euplexaura* sp.). No black coral colonies were found during the surveys.

6.4.102 The most recent dive survey at northern edge of Fat Tong Chau natural coastline was conducted in April 2008 for the *Tseung Kwan O Biodiesel Plant EIA Study* (ASB Biodiesel

HK Ltd., 2008). A total of five species of hard coral (*Montipora venosa, Psammocora superficialis, Turbinaria peltata, Cyphastrea serailia* and *Goniopora stutchburyi*) with 1 – 10% coverage and two species of gorgonians (*Euplexaura* sp. and *Echinomuricea* sp.) with 1 – 10% were recorded. Most of the recorded corals are common and widespread in Hong Kong water except one species, *Montipora venosa* is locally uncommon (Chan *et al*., 2004).

6.4.103 In summary, previous surveys at Fat Tong Chau indicated that this natural coastal stretch supported very limited hard corals in terms of abundance and the number of species present. Nevertheless, soft corals and gorgonians were frequent and occurred in moderate abundance.

6.4.104 The reclaimed artificial seawalls in vicinity of Fat Tong Chau were surveyed for the *South East New Territories (SENT) Landfill Extension EIA study* (EPD, 2007) and *Tseung Kwan O Biodiesel Plant EIA Study* (ASB Biodiesel HK Ltd., 2008). The pioneering hard coral species, *Oulastrea crispata* with low coverage (<1%) was the only coral recorded from this habitat.

Southwest Coast of Junk Bay (south of Chiu Keng Wan)

6.4.105 The hard subtidal habitat along the coastline stretching from south of Chiu Keng Wan to Lei Yuen Mun was surveyed under the *Area 131 Further Ecological Study* (TDD, 2001a), *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004), and *Pre-translocation Coral Survey* (Scott Wilson, 2009a) and *Baseline Post-translocation Coral Monitoring for Kai Tak Cruise Terminal Development* (Scott Wilson, 2009b).

6.4.106 Dive surveys for the *Area 131 Further Ecological Study* in February 1999 indicated very low abundance of hard coral (*Tubastrea* sp. and Faviids) along southwest coast of Junk bay (TDD, 2001a). However, an area (approximately 2.5 ha) south to this coast close to Lei Yue Mun was notable for its high abundance of soft and gorgonian corals (mainly *Dendronephthya* spp. and *Euplexaura curvata*). Colonies of black coral, (*Cirripathes* sp.) were also recorded from this area.

6.4.107 The southwest coast of Junk Bay was also surveyed in January 2003 with results documented in *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004). Hard coral communities supporting eight species (*Goniopora stutchburyi, Cyphastrea* sp., *Cyphastrea serailia, Favites pentagona, Oulastrea crispata* and *Turbinaria peltata* as well as the ahermatypic *Tubastrea* sp. and *Dendrophyllia* sp.) were confined to shallow (-2m to -5m C.D.) water with <5% cover. Soft and gorgonian corals were particularly prevalent in the middle and deep depth zones with 25 – 50% cover. Seven soft and gorgonian corals *Echinomuricea* sp., *Euplexaura* sp., *Dendronephthya* sp., *Echinogorgia* sp., *Anthogorgia* sp., *Menella* sp. and sea fans were recorded in this community.

Coral Recipient Site

6.4.108 To avoid direct loss or damage of any species of conservation interest resulting from the dredging and reclamation works of two development projects, namely *Wan Chai Development Phase II and Central-Wan Chai Bypass and Kai Tak Development*, coral translocation was recommended as a mitigation measure under the EIA studies (CEDD, 2007a; 2007c). Considering the species composition, hydrology and health condition of corals, a total of 900 m^2 sea area at southwestern coast of Junk Bay near Lei Yue Mun was proposed as the recipient sites for coral translocation for the two development projects.

6.4.109 The baseline ecological condition of the coral recipient site and translocated coral from the Kai Tak project site to the coral recipient site in Junk Bay were surveyed with findings presented in *Pre-translocation Coral Survey* (CEDD, 2009a) and *Baseline Post-translocation Coral Monitoring for Kai Tak Cruise Terminal Development* (CEDD, 2009b), respectively.

The coral recipient site *for Wan Chai Development Phase II and Central-Wan Chai* project was proposed to be near to that of *Kai Tak Development* (CEDD, 2009c).

6.4.110 Before translocation, the proposed coral recipient site for Kai Tak project at Junk Bay was found to harbor hard and soft cover of <10% and 30% respectively (CEDD, 2009a) Seven hermaptypic hard coral species (*Turbinaria peltata, Favia rotumna, Favites pentagona, Oulastrea crispata, Leptastrea purpurea, Goniopora stutchburyi* and *Goniopora* sp.), two ahermatypic hard coral species (*Tubastrea/Dendrophyllia* sp.), an unidentified cup coral species, ten octocoral species (*Anthogorgia* sp., *Cladiella* sp., *Dendronephthya* sp.A, *Dendronephthya* sp.B, *Echinogorgia* sp., *Echinomuricea* sp., *Euplexaura* sp., *Menella* sp.A, *Menella* sp.B and *Paraplexaura* sp.) and two black coral species (*Cirripathes* sp. and *Antipathes* sp.) were recorded within and adjacent to the proposed coral recipient site.

6.4.111 A total of 157 colonies of *Oulastrea crispata* were translocated to the coral recipient site at Junk Bay under the *Kai Tak Development* project (CEDD, 2009b). The baseline post-translocation monitoring indicated the majority of the translocated *O. crispata* were in good condition exhibiting no stress or damage attributed to the translocation works. The occurrence and percentage of partial mortality on the translocated coral was generally low.

6.4.112 Spot-check dive coral surveys at the proposed 10 m x 10 m recipient site at Junk Bay were also conducted under the *Wan Chai Development Phase II and Central – Wan Chai Bypass* project (CEDD, 2009c). Three species of hard coral (*Oulastrea crispata, Goniopora stutchburyi* and *Tubastrea* sp.), one soft coral (*Dendronephthya* sp.) and three species of gorgonian (*Echinomuricea* sp. A, *Echinomuricea* sp. B and *Echinogorgia* sp.) with low coverage (<1%) were recorded.

6.4.113 Although the subject of translocation, *Oulastrea crispata* is locally common and widespread, the translocated coral colonies as well as the coral recipient sites at Junk Bay are considered as ecologically sensitive receivers under the current study.

Chiu Keng Wan (northwest Junk Bay)

6.4.114 Information regarding the hard subtidal habitat along the Chiu Keng Wan coastline is available from surveys for the *Road P2 EIA Study* (CED, 2001), *Area 131 Further Ecological Study* (TDD 2001a, 2000), *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004), *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005) and *Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study* (HK Offshore Wind Ltd., 2009).

6.4.115 In October 1998, the coastline of Chiu Keng Wan was first surveyed for the *Road P2 EIA Study* (CED, 2001). It was reported five hard coral species (*Psammocora haimeana, Alveopora* sp., *Favia speciosa, Montipora* sp. and *Leptastrea purpurea*), a soft coral (*Dendronephthya* sp.), a gorgonian sea whip (*Ellisella* sp.) and two sea fans species (*Melithaea* sp. and *Plexauridae* sp.). The soft coral, *Dendronephthya* sp. was the most commonly occurring coral distributed patchily either in isolation or in small group of up to 5 to 6 colonies within an average coverage up to 18% from photo quadrats. Other subtidal marine life recorded included sponges (*Halichondria* spp.), hydroids (*Algaophenia whiteleggei*), burrowing anemones (*Entacmea quadricolor*, cf. *Discosoma* sp.) and cucamarid sea cucumber (*Colochirus crassus*). A suspected octopus midden containing broken crab carapaces were also encountered (CED, 2001).

6.4.116 The stretch of coastline was subsequently surveyed in February 1999 for the *Area 131 Further Ecological Study* (TDD 2001a, 2000). Patchy and sparse presence of hard coral in the family of faviid (mainly *Favia speciosa*), gorgonians and soft corals were recorded depths between

surface and -7.4m C.D. Black coral, *Cirripathes* sp., was also recorded from the northern edge of Chiu Keng Wan.

6.4.117 A spot-check dive survey for *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004) on coastline of Chiu Keng Wan was conducted in January 2003. Three hard coral species (*Platygyra* sp., the hermatypic *Turbinaria* sp. and *Leptastrea* sp.) and two gorgonian coral species (*Echinomuricea* sp. and *Euplexura* sp.) were recorded.

6.4.118 In September 2004, the subtidal habitat along 800 m stretch of coastline inside the proposed West Coast Road tunnel (former name of TKO-LT Tunnel) toll plaza reclamation area and additional 100 m section of coastline to the south of the proposed reclamation area were surveyed for *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005). The findings of the surveys were similar to the information obtained from the previous survey and indicated that Chiu Keng Wan coast supports sparse cover (<1%) of hard coral species (*Goniopora stutchburyi, Plesiastrea versipora, Psammocora superficialis, Oulastrea crispata, Favites pentagona, Favia* cf. *favus, Turbinaria peltata* and the ahermatypic *Tubastrea* sp.) which are common and widespread across Hong Kong. Patches of low to moderate cover (2 – 15%) of common and widespread octocorals (*Dendronephthya* sp. and *Cladiella* sp., *Echinomuricea* sp., *Menella* sp., *Euplexaura* sp. and *Echinogorgia* sp.) were also were recorded from Chiu Keng Wan. Unlike the previous survey (TDD 2001a, 2000), no black corals were found during these surveys.

6.4.119 Hard subtidal habitat along coastline of Chiu Keng Wan was investigated in 2007 with findings presented in *Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study* (HK Offshore Wind Ltd., 2009). The shallow zone (-4 m to -6 m C.D.) coral community consisted of both hard coral (<2%) and octocoral (5-10%), with the latter being more dominant. The deep zone was colonized mainly by octocoral (20 – 25 %) and black coral (<1%). A total of four hard coral species (*Favites pentagona, Turbinaria peltata, Psammocora superficialis,* and *Oulastrea crispata*) were recorded in shallow zone while no hard corals were found in deep zone. Five octocoral genera were also found in the shallow zone (*Euplexaura, Paraplexaura, Dendronephthya, Echinogorgia* and *Lobophytum*), with nine genera recorded in the deep zone (*Euplexaura, Paraplexaura, Echinomuricea, Menella, Dendronephthya, Carijoa, Scleronephthya, Astrogorgia* and *Anthogorgia*). Overall, the octocoral community was dominated by *Echinomuricea* sp. which account for 20 to 25% of total benthic cover.

Recent Survey Results

6.4.120 Following the literature review on the coral communities, dive surveys were conducted to check and update the existing condition of the hard substrata subtidal habitat of Chiu Keng Wan, particularly the area that would likely be impacted by marine works (e.g. reclamation) of the Project.

Spot-check Dive

6.4.121 In accordance with standard methodology for coral survey commonly adopted in the current EIA studies (DeVantier *et al*., 1998), spot-check dive surveys were conducted in 5 areas (**Figure 6.6** refers) in June 2009.

6.4.122 The substratum of the coastal area (Area 1 to 4) generally consist of hard seabed (e.g. natural bedrock, boulders and artificial seawall) at the shallow coastal area (down to -5 m to -7 m C.D.) and sandy/muddy bottom further seaward. The substratum of Area 5 is entirely composed of sandy and muddy bottom. Sparse cover (<1%) of hard coral from shallow water (-2 m to -4 m C.D.), and scattered colonies with patchy distribution of octocoral were recorded within Area 1 to 4 during the surveys. **Figure 6.10** presents an overview of the

coral distribution and general habitat types of the subtidal environment within the survey area.

Rapid Ecological Assessment (REA)

6.4.123 Following the spot-check dive surveys in 2009, more detailed Rapid Ecological Assessment (REA) surveys were conducted in August and September 2009 to collect more detailed quantitative information on the coral communities recorded during the spot-check dive. A total of twenty-three transects (T1 – T23) in parallel to the coastline were laid to cover the coral area at the 4 spot-check areas (Area 1, Area 2, Area 3 and Area 4) (**Figure 6.7** refers).

6.4.124 The REA surveys indicated hard coral cover was sparse (1-5%) within the Chiu Keng Wan in all depth zones. Most hard coral colonies recorded are small (< 5 cm in diameter), of encrusting growth form and attached to bedrock with occasional records of larger colonies (20-30 cm in diameter, e.g. *Favites chinensis* and *Psammocora superficialis*). More colonies of hard coral as well as the larger colonies tend to inhabit the shallow water zone (-2 m to -5 m C.D.).

6.4.125 The cover of octocoral at Chiu Keng Wan was relatively higher than hard coral, ranging from 0% to 10% with distribution of colonies largely confined to deeper water (> - 4.5 m C.D.). The highest octocoral cover of 6 – 10% was recorded at REA transect T10, at the midway of Chiu Keng Wan. The size range of octocoral colonies mainly fall within range of 5 to 30 cm in height with the largest colony sized 38 cm (*Menella* sp. A) recorded at REA transect T22. The octocoral community within the Chiu Keng Wan was dominated by *Echinomuricea* sp.

6.4.126 The REA surveys also recorded several colonies of black coral *Cirrhipathes* spp. (sized 12 – 57 cm in height) at the deep (-6 m to -8 m C.D.) zone of REA transect T10, at the midway of Chiu Keng Wan.

6.4.127 The ecological and substratum attributes of the REA transects are summarized in **Table 6.7**. The summary of the survey results on REA transects are given in **Table 6.8**. Detailed survey results for each of the REA transect are provided in **Appendix 6.10**.

Table 6.7 Ecological Attributes and Substratum of the REA Transects

Spot-check Dive Area	**Area 1**			**Area 2**							**Area 3**						**Area 4**						
REA Transect	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**	**T21**	**T22**	**T23**
Depth (m)	4	4	4	3.5	4.5	3.5	4.5	3	5	8	4	5.5	8	3.5	4.5	8.5	3.5	4.5	7	8.5	3.5	6	7.5
Ecological Attributes																							
Hard Corals	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Octocoral (soft coral and gorgonian)	0	0	0	0	0	0.5	0	0.5	0.5	1	0.5	0.5	0.5	0	0.5	0.5	0	0.5	0.5	0.5	0	0.5	0.5
Black Corals	0	0	0	0	0	0	0	0	0	0.5	0	0	0.5	0	0	0.5	0	0	0	0	0	0	0
Dead standing corals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Substratum Attributes																							
Bedrock/continuous pavement	4	4	3	4	0	4	1	4	1	0	0	0	0	4	1	1	4	1	1	0	4	1	0
Boulder Blocks (diam.>50 cm)	1	0	2	2	4	1	3	1	2	1	2	1	1	2	3	3	1	3	2	1	2	2	1
Boulder Blocks (diam.<50 cm)	1	2	1	1	2	1	1	0	2	1	1	2	1	1	1	1	1	1	1	1	1	1	2
Rubble	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soft Substrata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand	1	1	1	1	1	0	1	2	3	2	2	2	2	1	2	2	0	2	2	2	0	2	3
Mud/Silt	1	1	0	0	0	0	0	1	1	2	2	3	4	0	1	1	0	1	2	3	0	2	1

* Rank of percentage cover: 0 = None recorded; 0.5 = 1-5%; 1 = 6-10%; 2 = 11-30 %; 3 = 31-50%; 4= 51-75 %; 5 = 76-100%.

Table 6.8 Summary of the Results on Each REA Transect

Spot-check Dive Area		**Area 1**			**Area 2**							**Area 3**						**Area 4**						
REA Transect		**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**	**T21**	**T22**	**T23**
Total No. of Coral Colonies		50	56	112	76	86	83	68	126	136	250	81	105	66	79	96	132	68	88	92	62	59	103	109
No. of Coral Species		2	2	4	6	9	11	12	14	15	18	11	10	9	7	10	13	6	15	9	8	6	11	10
No. of Uncommon Coral Species		0	0	0	0	2	2	3	2	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0
No. of Rare Coral Species		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Condition of Corals	Good	32	44	90	67	79	78	68	126	128	221	81	105	57	79	96	127	68	83	79	52	57	76	88
	Fair	18	12	22	9	7	5	0	0	8	29	0	0	9	0	0	5	0	5	13	10	2	27	21
	Poor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Translocation Feasibility		10	23	27	4	12	6	10	14	39	212	11	22	43	5	17	78	5	20	74	54	1	32	75

6.4.128 A total of 35 species of corals including 15 hard corals, 13 gorgonians, 4 soft corals, two black corals and one sea pen were recorded from the survey area during the dive survey (**Table 6.9** refers). All the recorded corals are commonly found in Hong Kong waters except, three locally uncommon hard corals species *Favia helianthoides*, *Montipora mollis* and *Coscinaraea* sp. (Chan *et al*., 2005). **Table 6.9** summarizes the results on coral community recorded during the 2009 dive surveys from each area.

Table 6.9 Coral Species Recorded in the Survey Area during 2009 Dive Surveys

Coral Species	Area 1	Area 2	Area 3	Area 4	Area 5	Status in Hong Kong
Hard Corals						
Cyphastrea serailia		✓	✓	✓		Dominant
Favia speciosa		✓				Abundant
Favia helianthoides		✓				**Uncommon**
Favites chinensis		✓	✓	✓		Dominant
Favites acuticollis				✓		Common
Favites pentagona		✓	✓			Dominant
Coscinaraea sp.		✓				**Uncommon**
Goniopora stutchburyi	✓	✓	✓	✓		Common
Montipora mollis		✓				**Uncommon**
Oulastrea crispata	✓	✓	✓	✓		Common
Pavona decussata		✓				Abundant
Platygyra carnosus		✓	✓			Common
Psammocora superficialis	✓	✓	✓	✓		Abundant
Tubastrea sp.		✓		✓		Common
Turbinaria peltata	✓	✓	✓	✓		Common
Gorgonians						
Acanthogorgia sp. A		✓				Common
Echinomuricea sp. A		✓	✓	✓		Common
Echinomuricea sp. B		✓	✓	✓		Common
Euplexaura sp. A		✓	✓	✓		Common
Euplexaura sp. B		✓				Common
Euplexaura sp. C		✓				Common
Echinogorgia sp. A		✓	✓	✓		Common
Echinogorgia sp. B		✓		✓		Common
Leptogogia sp.		✓	✓			Common
Menella sp. A		✓	✓	✓		Common
Menella sp. B		✓		✓		Common
Paraplexaura sp. A		✓	✓			Common
Astrogorgia sp.		✓		✓		Common
Black Corals						
Cirrhipathes sp. A		✓	✓			Common
Cirrhipathes sp. B		✓				Common
Soft Corals						

Coral Species	Area 1	Area 2	Area 3	Area 4	Area 5	Status in Hong Kong
Dendronephthya sp.		✓	✓	✓		Common
Scleronephthya sp.		✓	✓	✓		Common
Cladiella sp.		✓				Common
Lobophytum sp.		✓				Common
Sea Pen						
Pteroeides sp.		✓				Common
Total No. of Coral Species	**4**	**34**	**18**	**18**	**0**	

6.4.129 In addition to coral communities, other benthic non-coral fauna and flora with low abundance and diversity were also recorded during the dive surveys. The surveyed area supported common species of benthic non-coral fauna including, rock oyster (*Saccostrea cucullata*), green mussels (*Perna viridens*), tunicates (*Styela plicata*), and sea urchins (*Diadema setosum* and *Anthocidaris crassispina*) from the hard substrates. The most abundant invertebrate recorded from the soft muddy substrates was tube anemone (*Cerianthus filiformis*). Encrusting algae *Corallina* sp. was commonly recorded on the rock surface at low littoral zone. All the fauna and flora recorded from Area 1 to Area 4 are common and widespread in Hong Kong. No other reef-associated marine life was observed from Area 5 during the dive survey.

Verification Spot-check Dive

6.4.130 As mentioned in **Section 6.3.22**, a verification spot-check dive was conducted in January 2013 at TKO. This survey covered Areas 1 to 3 and the upper portion of Area 4 where the proposed temporary barging point would be located. Survey results indicated that coral compositions were similar to that of the baseline survey undertaken in 2009.

6.4.131 The subtidal bottom substrates are composed of artificial seawall, natural bedrocks and big boulders which have remained unchanged when compared to the 2009 baseline surveys. Some small size rocks could also be found next to the slopping boulders and bedrocks. The maximum depth along the survey area is around 5 m to 9 m. Substrates beyond the maximum depth are all muddy and with visibility less than 0.5m.

6.4.132 During the recent survey, 18 species of corals were recorded, most of which are commonly found in Hong Kong with the exception of three uncommon species (*Favia helianthoides, Coscinaraea* sp., and *Montipora mollis*). Dominant species within the surveyed areas were *Oulastrea crispata*, *Goniopora stutchburyi*, *Psammocora superficialis*, *Cyphastrea serailia* and *Turbinaria peltata*. Beside the hard corals, two species of gorgonian (*Echinomuricea* sp. and *Menella* sp.) and two species of soft corals (*Dendronephthya* sp. and *Cladiella* sp.) were also recorded. Similar to the 2009 baseline surveys, this area exhibited relatively low coverage (less than 1%) and all the corals are in fair to good condition. Most of the corals are in small size (2-20cm) and only a few *Psammocora superficialis* colonies have medium size (>20cm in diameter).

6.4.133 Similar to the 2009 baseline surveys, common rock oyster *Saccostrea cucullata* was found on the surfaces of the big boulders and bedrocks. Common green mussel, *Perna viridis*, were found at shallow water in the clefts between boulders. Both species are commonly found in Hong Kong water. Common tunicate, Seaurchins *Diadema setosum* and *Anthocidaris crassispina*, tubeworm, *Sabelastarte japonica* and common tunicate *Styela plicata* were also

found at these sites. Finally, common tube anemone *Cerianthus filiformis* was also found at the muddy bottom of this area

Soft Subtrata Subtidal Habitat

Literature Review

6.4.134 Regarding ecological baseline condition the soft substrata subtidal habitat within the assessment area, literature is available from a series of previous studies. In general, the soft benthos communities with relative lower species diversity and abundance characterized by pollution tolerant polychaetes were recorded within the Victoria Harbour than within Junk Bay and Tathong Channel.

Victoria Harbour

6.4.135 A number of studies on benthic community assemblage within the Victoria Harbour have been conducted. The results indicated that the Harbour was generally of low habitat quality with low species diversity and species abundance in the past years.

6.4.136 A total of three sampling stations (Stations 52, 53 and 54) under the *Consultancy Study on Marine Benthic Communities in Hong Kong* were surveyed within the in Victoria Harbour WCZ (AFCD, 2002). The communities at these sampling stations recorded low value of species richness (d =<5) and species diversity (H' = 1-2.5). Benthic communities in Victoria Harbour was represented by polychaetes (*Cirratulus* sp., *Schistomeringos rudolphi*, *Dodecaceria* sp. and *Naineris* sp.), and bivalve (*Ruditapes philippinarum*) in summer; and by polychaetes (*Spionidae* sp., *Schistomeringos rudolphi*, *Spiophanes* sp. and *Sigambra hanaokai*), and amphipod (*Cheiriphotis megacheles*) in winter.

6.4.137 The field survey carried out by EPD (2000) for the *Strategic Sewage Disposal Scheme EIA Study* showed a very low species diversity and evenness for benthic assemblages in Victoria Harbour and was indicative of stressful environment for benthos.

6.4.138 A benthos survey was carried out for *Kai Tak Development EIA Study* at Kowloon Bay and Kwon Tong Typhoon Shelter (CEDD, 2007). A total of 54 species was found. Ninety-seven percent of the specimens were dominated by polychaete (61%) and crustacean (36%). *Eunice indica* was the most abundant species, followed by *Mediomastus* sp., *Cirriformia* sp., *Glycinde gurjanovae*, *Glycera chirori* and other species. All the species recorded are common and widespread in Hong Kong waters. The species diversity at Kowloon Bay and KTTS was low (H' = 1.05-2.31) and evenness was moderate (J = 0.55-0.89).

6.4.139 TDD (2001b) undertook benthos samplings at the seabed in the Victoria Harbour near the Central District and documented the findings in *WD II EIA Study*. No macroinvertebrate community was found and the soft bottom marine environment in the Victoria Harbour was polluted.

6.4.140 Another benthic survey was conducted by TDD (2001c) at To Kwa Wan typhoon shelter (TKWTS), Kwon Tong Typhoon Shelter and Kai Tak Approach Channel. Only two species of benthic fauna were found at TKWTS, including the dominant polychaete (*Capitella capitata*) (>99% of all collected specimens) and a juvenile Ocypodid Crab (*Macrophthalmus* sp.). The species diversity and evenness were very low (H' = 0.049; J = 0.049). No living organism was collected from KTTS and KTAC, showing that the habitat quality at these areas was very poor.

6.4.141 Further surveys on benthic communities at North Point were conducted for the *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004). Highest abundance, biomass and biodiversity of the benthic community among the surveyed sites were recorded at this site. The community was dominated by common polychaetes and mollusks, with *Ruditapes* sp. as the most dominant species. This species is a commercial species though the conservation importance is not high.

Tathong Channel

6.4.142 Ecological baseline of soft benthos communities within Tathong Channel are available in *Consultancy Study on Marine Benthic Communities in Hong Kong* (AFCD, 2002), and *Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study* (HK Offshore Wind Ltd., 2009).

6.4.143 Two sampling stations 75 and 80 under the *Consultancy Study on Marine Benthic Communities in Hong Kong* (AFCD, 2002) were surveyed within the Tathong Channel. These sampling stations within Tathong channel supported benthos communities with moderate or high species richness (d = 5-10 / >10) and species diversity (H' = 2-3 / >3). The communities surveyed within the Tathong Channel is characterized by polychaetes (*Aglaophamus dibranchis, Mediomastus* sp., *Sigambra hanaokai¸ Cossurella dimorpha, Sigambra* sp., *Ophiodromus angustifrons* and *Prionospio malmgreni*), brittle star (*Amphipodia obtecta*), shrimp (*Callianassa japonica*), crab (*Neoxenophthalmus obscurus*) and sipunculan (*Apionsoma trichocephalus*) in summer; and by polychaetes (*Mediomastus* sp., *Aglaophamus dibranchis, Sigambra hanaokai¸ Prionospio malmgreni, Prionospio ehlersi, Paraprionospio pinnata* and *Otopsis* sp.), brittle star (*Amphipodia obtecta*), crab (*Neoxenophthalmus obscurus*) and sipunculan (*Apionsoma trichocephalus*) in winter.

6.4.144 In the wet season survey, amphioxus (*Branchiostoma belcheri*), the cephalochordate of high conservation value, was recorded at sampling station 80 (AFCD, 2002), which was about 9 km away from the proposed marine works. Amphioxus is considered as rare animal because it inhabits a few scattered locations with high density of occurrence (Poss and Boschung, 1996). It can be found globally in shallow, subtidal sand flats in tropical, subtropical and temperate regions (Chen, 2007). Amphioxus is listed as Category II protected species in China (Yang *et al*., 1993).

6.4.145 Further surveys on benthic communities at Tathong Channel were conducted for the HATS Environmental and Engineering Feasibility Assessment Study (EPD, 2004). The benthic community structure was relatively stable. Similar to previous studies (AFCD, 2002), it was characterized by high abundance and biodiversity but low biomass. However, the community was dominated by small opportunistic species of polychaetes with very low conservation importance.

6.4.146 Near the sampling station 80 of the Consultancy Study on Marine Benthic Communities in Hong Kong (AFCD, 2002), the benthos habitat east to Tit Cham Chau was surveyed for the Hong Kong Offshore Wind Farm in Southeastern Waters EIA Study (HK Offshore Wind Ltd., 2009). The benthos community recorded during this survey had relative lower species richness (d = 2.76 – 3.52; H' = 0.97 – 2.53; J = 0.34 – 0.96) as compared to station 80 (d = >10; H' = 3.21 – 3.29; J = 0.72 – 0.75), and was dominated by shrimp larvae and nemertean spp. Amphioxus was not found during the survey.

Junk Bay

6.4.147 Within Junk Bay, sampling station 85 was surveyed in 2001 for the *Consultancy Study on Marine Benthic Communities in Hong Kong* (AFCD, 2002). Another three grab sampling

stations within the proposed reclamation of West Coast Road tunnel (former name of TKO-LT Tunnel) toll plaza were surveyed in more recent surveys for the *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005).

6.4.148 The results of the *Consultancy Study on Marine Benthic Communities in Hong Kong* showed that soft benthos habitat of sampling station 85 supported a low abundance of benthic infauna. The sampling recorded 114 benthic animals per m^2 with biomass of 1.62 g m^{-2}. The community was characterized by moderately disturbed community dominated by polychaetes (*Mediomastus* sp. in terms of number and *Aglaophamus dibranchis* in terms of biomass). Of the 23 species recorded, none were rare or of conservation interest.

6.4.149 *Further Development of Tseung Kwan O EIA Study* (CEDD, 2005) reported that the soft benthos community at Chiu Keng Wan was dominated by polychaetes: 36 species from 22 families, 83.1% of all specimens and 55.8% of total biomass. The polychaetes *Pseudopolydora kempi* and *Glycinde kameruniana* accounted for ~25% and 17% of all benthos species, respectively. Crustaceans accounted for 10.4% of all specimens and 24.6% of total biomass mainly due to the presence of 10 specimens of the crab *Typhlocarcinus nudus*. Overall, the survey results indicated the three surveyed stations in Junk Bay supported a disturbed benthic community of moderate diversity (*H'* = 2.49) and low abundance. No species of conservation interest were identified.

Recent Survey Results

6.4.150 The recent benthos surveys were conducted in wet season (June 2009) and dry season (November 2009) to update and verify the ecological baseline condition of soft benthos infaunal communities within Chiu Keng Wan, focusing on the area within and in vicinity of the possible reclamation area or water that would likely be impacted by marine works of the Project.

6.4.151 The collected sediments from the four sampling stations were similar in texture and composition. The sediments were grey, fine mud at all sampling sites. They consisted of about 85% silt-clay fraction (particle diameter <64 μm) and 15% coarse materials. The coarse materials included gravels, coarse sand and broken shells of mollusks and crustaceans. Mild smell of hydrogen sulphite was recorded at stations JB C and JB D during the wet season sampling.

6.4.152 A total of 94 and 149 specimens were collected in wet season and dry season respectively. Of 54 taxa recorded, 51 were identified to the genus or species level. The most diverse faunal group was polychaeta (35 species) followed by of crustacea (9 species + amphipod spp. + 1 unidentified juvenile shrimp), mollusca (4 species), sipuncula (1 species), echinodermata (1 species) and chordata (1 species). Amphipods and nemerteans were classified into two general taxa due to limited taxonomic references. Polychaetes were the most abundant phylum by number of individuals. The species diversity index *H'* ranged 2.12 – 3.03 and 2.26 – 3.11 among the sampling stations during the wet and dry season surveys respectively. There was no consistent trend in variations of the species diversity index among the sampling stations during surveys of both seasons. For species evenness index *J*, the higher variance was recorded in wet season (0.88 – 0.97) than dry season (0.91 – 0.95). However, seasonal differences in species evenness at all sampling stations were insignificant.

6.4.153 **Table 6.10** summarizes the two indices of the benthos assemblage recorded during the surveys of both seasons.

Table 6.10 Total Number of Species, Abundance, Biomass, Species Diversity and Evenness at Each Sampling Point Recorded During the Benthos Surveys

	Season	JB-A	JB-B	JB-C	JB-D
Total no. of species (spp. 0.3 m^{-2})	Wet	23	13	11	11
	Dry	19	12	21	27
Total abundance (individual m^{-2})	Wet	137	67	53	57
	Dry	113	73	133	177
Total biomass (g m^{-2})	Wet	2.91	11.72	1.37	1.73
	Dry	8.55	3.91	3.14	1.93
Species diversity (*H'*)	Wet	3.03	2.39	2.27	2.12
	Dry	2.79	2.26	2.81	3.11
Species evenness (*J*)	Wet	0.97	0.93	0.95	0.88
	Dry	0.95	0.91	0.92	0.94

6.4.154 A complete list of collected organisms is shown in **Appendix 6.11**. All the species recorded were common and no rare species or species of conservation concern were found.

6.4.155 Benthic communities are spatially divided into four groups for Hong Kong waters; Tolo Harbour, Eastern and Southern Waters, Victoria Harbour, and Deep Bay (Shin *et al*., 2004). The diversity of benthic communities surveyed in the current survey was between Eastern and Southern Waters and Deep Bay group, while the species evenness was higher than other four areas (**Table 6.11** refers). In terms of spatial comparison, the current results show that the benthos community in Chiu Keng Wan is currently healthy and comparable to clean water bodies in Hong Kong in a general sense. In terms of temporal comparison, the current diversity of benthos community in Chiu Keng Wan was similar to previous surveys conducted in 2004 for the *Further Development of Tseung Kwan O* (CEDD, 2005), but the species evenness has increased indicating a possible improvement in water quality.

Table 6.11 Comparison of Mean H' and J of Benthic Communities at Different Hong Kong Waters within Survey Area (Data after Shin et al., 2004)

	Season	Chiu Keng Wan		Tolo Harbour	Eastern and Southern Waters	Victoria Harbour	Deep Bay
		Current Survey	Further Development of TKO EIA				
H'	Wet	2.74	2.49	1.36	2.82	1.64	2.32
	Dry	2.45	-	1.42	2.87	1.79	1.46
	Average	**2.60**	-	**1.39**	**2.85**	**1.72**	**1.89**
J	Wet	0.93	0.73	0.83	0.81	0.44	0.73
	Dry	0.93	-	0.73	0.82	0.47	0.53
	Average	**0.93**	-	**0.82**	**0.82**	**0.46**	**0.63**

Pelagic Subtidal Habitat

Literature Review

Fish Communities

6.4.156 Two fish species of conservation interest, Philippine Neon Goby (*Stiphodon atropurpureum*) and Grassy Puffer Fish (*Takifugu niphobles*), were previously recorded at stream and intertidal habitat at Chiu Keng Wan during ecological surveys for *Further Development of Tseung Kwan O* (CEDD, 2005).

6.4.157 Philippine Neon Goby generally inhabit the lower and middle section of small to medium-sized streams close to the sea. This species is known to be diadromous with adults live and breed in the wet season in pure freshwater sections of coastal streams, after which the larvae drift downstream into the sea. The larvae tend to stay near the breeding stream and feed around the estuaries until they reach juvenile stage when they will travel upstream into pure freshwater section. Philippine Neon Goby has been locally recorded in a few streams in Northeast of New Territories and on Lantau Island (Chan, 2001, Lee *et al*., 2004), and is considered to be of global conservation concern by Fellowes *et al*. (2002) due to restricted and declining local, regional and global populations.

6.4.158 Grassy Puffer fish is considered to be of potential conservation interest on the basis of its "Data Deficiency" listing status under IUCN Red List of Threaten Species (IUCN, 2012). Despite its listing, *T. niphobles* has a widespread regional distribution, with records throughout the Pacific North-west region including Japan, Korea, Taiwan, China, Hong Kong and Vietnam, (Roberts, 1996). According to Sadovy & Cornish (2000), *T. niphobles* is moderately abundant in Hong Kong and is known recently from several individuals along shallow boulder shores, such as within the Cape d'Aguilar Marine Reserve. Other researchers (e.g. Yu & Yu, 2002) have also reported this species to be common in Hong Kong coastal waters.

6.4.159 Special attention was paid to ecological resources with conservation interest including the two fish species mentioned above. To address the special concern over these two fish species, survey on fish communities were conducted along the coastline of Chiu Keng Wan (**Figure 6.8** refers).

Recent Survey Results

6.4.160 Under the recent fish survey for this Project, a total of twelve fish species were recorded. Most of them were found at the coastal marine subtidal and intertidal areas. Rabbitfish (*Siganus canaliculatus*) was the most dominant fish species observed in the coastal marine subtidal habitat. *Bathygobius fuscus* were commonly recorded from intertidal rock pools dominated the intertidal area. No fishes were observed from the freshwater streams or the estuarine subtidal habitats. *Takifugu niphobles* was recorded in the form of dead bodies during the intertidal scoping survey in May 2009. All of the fish species recorded are locally common and widespread in Hong Kong. Photographic record of the fish surveys are provided in **Appendix 6.8**.

6.4.161 **Table 6.12** summarizes the fish species recorded during the fish surveys of the two studies. Philippine Neon Goby was not recorded during the fish surveys.

Table 6.12 Fish Species Recorded during the Fish Surveys

Species Name	Habitat Recorded	Status in Hong Kong	TKO-LT Tunnel Fish Survey	Cross Bay Link Fish Survey
Mugil cephalus	Coastal marine subtidal and intertidal Rock Pool	Widespread and common	✓	✓

Species Name	Habitat Recorded	Status in Hong Kong	TKO-LT Tunnel Fish Survey	Cross Bay Link Fish Survey
Bathygobius fuscus	Intertidal rock pool	Widespread and common	✓	✓
Siganus canaliculatus	Coastal marine subtidal	Widespread and common	✓	✓
Abudefduf sp.	Coastal marine subtidal	Common	✓	✓
Epinephelus sp.	Coastal marine subtidal	Common	✓	✓
Lutjianus russellii	Coastal marine subtidal	Widespread and common	✓	
Terapon jarbua	Coastal marine subtidal	Widespread and common	✓	✓
Entomacrodus stellifer lighti	Exposed rocky coastal water	Widespread and common	✓	
Pennahia anea	Coastal marine subtidal	Common	✓	✓
Leiognathus sp.	Coastal marine subtidal	Common	✓	✓
*Takifugu niphobles**	Intertidal rock pool	Common	✓	
Takifugu alboplumbeus	Intertidal rock pool	Common	✓	✓
Epinephelus awoara	Coastal waters	Moderately abundant		✓
Gerres macrosama	Coastal waters	Common		✓

Note: * This species is listed as "Data Deficient" in the IUCN Red List of threatened species (IUCN, 2012).

Marine Mammal

6.4.162 Seventeen species of cetaceans have been recorded in Hong Kong waters, but only Chinese White Dolphin (*Sousa chinensis*) and Finless Porpoise (*Neophocaena phocaenoides*) reside in Hong Kong (AFCD, 2012). Among the two resident cetacean species in Hong Kong, only the home range of Finless Porpoise coincides with the assessment area. It is protected locally by the Wild Animals Protection Ordinance (Cap. 170), and is also listed as "Vulnerable" in the IUCN Red List of Threatened Species (IUCN, 2012). Finless Porpoise is also listed in CITES Appendix I, and is listed as "Endangered" in the China Species Red List. As such Finless Porpoise is considered a species of conservation interest/concern, both locally in Hong Kong and regionally in China.

6.4.163 In Hong Kong, Finless Porpoise can be found year-round usually the southern (i.e. Po Toi, Lamma, Southeast and Southwest Lantau) and eastern (i.e. Mirs Bay, Sai Kung and Ninepins) waters of the territory (AFCD, 2012; Jefferson *et al.*, 2002). The local population also exhibited distinct seasonal variation in distribution in Hong Kong (Hung, 2008; Jefferson *et al.*, 2002). They are more commonly sighted in southern waters (i.e. South Lantau and Lamma) during winter and spring, while in summer and autumn they shift to the eastern waters to a great extent (i.e. Po Toi, Ninepins and Sai Kung).

6.4.164 Based on the best available information, waters within and adjacent to Junk Bay within the assessment area do not appear to be utilized by Finless Porpoise and are considered not

important for this species.

6.5 Evaluation of Ecological Value

6.5.1 In accordance with the EIAO-TM Annex 8 criteria, the ecological value of recorded habitats has been evaluated in **Table 6.13** to **Table 6.22** below.

Table 6.13 Ecological Value of Mixed Woodland and Disturbed Woodland within the Assessment Area

Criteria	Mixed Woodland	Disturbed Woodland
Naturalness	Mostly natural, although some fruit trees and amenity planting were recorded.	Habitat established on recently abandoned village and abandoned agricultural land.
Size	Small, 2.8 ha	Small, 10.5 ha
Diversity	Flora diversity: Low Fauna diversity: Low	Flora diversity: Low Fauna diversity: Low
Rarity	All species recorded are common and widespread in Hong Kong	Greater Coucal (*Centropus sinensis*) recorded from this habitat type.
Recreatability	Low, habitat can be recreated but would take several decades to mature.	Moderate, habitat would take 10-20 years to mature.
Fragmentation	Not fragmented	Habitat is surrounded on all sides by high-density urban development.
Ecological Linkage	Not functionally linked to any highly valued habitat in close proximity	Not functionally linked to any highly valued habitat in close proximity
Potential Value	Moderate	Low-moderate
Nursery Ground	No significant records	No significant records
Age	The woodland is probably several decades old	Habitat is probably 10-20 years old
Abundance / Richness of Wildlife	Low-moderate	Low
Ecological Value	**Low-moderate**	**Low**

Table 6.14 Ecological Value of Grassland/Shrubland Mosaic and Village/Orchard within the Assessment Area

Criteria	Grassland/Shrubland Mosaic	Village/Orchard
Naturalness	Largely natural with some disturbance from occasional hill fire	Man-made habitat
Size	Moderate, 94.0 ha	Small, 4.1 ha
Diversity	Flora diversity: Moderate Fauna diversity: Moderate	Flora diversity: Low Fauna diversity: Low
Rarity	One flora species of conservation interest, Bamboo Orchid (*Arundina graminifolia*) were recorded. Black Kite (*Milvus migrans*), Greater Coucal (*Centropus sinensis*), Zitting Cisticola (*Cisticola juncidis*), Collared Crow (*Corvus torquatus*), Large Banded Swift (*Pelopidas subochraceus*) were recorded from this habitat type.	Black Kite (*Milvus migrans*) was recorded from this habitat type.
Recreatability	Moderate	High
Fragmentation	Habitat mostly fragmented by urban developed area	Not fragmented
Ecological Linkage	Not functionally linked to any highly valued habitat in close proximity	Not functionally linked to any highly valued habitat in close proximity
Potential Value	Low-moderate	Low
Nursery Ground	No significant record	No significant record
Age	N/A	N/A
Abundance / Richness of Wildlife	Moderate	Low
Ecological Value	**Low-moderate**	**Low**

Table 6.15 Ecological Value of Plantation and Wasteland / Developed Area within the Assessment Area

Criteria	Plantation	Wasteland / Developed Area
Naturalness	Man-made habitat	Man-made habitat
Size	Moderate, 62.5 ha	Large, 283.5 ha
Diversity	Flora diversity: Low-moderate Fauna diversity: Low-moderate	Flora diversity: Low-moderate Fauna diversity: Low
Rarity	Black Kite (*Milvus migrans*) and Greater Coucal (*Centropus sinensis*) were recorded from this habitat.	Chinese Pond Heron (*Ardeola bacchus*) and Eastern Buzzard (*Buteo buteo*) were recorded from this habitat.
Recreatability	High	High
Fragmentation	Not fragmented	Not fragmented
Ecological Linkage	Not functionally linked to any highly valued habitat in close proximity	Not functionally linked to any highly valued habitat in close proximity
Potential Value	Low	Low
Nursery Ground	No significant record	No significant record
Age	N/A	N/A
Abundance / Richness of Wildlife	Low	Low
Ecological Value	**Low**	**Very low**

Table 6.16 Ecological Value of Pond and Stream within the Assessment Area

Criteria	Pond	Streams (1, 2, 3 and 4)
Naturalness	Man-made habitat	Natural in nature but disturbed by pollution and fragmentation
Size	Small, 1.0 ha	Small, 0.1 ha (Length: 782 m) with width ranging from 1 to 2 m
Diversity	Flora diversity: Low Fauna diversity: Low	Flora diversity: Low Fauna diversity: Low
Rarity	Black Kite (*Milvus migrans*) was recorded from this habitat	All species recorded are common and widespread in Hong Kong, though it is a potential habitat for Philippine Neon Goby
Recreatability	High	Low
Fragmentation	Moderate, habitat only encompasses a small portion of assessment area.	High
Ecological Linkage	Not functionally linked to any highly valued habitat in close proximity	Not functionally linked to any highly valued habitat in close proximity
Potential Value	Low	Low
Nursery Ground	No significant record	No significant record
Age	N/A	N/A
Abundance / Richness of Wildlife	Low	Low
Ecological Value	**Low**	**Low**

Table 6.17 Ecological Value of Intertidal Habitat (Natural Rocky Shore) within the Assessment Area

Criteria	Intertidal Habitat (Natural Rocky Shore)		
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay (Eastern coast)**	**Victoria Harbour WCZ**
Naturalness	Mostly natural, relatively undisturbed	Natural, but subject to high level of disturbance by human activities, reclamation and construction works	Natural, but subject to high level of disturbance by human activities, reclamation and construction works
Size	Moderate	Small	Very small
Diversity	Moderate	Low-moderate	Low
Rarity	One fish species (Grassy Puffer Fish, *Takifugu niphobles*) and four bird species (Little Egret, *Egretta garzetta*; Pacific Reef Egret, *Egretta sacra*; Grey-tailed Tattler, *Heteroscelus brevipes*; Sanderling, *Calidris alba*) of conservation interest were recorded.	No rare species were recorded	No rare species were recorded
Recreatability	Habitat is moderately recreatable. Intertidal biota may recolonize hard substrata shores	Habitat is moderately recreatable. Intertidal biota may recolonize hard substrata shores	Habitat is moderately recreatable. Intertidal biota may recolonize hard substrata shores
Fragmentation	Low, natural rocky shore fragmented by small segments of sandy shores	Highly fragmented by artificial seawall currently formed by reclamation.	Highly fragmented. The intertidal habitats within Victoria Harbour are dominated by artificial intertidal habitats (e.g. vertical seawall)
Ecological Linkage	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity
Potential Value	Low	Low	Very low
Nursery Ground	One rock pool within the rocky shore habitat is apparently used for spawning of *Takifugu niphobles*. However this	No significant record	No significant record

Criteria	Intertidal Habitat (Natural Rocky Shore)		
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay (Eastern coast)**	**Victoria Harbour WCZ**
	species is widespread in Hong Kong waters, and breeding populations in Junk Bay are not thought to be of particular conservation significance.		
Age	N/A	N/A	N/A
Abundance / Richness of Wildlife	Moderate	Low-moderate	Low
Ecological Value	**Low to moderate**	**Low**	**Low**

Table 6.18 Ecological Value of Intertidal Habitat (Sandy Shore) within the Assessment Area

Criteria	Intertidal Habitat (Sandy Shore)	
	Western Coast of Junk Bay	**Remaining Part of the Assessment Area**
Naturalness	Largely natural, relatively undisturbed by human activities	Natural, but subject to high level of disturbance by human recreation activities
Size	Small	Small
Diversity	Very low	Very Low
Rarity	No rare species were recorded	No rare species were recorded
Recreatability	Habitat is readily re-creatable	Habitat is readily re-creatable
Fragmentation	Moderate, sandy shores form a small portion of intertidal habitat along the coastline of western Junk Bay	Highly fragmented. Sandy shores only encompasses very small portions of the intertidal habitat within the assessment area
Ecological Linkage	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity
Potential Value	Low	Low
Nursery Ground	No significant record	No significant record

Age	N/A	N/A
Abundance / Richness of Wildlife	Very low	Low
Ecological Value	**Low**	**Low**

Table 6.19 Ecological Value of Intertidal Habitat (Artificial Seawall) within the Assessment Area

Criteria	**Intertidal Habitat (Artificial Seawall)**		
	Within or in Vicinity of the Project Site (Western Coast of Junk Bay)	**Remaining Part of the Junk Bay**	**Victoria Harbour**
Naturalness	Artificially made, mostly constructed by reclamation	Artificially made, mostly constructed by reclamation	Artificially made , mostly constructed by reclamation
Size	Small	Moderate	Large
Diversity	Low	Low	Low
Rarity	Species assemblages similar to rocky shore. No records of species of conservation interest	Species assemblages similar to rocky shore. No records of species of conservation interest	Species assemblages similar to rocky shore. No records of species of conservation interest
Recreatability	High. Man-made habitat can be readily recreated. Intertidal biota may readily recolonise the artificial seawall	High. Man-made habitat can be readily recreated. Intertidal biota may readily recolonise the artificial seawall	High. Man-made habitat can be readily recreated. Intertidal biota may readily recolonise the artificial seawall
Fragmentation	Not Fragmented	Not Fragmented	Not Fragmented
Ecological Linkage	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity
Potential Value	Low	Low	Low
Nursery Ground	No significant Record.	No significant Record.	No significant Record.
Age	N/A	N/A	N/A

Criteria	Intertidal Habitat (Artificial Seawall)		
	Within or in Vicinity of the Project Site (Western Coast of Junk Bay)	**Remaining Part of the Junk Bay**	**Victoria Harbour**
Abundance / Richness of Wildlife	Low	Low	Low
Ecological Value	**Low**	**Low**	**Low**

Table 6.20 Ecological Value of Hard Substrata Subtidal Habitat within the Assessment Area

Criteria	Hard Substrata Subtidal Habitat			
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
Naturalness	Mostly natural	Mostly artificial with small portion of natural shore	Mostly natural	Mostly artificial
Size	Small habitat size with low to moderate coral coverage distributed along the natural coastline of western coast of Junk Bay	Small habitat size with low to moderate coral coverage mainly restricted to natural coastline at Fat Tong Chau	Moderate habitat size with moderate to high coverage at a restricted number of sites such as Joss House Bay, Tung Lung Chau	Large habitat size with limited extent and low coverage of coral
Diversity	**Southwest Coast of Junk Bay** Low to moderate coral diversity (3-8 hard coral spp., 4-10 octocoral taxa, 2 black coral spp.) **Chiu Keng Wan**	**Fat Tong Chau** Low to moderate coral diversity (3-5 hard coral spp., 2-4 octocoral taxa) **Artificial Seawall** Low coral diversity	Moderate coral diversity at Joss House Bay, Tung Lung Chau, and Ngan Chau (4-23 hard coral spp., 3-8 octocoral taxa	Low

Criteria	Hard Substrata Subtidal Habitat			
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
	Low to moderate coral diversity (3-15 hard coral spp., 2-17 octocoral taxa, 1 black coral spp.)			
Rarity	No rare species recorded	No rare species recorded	No rare species recorded	No rare species recorded
Recreatability	Low to moderate, coral recolonization may occur and take 5 -10 years to recover to the natural communities Shorter period required for recolonization on artificial seawall	Low to moderate, coral recolonization may occur and take 5 -10 years to recover to the natural communities Shorter period required for recolonization on artificial seawall	Low to moderate, coral recolonization may occur and take 5 -10 years to recover the natural communities	Moderate, coral may recolonize the hard substrata subtidal habitat
Fragmentation	Not fragmented	Not fragmented	Not fragmented	Not fragmented
Ecological Linkage	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity
Potential Value	**Southwest Coast of Junk Bay** Moderate due to the presence of ~2.5 ha area of high gorgonian and soft coral cover **Chiu Keng Wan** Low to moderate, with relative more diverse but lower	Low, due to limited extent of coral coverage	Moderate, due to the high coverage and moderate coral diversity particularly at Joss House Bay and Tung Lung Chau	Low

Criteria	Hard Substrata Subtidal Habitat			
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
	coverage of coral than the southwest coast of Junk Bay			
Nursery Ground	No significant record			
Age	N/A	N/A	N/A	N/A
Abundance / Richness of Wildlife	**Southwest Coast of Junk Bay** Hard coral: low to moderate (<5-<10%) Octocoral & Black Coral: moderate to high (25 – 50%) **Chiu Keng Wan:** Hard Coral: low to moderate (<1–10%) Octocoral & Black Coral: low to moderate (<1 – 25%)	Hard coral: low to moderate (<1-20%) Octocoral: moderate to high (<5-50%)	Hard coral: low to moderate (<5 – 25%) Octocoral: moderate to high (<5 – 50%)	Generally low with coverage of (< 1% to 5%)
Ecological Value	**Southwest Coast of Junk Bay: Moderate** **Chiu Keng Wan:** **Low to moderate**	**Low**	**Low to moderate**	**Very Low**

Table 6.21 Ecological Value of Soft Substrata Subtidal Habitat within the Assessment Area

Criteria	Soft Substrata Subtidal Habitat			
	Within or in Vicinity of the Project Site (proposed reclamation area)	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
Naturalness	Habitat disturbed by pollution and coastal development	Habitat disturbed by pollution, fisheries and coastal development	Habitats have been subjected to anthropogenic disturbance from urban development and are under the influence of water pollutants from local urban discharges	Habitats have been subjected to high degree of disturbance from urban development and fisheries and are under the influence of water pollutants from Pearl River and local urban discharges
Size	Habitat is small in extent	Habitat is moderate in extent	Habitat is large in extent	Habitat is large in extent
Diversity	Moderate	Moderate	Moderate to high	Low
Rarity	No rare species recorded	No rare species recorded	Amphioxus *Branchiostoma belcheri* was previously found in Tathong Channel (AFCD, 2002)	No rare species recorded
Recreatability	High, benthic organisms may recolonize disturbed seabed area.	High, benthic organisms may recolonize disturbed seabed area.	Moderate, benthic organisms may recolonize disturbed sea area. Amphioxus *Branchiostoma belcheri* inhabited in a few scattered locations.	High, benthic organisms may recolonize disturbed seabed area.
Fragmentation	Not fragmented	Not fragmented	Not fragmented	Not fragmented
Ecological Linkage	Not structurally and functionally linked to any highly valued habitat in close proximity	Not structurally and functionally linked to any highly valued habitat in close proximity	Functionally linked to highly valued habitat where Amphioxus *Branchiostoma belcheri* was found.	Not structurally and functionally linked to any highly valued habitat in close proximity
Potential Value	Low. It is unlikely that soft substrata habitat will develop conservation value.	Low	Moderate due to presence of Amphioxus *Branchiostoma belcheri*	Low

Criteria	Soft Substrata Subtidal Habitat			
	Within or in Vicinity of the Project Site (proposed reclamation area)	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
Nursery Ground	No significant record	No significant record	No significant record	No significant record
Age	N/A	N/A	N/A	N/A
Abundance / Richness of Wildlife	Low	Low	Low to moderate	Low
Ecological Value	**Low**	**Low**	**Low to moderate**	**Low**

Table 6.22 Ecological Value of Pelagic Subtidal Habitat within the Assessment Area

Criteria	Pelagic Subtidal Habitat
Naturalness	Habitat disturbed by pollution and coastal development
Size	Large
Diversity	Low
Rarity	No rare species recorded
Recreatability	Moderate
Fragmentation	Not fragmented
Ecological Linkage	Not structurally and functionally linked to any highly valued habitat in close proximity
Potential Value	Low
Nursery Ground	No significant record
Age	N/A
Abundance / Richness of Wildlife	Low
Ecological Value	**Low**

6.5.2 The species of conservation interest recorded in the assessment area are summarized in **Table 6.23**.

Table 6.23 Species of Conservation Interest Recorded within the Assessment Area during Recent Surveys

Species	Locations of Record	Protection Status	Distribution in Hong Kong
Flora			
Bamboo Orchid *Arundina graminifolia*	Grassland/shrubland mosaic habitat above the TKO Chinese Permanent Cemetery	Listed under Cap. 96 and Cap 586	Locally very common
Avifauna*			
Little Egret *Egretta garzetta*	Natural Rocky Shore at Chiu Keng Wan	PRC, (RC)[1]	Common
Pacific Reef Egret *Egretta sacra*	Natural Rocky Shore at Chiu Keng Wan	(LC) [1]	Uncommon
Chinese Pond Heron *Ardeola bacchus*	Near a construction site at TKO	PRC, (RC) [1]	Common
Black Kite *Milvus migrans*	Various habitats within assessment area	(RC) [1], Class II[2]	Common
Eastern Buzzard *Buteo japonicus*	Developed area near TKO cemetery	Class II[2]	Common
Grey-tailed Tattler *Tringa brevipes*	Natural Rocky Shore at Chiu Keng Wan	LC[1]	Common
Sanderling *Calidris alba*	Natural Rocky Shore at Chiu Keng Wan	LC[1]	Uncommon
Greater Coucal *Centropus sinensis*	Various habitats within assessment area	Class II[2]	Common
Zitting Cisticola *Cisticola juncidis*	Grassland/shrubland mosaic habitat above Cha Kwo Ling Tsuen	LC[1]	Common
Collared Crow *Corvus torquatus*	Various habitats within assessment area	LC	Uncommon

Species	Locations of Record	Protection Status	Distribution in Hong Kong
Coral community			
Hard Corals (15 spp.)	Hard substrata subtidal habitat at Chiu Keng Wan	All hard corals (in order Scleractinia) and black corals are protected under local regulation (Cap586).	Mostly common except three uncommon species (*Favia helianthoides*, *Coscinaraea* sp. and *Montipora mollis*)
Black Corals (2 spp.)			Common
Octocoral (4 soft coral spp., 13 gorgonian)		N/A	Common
Fish Community			
Grassy Puffer Fish *Takifugu niphobles*	Dead stranded bodies recorded from the natural rock shore at Chiu Keng Wan	IUCN Red List data deficient	Common

Notes:

* All wild birds are protected under the Wild Animals Protection Ordinance (Cap. 170).

1. Fellowes *et al.* (2002); RC=Regional Concern; LC=Local Concern; PRC=Potential Regional Concern. Letter in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
2. List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989)

6.5.3 Based on the ecological baseline condition as evaluated in the above tables, most of the terrestrial habitats within the assessment area are of very low to low-moderate ecological value due to their disturbed nature and low diversity of flora/fauna. Most species recorded are common and widespread in Hong Kong.

6.5.4 Intertidal habitats within the assessment area, except the natural rocky shore on western coast of Junk Bay (near Chiu Keng Wan), are generally considered low in ecological value given the high level of human disturbance and low diversity and abundance of wildlife recorded. However, the natural rocky shore on western coast of Junk Bay is considered to have low to moderate ecological value owing to its relative undisturbed nature and the record of a species of potential conservation interest *Takifugu niphobles*.

6.5.5 Ecological value of hard substrata subtidal habitats along southwest coast of Junk Bay and Chiu Keng Wan are considered moderate and low to moderate respectively mainly due to the record of diverse and abundant coral coverage along the natural coastline. With relative lower abundance/coverage of coral recorded, the ecological value of hard substrata subtidal habitats in Tathong Channel is considered low to moderate. Victoria Harbour only supported low diversity and sparse cover of locally common coral (mainly *Oulastrea crispata*), and thus is considered to have very low ecological value.

6.5.6 The soft substrata subtidal habitat in Tathong Channel is considered to be of low to moderate ecological value due to the record of species of conservation interest Amphioxus, *Branchiostoma belcheri*. However, the ecological value of the soft substrata habitat in the areas outside of Tathong Channel is ranked as low.

6.5.7 Similar to any other marine ecological habitats, pelagic habitat within the assessment area is under various disturbances such as pollution and coastal development. Low diversity and abundance of associated wildlife was recorded from the pelagic habitat within the assessment area. Ecological value of pelagic habitat is thus considered to be low.

6.6 Identification, Prediction and Evaluation of Environmental Impacts

Construction Phase

Direct Impacts – Land-based Construction

Habitat and Vegetation Loss

6.6.1 Terrestrial habitats falling within the footprint of proposed aboveground works (including roads, tunnel portals, stock piling area, site office and ancillary structures) in the assessment areas would be directly and permanently impacted. The approximate areas of directly affected terrestrial habitats are summarized in **Table 6.24** below.

Table 6.24 Direct Terrestrial Habitat Loss Resulting from Proposed Works

Habitat Type	Area Loss (ha)	Percentage of Total Area Affected (%)
Mixed Woodland	-	-
Disturbed Woodland	-	-
Grassland/Shrubland Mosaic	2.0	12%

Habitat Type	Area Loss (ha)	Percentage of Total Area Affected (%)
Village/Orchard	<0.1	<1%
Plantation	1.8	11%
Pond/Stream	-	-
Wasteland/Developed Area	12.1	75%
Artificial Seawall	0.2	<1%
Natural Rocky Shore	0.1	<1%
Total	**16.3 ha**	**100%**

6.6.2 The majority of the temporary works areas (e.g. site depot and conveyor belt, etc.) occur within wasteland/developed area, followed by plantation and grassland/shrubland mosaic and a small area of natural rocky shore and village/orchard. In general, most of the loss would occur in habitats with low or low to moderate ecological value and thus it is considered minor in scale.

6.6.3 The proposed aboveground works would unavoidably require removal of certain existing vegetation in grassland/shrubland and plantation habitats. Floral diversity in these habitats are moderate and low to moderate respectively. The total area of vegetated habitat to be removed amounts to 3.8 ha (including 2.0 ha of grassland/shrubland and 1.8 ha of plantation). The age of the grassland/shrubland habitat is relatively young, dominated by native pioneer trees, shrubs, ferns, grasses and herbs. Whilst, vegetation in plantation habitat is dominated by exotic tree species like *Acacia confusa, Bauhinia blakeana* and *Eucalyptus* spp. The removal of vegetation and destruction of habitat would cause a loss of foraging, roosting or possible breeding habitat. Since the vegetation lost in these two habitats confined to some common species and other grassland/shrubland and plantation habitats are nearby and available for associated fauna, impacts due to the vegetation loss are therefore considered to be minor.

6.6.4 One flora species of conservation interest, Bamboo Orchid, was recorded at the grassland/shrubland mosaic habitat which links to the works area of the proposed portal. There is a possibility that it could be found within the works area, and would be directly impacted by the proposed works. Although it is protected under local legislation, it is also commonly found in Hong Kong.

6.6.5 Considering the relatively small size of affected habitats, no adverse impact due to direct loss of habitat and vegetation is expected. However, mitigation measures to minimize the impact on plant species of conservation interest are recommended (refer to **Section 6.8.3**).

Direct Impacts – Marine-based Construction

Habitat and Fauna Loss

6.6.6 Reclamation and bridge piers would lead to direct permanent loss of marine habitat and associated organisms, while marine works area and construction of barging points at Cha Kwo Ling and Chiu Keng Wan would result in temporary loss of marine habitat.

6.6.7 Reclamation at Road P2 and the installation of bridge piers would result in a permanent loss of approximately 3.6 ha of subtidal habitats around Chiu Keng Wan (3 ha due to reclamation, 0.6 ha due to bridge piers). In addition, 540 m artificial seawall intertidal habitat would be permanently replaced by the reclaimed land at P2 Road.

6.6.8 The recent dive surveys indicated that the affected hard substrata subtidal habitat within the proposed reclamation area supports a low diversity and sparse coverage (<1%) of 12 hard coral species. The surveyed areas were largely dominated by pioneer species *Oulastrea crispata* (Spot-check Area 1 and Area 2, and REA transects T1 to T3, T5 and T7 refer). Low quantity of small sized (7 – 15 cm) uncommon coral (*Coscinaraea* sp., *Favia helianthoides* and *Montipora mollis*) were also found. These affected hard substrata subtidal habitat and coral colonies are considered to be of limited ecological value. The soft substrata and pelagic subtidal habitats and the artificial seawall intertidal habitat within or in vicinity of the proposed reclamation area are ranked as low in ecological value. Furthermore, these areas are not considered to be important habitats for marine mammals. Hence, the direct loss of subtidal habitats and artificial seawall intertidal habitat resulting from the proposed reclamation would not lead to significant adverse direct impact on the marine ecological system in the Project area and its vicinity.

6.6.9 Hard substrata subtidal habitat within the footprint of the bridge piers (Spot-check Area 2 and REA transects T8 to T10 refer) supports a more diverse (30 species) and higher coverage (hard coral: 1-5%, octocoral: 1-10%) of coral assemblages with 2 uncommon coral species recorded (*Coscinaraea* sp. and *Montipora mollis*). In view of small size of the hard substrata subtidal habitat affected (0.6 ha) and low coral coverage, impact due to loss of hard coral is considered to be low to moderate. Mitigation measures to minimize the direct loss on uncommon hard corals are required.

6.6.10 The installation of barging points at Chiu Keng Wan and Cha Kwo Ling coastal area would also lead to a temporary loss of subtidal marine habitats of approximately 0.3 ha. The subtidal habitat within the footprint of the barging point at Chiu Keng Wan supports low to moderate value of coral species, while the subtidal habitat at Cha Kwo Ling barging point supports subtidal habitat of very low ecological value. These habitats and the associated benthic and intertidal organisms would be affected.

6.6.11 The construction of barging point at TKO would also result in a small loss of natural rocky shore. Non-mobile fauna (such as those found on natural rocky shore habitats) would experience habitat loss for the duration of construction phase and would be able to re-establish upon the completion of the Project when the barging point is decommissioned.

Indirect Impact – Land-based Construction

Noise/Vibration, Disturbance Impact, Construction Dust and Site Runoff

6.6.12 The proposed tunneled section would be approximately 2.4 km in length and would be constructed, at depth ranging from 15 m to 180 m below ground, under various habitats such as disturbed woodland, grassland/shrubland mosaic, stream, village/orchard and developed area/wasteland. Starting from the TKO side, the tunnel will enter the tunnel portal from grassland/shubland mosaic habitat near the northern coast of Chiu Keng Wan. It then runs under Chiu Keng Wan Shan and passes under O King Street and its surrounding plantation habitats. Upon passing under O King Street, the tunnel continues under a grassland/shrubland mosaic slope, this is also where the tunnel is at its greatest depth of 180 m below ground. Continuing due west, the tunnel depth slowly decreases, it runs under the developed areas of Kwong Tin Estate. After passing under the disturbed woodland and Lei Yue Mun Road, the tunnel finally reaches its tunnel portal and surfaces above ground just south of Sai Tso Wan Recreation Ground. The majority of the tunnel runs beneath grassland/shrubland mosaic habitat of low to moderate value. The tunnel would be constructed by drill-and-blast method, which could cause noise and vibration disturbance to the habitats and associated fauna above. The proposed frequency of tunnel blasting is once

per day for the duration of 13 months (refer to **Section 2**). Since the tunnel is proposed to be constructed at a depth of up to 180 m, with most of the tunneled area being at least 20 m below ground surface, blasting is not expected to cause significant disturbance to the terrestrial habitats above (refer to **Section 4**).

6.6.13 The Project might have indirect impacts to terrestrial habitats and associated fauna adjacent to works areas during construction phase. Increased human activities/disturbance such as noise-generating construction plant could disturb wildlife utilizing habitats close to the works areas. Potential disturbance may lead to the avoidance of areas adjacent to the works area, and reductions in wildlife density close to the source of disturbance.

6.6.14 Other indirect impacts include dust deposition and increased sedimentation due to construction site runoff, disturbance from improper storage or dumping of construction materials, potential spillage of oils/chemicals.

6.6.15 Dust generated during the construction phase, if not effectively controlled, could impact vegetation and habitats adjacent to works areas. Dust covering leaves can lead to lethal/non-lethal impacts due to a reduction in photosynthetic rates, abrasion and blocking of stomata.

6.6.16 The works area near the tunnel portal at the TKO side covers the area of Stream 4, where indirect impact is expected. This includes increased sedimentation and accidental spillage that could impact aquatic communities in streams and pelagic subtidal habitats within and downstream of the proposed works areas. Adverse effects on aquatic communities due to increase in sedimentation may include physical damage by large suspended particles, clogging of respiratory and feeding organs, and inhibiting photosynthetic activities of aquatic plant. Potential spillage of oils/chemical could also lead to direct lethal/non-lethal effect. However, the ecological value of Stream 4 is low and only supports a low abundance of common species.

6.6.17 Overall, the indirect impact to the terrestrial habitat in vicinity of the proposed construction works areas is expected to be minor considering that the ecological value of these affected habitats were of low or low to moderate ecological value. Most of the habitats close to the proposed construction works areas were either highly urbanized or disturbed by human activities and thus would be unlikely to have valuable or important roosting / breeding habitat for wildlife. Therefore, indirect ecological impacts arising from proposed construction works on the wildlife associated with / recorded from these habitats are considered to be minor.

6.6.18 These indirect impacts would be short-term and temporary in nature (approximately 4.5 years). The impacts of construction noise, dust, site runoff, improper dumping activity and oil/chemical spillage could be avoided or minimized through implementation of appropriate mitigation measures and good-site practices (**Sections 6.8.3** to **Section 6.8.5.** refer). With the proper implementation of these mitigation measures, unacceptable indirect impacts are not anticipated.

Hydrological Disruption

6.6.19 The proposed tunnel would be constructed by drill and blast method, and operate underground at Chiu Keng Wan Shan. Inflow of water into underground works area of tunnels might occur during excavation, if not properly controlled. This could in turn affect ground water levels beyond the excavation zone. Potential impacts of groundwater drawdown may include depletion of groundwater sources and drying out of streams or ponds.

The wildlife dependant of these habitats might lose their foraging, roosting or breeding grounds due to habitat degradation.

6.6.20 The tunnel would be a deep tunnel driven under mountainous terrain. According to the results of the geotechnical assessment, groundwater inflow would not be significant especially with the implementation of mitigation measures. The drained tunnel construction method with groundwater inflow control measures would generally be adopted. A range of groundwater control criteria would be implemented to ensure that the groundwater drawdown is within acceptable limits based on consideration of various factors, including constructability, ground settlement, ecological effect, etc. The amount of groundwater drawdown would be predicted based on the geological conditions, the hydrogeological model and the design groundwater inflow limits.

6.6.21 During the tunnel excavation, pre-excavation grouting could be adopted to reduce the groundwater inflow and ensure that the tunnel would meet the long-term water tightness requirements. Since no large potential source of water inflow has been identified, the inflow criteria encouraging the adoption of pre-excavation grouting would be sufficient safeguard against excessive inflows.

Indirect impacts – Marine-based Construction

Change in Water Quality

6.6.22 Indirect impacts on marine ecological resources resulting from the construction of the Project would mainly be associated with the changes in water quality due to reclamation activities and site runoff from land-based construction works.

Elevation of Suspended Solid (SS)

6.6.23 The proposed marine works of the Project such as, reclamation and installation of bridge piers, would temporarily elevate the SS level and create sediment plumes. The increase in SS would deteriorate the water quality, and in turn degrade the marine ecological habitats. Marine fauna particularly sessile filter feeders such as hard corals are susceptible to deleterious impacts from sedimentation through smothering and clogging their respiratory and feeding apparatus. Increase in SS in water reduces the amount of light reaching beneath the water surface. This may cause detrimental effect to light-dependent marine fauna and flora. Hard corals which are of particular ecological concern are highly susceptible to the light reduction effect. With less light, growth rate of zooxanthellate hard corals (coral which possesses photosynthetic algae called zooanthellae) may be reduced. Hard corals possess mechanisms for rejecting sediment from their surfaces, but employment of these mechanisms expend energy and may cause stress ultimately leading to bleaching (expulsion of zooxanthellae) or tissue necrosis. Suspended sediment concentration which reefs can be subject to is below 10 mg/L (Rogers, 1990). Whilst, the threshold value of local corals to SS adopted by AFCD is 30% increase of ambient level (AFCD, 2005b). High levels of SS can lead to fewer coral species, less live coral, lower coral growth rate, greater abundance of branching forms, reduced coral recruitment, decreased calcification and decreased net productivity of corals (Rogers, 1990).

6.6.24 The water quality modeling results are based on the scenario (Scenario 1a) that the marine works of Cross Bay Link (CBL) is happening concurrently and the application of silt curtain has been implemented. While Scenario 1c takes into consideration of Scenario 1c plus other concurrent projects including construction of Road T2 and CLP Offshore Windfarm. Based on the prediction of the construction phase water quality modeling (see **Table 5.14 and 5.15**

of this Report), SS elevation would be confined within Junk Bay. Along the west coast of Junk Bay, where coral sites are located (CC1 to CC3 and CC13) SS levels would remain in compliance with WQOs. It is predicted that the highest SS elevation at Chiu Keng Wan (CC2 and CC3) would be 1.5 mg/L which is below the Water Quality Objectives (WQOs, i.e. 30% increase from ambient level). The predicted maximum SS levels are tabulated in **Table 6.25**.

Table 6.25 Predicted SS (mg/L) Level at Coral Sites

	Surface		Middle		Bed		Depth Averaged	
Season	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Baseline	4.5	4.0	5.9	4.1	9.8	6.7	6.4	5.4
Scenario 1a								
CC1	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.2
CC2	0.1	0.3	0.1	0.5	0.1	0.5	0.1	0.3
CC3	0.1	0.2	0.1	0.2	0.2	0.4	0.1	0.2
CC13	0.1	0.2	0.2	0.3	0.2	0.4	0.2	0.3
Scenario 1c								
CC1	0.2	0.3	0.3	0.5	0.4	0.5	0.3	0.5
CC2	0.1	0.5	0.2	1.0	0.3	1.5	0.2	1.0
CC3	0.1	0.1	0.2	0.5	0.3	1.5	0.2	0.5
CC13	0.3	0.3	0.5	0.5	0.5	1.0	0.5	0.5

Note**:**

1. Baseline SS Level is 90% percentile at Station JM3 from EPD Routine Monitoring Programme (2001-2010).
2. Predicted SS level above 10 mg/L is highlighted.

6.6.25 There are no WQOs regarding sedimentation rates. In the current study, an upper limit of 100 g/m^2/day is used to protect any sensitive areas. Sedimentation rates are well within this criterion as no ecological sensitive receivers exceed 100 g/m^2/day (**Table 5.16** refers).

6.6.26 Hard coral around Chiu Keng Wan and its vicinity were of low to moderate diversity (15 hard coral species) and coverage (<1-10%) with 3 uncommon hard coral species. In view of the transient nature of the impact and small size of impact zone, the impact due to SS elevation on hard coral is considered to be low to moderate. Mitigation measures are therefore recommended.

6.6.27 Soft corals, black corals and gorgonians are considered to have greater tolerance of turbid conditions. Owing to their flexible branches and erect growth forms, these corals are not prone to sediment accumulation. They feed independently without contributions from algal associates and therefore are not affected by light reduction due to increased turbidity.

6.6.28 The effects of increased sediment levels in the water column could also extend to intertidal, benthic and pelagic organisms in addition to corals. Fauna inhabiting the intertidal zone and soft substrate may also be smothered if sedimentation rates are high. In view of small size of the impact zone and the low ecological value of the affected habitat, the impact due to SS elevation is considered to be minor.

Marine Traffic Disturbance

6.6.29 The proposed marine works of the Project may temporarily cause disturbance impacts on marine life such as underwater noise due to increase in marine traffic during construction phase. Considering that the subtidal and intertidal habitats have already been subject to high level of human disturbance, impact resulting from the proposed construction activities is not expected to substantially exceed that than the baseline condition.

6.6.30 Based on the current assessment, the waters in and adjacent to Junk Bay within the assessment area are not within the known habitat range of local resident marine mammal. Therefore, impact of underwater noise to marine mammal due to increase in marine traffic for construction of the Project is considered insignificant.

Operation Phase

Disturbance Impact

6.6.31 Operation phase disturbance impacts of the Project to terrestrial ecological resources would largely be restricted to noise and lighting from the proposed open roads. This impact is expected to be relatively minor in scale, as the habitats recorded close to the proposed road alignment are mostly of low or low to moderate ecological value.

6.6.32 Noise from traffic flows could be transmitted from the bridge to the waters, causing disturbance impacts on marine life. As discussed above, the subtidal and intertidal habitats are subject to high level of human disturbance and the impact area is not within the known habitat range of local resident marine mammal. Noise impact due to traffic flow is thus considered insignificant.

Physical Barrier

6.6.33 The bridge section could create a physical barrier, obstructing the flight of avifauna if located on the daily flight pathway. This would in turn alter the roosting and foraging behaviors. However, the EIA study for Shenzhen Western Corridor demonstrated that birds were able to fly over or beneath bridge (HyD, 2002). As the bridge is neither located near any known localities with high bird abundance, nor on the daily flight pathways of large number of birds, the barrier impact on avifauna is therefore considered insignificant.

Shading Effect

6.6.34 The physical structure decking over light-sensitive habitats could affect the growth of the associated light dependent wildlife by blocking the sunlight for photosynthesis. The bridge section of TKO-LT Tunnel and barging point at Chiu Keng Wan would span over grassland/shrubland mosaic habitat, natural rocky shore and hard substrata subtidal habitats. The growth of vegetation and hard coral inhabited would therefore be impacted. The bridge would be on northwest-southeast bearing and have a certain angle diagonal with the east-west direction. Light would thereby reach the associated wildlife beneath the bridge but with reduced intensity. As no floral species of conservation interest but low to moderate coverage of hard coral (REA transect T8 to T10 refer) recorded beneath, impact on terrestrial and marine ecological resources is considered to be low and low to moderate respectively. Mitigation measures for hard coral are therefore recommended.

Changes in Tidal Flow Pattern

6.6.35 The newly reclaimed land may change in configuration of the coastline. This change would affect hydrodynamic regime and the subsequent tidal flow pattern. Water quality would

alter, causing seabed scour and affecting subtidal assemblages. Based on the tidal flow simulations results presented in **Appendix 5.6**, hydrodynamic impact due to the reclamation is regarded as insignificant. No adverse impact on marine ecological resources is therefore expected.

Overall Evaluation of Impact

Impact on Ecological Habitats

6.6.36 Based on the above discussion, potential ecological impacts associated with the construction and operation of the Project have been evaluated in accordance with the EIAO-TM Annex 8 and are presented in **Table 6.26** to **Table 6.35**.

Table 6.26 Overall Impact Evaluation for Mixed Woodland and Disturbed Woodland

Evaluation Criteria	Mixed Woodland	Disturbed Woodland
Habitat quality	Low to moderate	Low
Species	Predominantly common and widespread species with low diversity	Predominantly common and widespread species with low diversity, Greater Coucal (*Centropus sinensis*) was recorded from this habitat type.
Size / Abundance	No direct impact to this habitat type	No direct impact to this habitat type
Duration	Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase Permanent disturbance impact (traffic noise) during the operation phase	No adverse indirect impacts are anticipated in both construction and operation phases.
Reversibility	Indirect Impact Construction phase disturbance would be temporary and reversible. Operation phase disturbance would be permanent and irreversible	No adverse indirect impacts are anticipated in both construction and operation phases.
Magnitude	Low	No adverse indirect impacts are anticipated in both construction and operation phases
Overall Impact Conclusion	**Low**	**Low**

Table 6.27 Overall Impact Evaluation for Grassland/Shrubland Mosaic and Village/Orchard

Evaluation Criteria	Grassland/Shrubland Mosaic	Village/Orchard
Habitat quality	Low to moderate	Low
Species	Predominantly common and widespread species with moderate diversity. One flora species of conservation interest, Bamboo Orchid (*Arundina graminifolia*) was recorded. Black Kite (*Milvus migrans*), Greater Coucal (*Centropus sinensis*), Zitting Cisticola (*Cisticola juncidis*), Collared Crow (*Corvus torquatus*), Large Banded Swift (*Pelopidas subochraceus*) were recorded from this habitat type.	Predominantly common and widespread species with low diversity. Black Kite (*Milvus migrans*) was recorded from this habitat type.
Size / Abundance	Direct impact to approximately 2.0 ha of this habitat.	Direct impact to <0.1 ha of this habitat.
Duration	Direct Impact Loss of habitat within footprint of proposed development would be permanent. Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase. Permanent disturbance impact (traffic noise) and shading effect during the operation phase.	Direct Impact Loss of habitat within footprint of proposed development would be permanent. Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase. Permanent disturbance impact (traffic noise) and shading effect during the operation phase..
Reversibility	Direct Impact Loss of habitat within footprint of proposed development would be irreversible. Indirect Impact Construction phase disturbance would be temporary and reversible.	Direct Impact Loss of habitat within footprint of proposed development would be irreversible. Indirect Impact Construction phase disturbance would be temporary and reversible.

Evaluation Criteria	Grassland/Shrubland Mosaic	Village/Orchard
	Operation phase disturbance would be permanent and irreversible.	Operation phase disturbance would be permanent and irreversible.
Magnitude	Low	Low
Overall Impact Conclusion	**Low**	**Very Low**

Table 6.28 Overall Impact Evaluation for Plantation and Wasteland / Developed Area

Evaluation Criteria	Plantation	Wasteland / Developed Area
Habitat quality	Low	Low
Species	Predominantly common and widespread species with low to moderate diversity. Black Kite (*Milvus migrans*) and Greater Coucal (*Centropus sinensis*) were recorded from this habitat.	Predominantly common and widespread species with low to moderate diversity. Chinese Pond Heron (*Ardeola bacchus*) and Eastern Buzzard (*Buteo buteo*) were recorded from this habitat.
Size / Abundance	Direct impact to approximately 1.8 ha of this habitat.	Direct impact to approximately 12.1 ha of this habitat.
Duration	Direct Impact Loss of habitat within footprint of proposed development would be permanent. Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase. Permanent disturbance impact (traffic noise) during the operation phase.	Direct Impact Loss of habitat within footprint of proposed development would be permanent. Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase. Permanent disturbance impact (traffic noise) during the operation phase.
Reversibility	Direct Impact Loss of habitat within footprint of proposed development would be irreversible. Indirect Impact	Direct Impact Loss of habitat within footprint of proposed development would be irreversible. Indirect Impact

Evaluation Criteria	Plantation	Wasteland / Developed Area
	Construction phase disturbance would be temporary and reversible. Operation phase disturbance would be permanent and irreversible.	Construction phase disturbance would be temporary and reversible. Operation phase disturbance would be permanent and irreversible.
Magnitude	Low	Low
Overall Impact Conclusion	**Low**	**Low**

Table 6.29 Overall Impact Evaluation for Pond and Stream

Evaluation Criteria	Pond	Stream
Habitat quality	Low	Low
Species	Predominantly common and widespread species with low diversity. Black Kite (*Milvus migrans*) and White-throated Kingfisher (*Halcyon smyrnensi*) were recorded from this habitat.	Predominantly common and widespread species with low diversity. However, this is potential habitat for species of conservation interest Philippine Neon Goby.
Size / Abundance	No direct impact to this habitat type.	Indirect impact to Stream 4 (63 m) as it lies within the works area
Duration	Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase. Permanent disturbance impact (traffic noise) during the operation phase.	Indirect Impact Short-term disturbance impact (noise, human, construction dust and site runoff) during the construction phase. Permanent disturbance impact (traffic noise) during the operation phase.
Reversibility	Indirect Impact Construction phase disturbance would be temporary and reversible. Operation phase disturbance would be permanent and irreversible.	Indirect Impact Construction phase disturbance would be temporary and reversible. Operation phase disturbance would be permanent and irreversible.

Evaluation Criteria	Pond	Stream
Magnitude	Low	Low
Overall Impact Conclusion	**Low**	**Low**

Table 6.30 Overall Impact Evaluation for Intertidal Habitat (Natural Rocky Shore)

Evaluation Criteria	Intertidal Habitat (Natural Rocky Shore)		
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay (Eastern coast)**	**Victoria Harbour WCZ**
Habitat Quality	Low to moderate	Low	Low
Species	Predominantly common and widespread species with moderate diversity. One fish species (Grassy Puffer Fish, *Takifugu niphobles*) and four bird species (Little Egret, *Egretta garzetta*; Pacific Reef Egret, *Egretta sacra*; Grey-tailed Tattler, *Heteroscelus brevipes*; Sanderling, *Calidris alba*) of conservation interest were recorded from this habitat.	Predominantly common and widespread species with low to moderate diversity.	Predominantly common and widespread species with low diversity.
Size / Abundance	Direct impact to approximately 0.1 ha of this habitat.	No direct impact to this habitat type	No direct impact to this habitat type
Duration	<u>Direct Impact</u> Loss of habitat within footprint of proposed development would be permanent. <u>Indirect Impact</u> Short-term disturbance impact (noise, human, construction dust, site runoff) and SS elevation during the	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.

Evaluation Criteria	Intertidal Habitat (Natural Rocky Shore)		
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay (Eastern coast)**	**Victoria Harbour WCZ**
	construction phase Permanent disturbance impact (traffic noise) and shading effect during the operation phase.		
Reversibility	Indirect Impact Construction phase disturbance would be temporary and reversible. Operation phase disturbance and shading effect would be permanent and irreversible.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.
Magnitude	Low	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.
Overall Impact Conclusion	**Low**	**Very Low**	**Very Low**

Table 6.31 Overall Impact Evaluation for Intertidal Habitat (Sandy Shore)

Evaluation Criteria	Intertidal Habitat (Sandy Shore)	
	Western Coast of Junk Bay	**Remaining Part of the Assessment Area**
Habitat Quality	Low	Low
Species	Very low diversity of common and widespread species recorded. No rare species was recorded.	Very low diversity of common and widespread species recorded. No rare species was recorded.

Size / Abundance	No direct impact to this habitat type	No direct impact to this habitat type
Duration	Indirect Impact Short-term disturbance impact (noise, human, construction dust, site runoff) and SS elevation during the construction phase	No adverse indirect impacts are anticipated in both construction and operation phases.
Reversibility	Indirect Impact Construction phase disturbance and SS elevation would be temporary and reversible.	No adverse indirect impacts are anticipated in both construction and operation phases.
Magnitude	Low	No adverse indirect impacts are anticipated in both construction and operation phases.
Overall Impact Conclusion	**Low**	**Very Low**

Table 6.32 Overall Impact Evaluation for Intertidal Habitat (Artificial Seawall)

Evaluation Criteria	**Intertidal Habitat (Artificial Seawall)**		
	Within or in Vicinity of the Project Site (Western Coast of Junk Bay)	**Remaining Part of the Junk Bay**	**Victoria Harbour**
Habitat Quality	Low	Low	Low
Species	Predominantly common and widespread species with low diversity.	Predominantly common and widespread species with low diversity.	Predominantly common and widespread species with low diversity.
Size / Abundance	Direct impact to approximately 540 m of this habitat	No direct impact to this habitat type	No direct impact to this habitat type
Duration	Direct Impact Loss of 0.1 ha of habitat within footprint of proposed development would be permanent. Indirect Impact	No adverse indirect impacts are anticipated in both construction and operation phases.	Direct Impact Loss of approximately 30 m of habitat within footprint of temporary barging point at Cha Kwo Ling Indirect Impact

Evaluation Criteria	Intertidal Habitat (Artificial Seawall)		
	Within or in Vicinity of the Project Site (Western Coast of Junk Bay)	**Remaining Part of the Junk Bay**	**Victoria Harbour**
	Short-term disturbance impact (noise, human, construction dust, site runoff) and SS elevation during the construction phase		Short-term disturbance impact (noise, human, construction dust, site runoff) during the construction phase
Reversibility	Direct Impact Loss of habitat within footprint of proposed development would be irreversible. Indirect Impact Construction phase disturbance and SS elevation would be temporary and reversible.	No adverse indirect impacts are anticipated in both construction and operation phases.	Direct Impact Loss of habitat within footprint of proposed development would be irreversible. Indirect Impact Construction phase disturbance would be temporary and reversible.
Magnitude	Low in proportion in the local context within Junk Bay	No adverse indirect impacts are anticipated in both construction and operation phases.	Very low, the affected area is small
Overall Impact Conclusion	**Low**	**Very Low**	**Very Low**

Table 6.33 Overall Impact Evaluation for Hard Substrata Subtidal Habitat

Evaluation Criteria	Hard Substrata Subtidal Habitat			
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
Habitat Quality	**Southwest Coast of Junk Bay:** Moderate **Chiu Keng Wan:** Low to moderate	Low	Low to moderate	Very low
Species	Hard corals, Octocorals (soft corals, gorgonians and sea pen) and Black Corals recorded Predominantly common and widespread species with three uncommon hard coral (*Favia helianthoides, Coscinaraea* sp., *Montipora mollis*) recorded	Hard corals, Octocorals (soft corals and gorgonians) recorded	Hard corals, Octocorals (soft corals and gorgonians) recorded	Low diversity of hard coral recorded
Size / Abundance	Permanent loss of about 3.6 ha (3 ha due to reclamation and 0.6 ha due to bridge piers) of subtidal habitat and about 540 m submerged artificial seawall with low coverage (<1%) of hard coral).	No direct impact to this habitat type	No direct impact to this habitat type	No direct impact to this habitat type

Evaluation Criteria	Hard Substrata Subtidal Habitat			
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
Duration	Direct Impact Loss of habitat due to temporary marine works area would be temporary (about 4.5 years). Loss of habitat due to reclamation and bridge pier and loss of coral would be permanent. Indirect Impact Short-term SS elevation during the construction phase Operation phase shading effect would be permanent.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.
Reversibility	Direct Impact Loss of habitat due to temporary marine works area would be reversible. Loss of habitat and corals due to reclamation and bridge pier and loss of coral would be irreversible. Indirect Impact	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.

Evaluation Criteria	Hard Substrata Subtidal Habitat			
	Western Coast of Junk Bay	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
	SS elevation during construction phase would be reversible. Operation phase shading effect would be irreversible.			
Magnitude	Low	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.
Overall Impact Conclusion	**Low to moderate (without mitigation measures)**	**Very Low**	**Very Low**	**Very Low**

Table 6.34 Overall Impact Evaluation for Soft Substrata Subtidal Habitat

Evaluation Criteria	Soft Substrate Subtidal Habitat			
	Within or in Vicinity of the Project Site	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
Habitat Quality	Low	Low	Low	Low
Species	Predominantly common and widespread species with moderate diversity.	Predominantly common and widespread species with moderate diversity.	Predominantly common and widespread species with moderate to high diversity.	Predominantly common and widespread species with low diversity.
Size / Abundance	Small. Approximately 3.6 ha (3 ha due to reclamation and 0.6 ha due to bridge piers) and 18.9 ha of soft substrata subtidal habitat would be lost permanently and temporarily respectively.	No direct impact to this habitat type	No direct impact to this habitat type	No direct impact to this habitat type
Duration	Direct Impact Loss of habitat due to temporary marine works area would be temporary (about 4 years). Loss of habitat due to reclamation and bridge pier and loss of coral would be permanent. Indirect Impact Short-term SS elevation during the construction	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.

Evaluation Criteria	Soft Substrate Subtidal Habitat			
	Within or in Vicinity of the Project Site	**Remaining Part of the Junk Bay**	**Tathong Channel**	**Victoria Harbour WCZ**
	phase Operation phase shading effect would be permanent.			
Reversibility	Direct Impact Loss of habitat due to temporary marine works area would be reversible. Loss of habitat and corals due to reclamation and bridge pier and loss of coral would be irreversible. Indirect Impact SS elevation during construction phase would be temporary and reversible. Operation phase shading effect would be irreversible.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.
Magnitude	Low	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.	No adverse indirect impacts are anticipated in both construction and operation phases.
Overall Impact Conclusion	**Low**	**Very Low**	**Very Low**	**Very Low**

Table 6.35 Overall Impact Evaluation for Pelagic Subtidal Habitat

Evaluation Criteria	Pelagic Subtidal Habitat
Habitat Quality	Low
Species	Predominantly common and widespread species with moderate diversity.
Size / Abundance	Direct impact to approximately 3.6 ha of subtidal pelagic habitat
Duration	Direct Impact Loss of habitat within footprint of proposed development would be permanent. Indirect Impact Short-term disturbance impact during the construction phase
Reversibility	Direct Impact Loss of habitat and corals within footprint of proposed development would be irreversible. Indirect Impact Construction phase disturbance would be temporary and reversible
Magnitude	Low
Overall Impact Conclusion	**Low**

Impact on Species of Conservation Interest

6.6.37 There were in total one flora (**Section 6.4.15** refers), 10 avifauna (**Table 6.4** refers) and one butterfly species (**Section 6.4.43** refers) of conservation interest recorded within the assessment area. However, none of them were recorded within the proposed works areas of the Project.

6.6.38 A summary of potential ecological impacts to the species of conservation interest recorded in the assessment areas during the recent surveys is provided in **Table 6.36** and **Table 6.37** below.

Table 6.36 Overall Impact Evaluation for Terrestrial Species of Conservation Interest Recorded from in the Assessment Area during Recent Surveys

Evaluation Criteria	Flora	Fauna
Habitat Quality	One flora species of conservation interest was recorded from grassland/shrubland mosaic habitat with low to moderate ecological value	Avifauna species of conservation interest recorded from various habitats with ecological value ranging from low to low to moderate. Butterfly species of conservation interest recorded from grassland/shrubland mosaic habitat with low to moderate ecological value
Species	Bamboo Orchid (*Arundina graminifolia*)	<u>Avifauna</u> Little Egret (*Egretta garzetta*), Pacific Reef Egret (*Egretta sacra*), Chinese Pond Heron (*Ardeola bacchus*), Black Kite (*Milvus migrans*), Common Buzzard (*Buteo buteo*), Grey-tailed Tattler (*Heteroscelus brevipes*), Sanderling (*Calidris alba*), Greater Coucal (*Centropus sinensis*), Zitting Cisticola (*Cisticola juncidis*) and Collared Crow (*Corvus torquatus*) <u>Butterfly</u> Large Banded Swift (*Pelopidas subochraceus*)
Size / Abundance	Small number of individuals recorded Possible direct impact to this flora of conservation interest since it is possible for to it be found within the footprints of the Project	Small number of individuals of each species recorded No direct impact to the roosting / breeding site of these fauna of conservation interest
Duration	<u>Indirect Impact</u> Short-term disturbance impact during the construction phase	<u>Indirect Impact</u> - Loss of potential inhabiting habitat would be permanent. - Short-term disturbance impact during the construction

Evaluation Criteria	Flora	Fauna
		phase - Permanent disturbance impact during operation phase
Reversibility	Indirect Impact Construction disturbance impact would be reversible	Indirect Impact - Loss of potential inhabiting habitat would be irreversible. - Construction disturbance impact would be reversible - Operation disturbance impact would be irreversible
Magnitude	Low	Low
Overall Impact Conclusion	**Low**	**Low**

Table 6.37 Overall Impact Evaluation for Marine Species of Conservation Interest Recorded from in the Assessment Area during Recent Surveys

Evaluation Criteria	Coral Communities	Fish
Habitat Quality	Coral communities were recorded from hard substrata subtidal habitat with moderate ecological value	A single fish species of conservation interest recorded from natural intertidal rocky shore with low to moderate ecological value
Species	Hard Coral (15 spp.) *Cyphastrea serailia, Favia speciosa, Favia helianthoides, Favites chinensis, Favites acuticollis, Favites pentagona, Coscinaraea* sp., *Goniopora stutchburyi, Montipora mollis, Oulastrea crispata, Pavona decussata, Platygyra carnosus, Psammocora superficialis, Tubastrea* sp. and *Turbinaria peltata* Gorgonians (13 spp.) *Acanthogorgia* sp. A, *Echinomuricea* sp. A, *Echinomuricea* sp. B, *Euplexaura* sp. A, *Euplexaura* sp. B, *Euplexaura* sp. C, *Echinogorgia* sp. A, *Echinogorgia* sp. B, *Leptogogia* sp., *Menella* sp. A, *Menella* sp. B, *Paraplexaura* sp. A and *Astrogorgia* sp. Soft Corals (4 spp.) *Dendronephthya* sp., *Scleronephthya* sp., *Cladiella* sp. and *Lobophytum* sp. Black Corals (2 spp.) *Cirrhipathes* sp. A and *Cirrhipathes* sp. B	Grassy Puffer fish (*Takifugu niphobles*) Philippine Neon Goby (*Stiphodon atropurpureus*)

Evaluation Criteria	Coral Communities	Fish
	Sea Pen (1 sp.) *Pteroeides* sp.	
Size / Abundance	Direct loss of about 19.8 ha subtidal habitat with low coverage (<1%) of 12 hard coral species due to temporary marine works area and reclamation	Project unlikely to have direct impact on this fish species
Duration	Direct Impact Loss of coral colonies would be permanent Indirect Impact Short-term water quality impact during the construction phase Operation phase shading effect would be permanent.	Indirect Impact Short-term water quality impact during the construction phase
Reversibility	Direct Impact Loss of coral colonies would be irreversible. Indirect Impact Water quality impact during the construction phase would be reversible Operation phase shading effect would be irreversible.	Indirect Impact Construction phase water quality impact would be reversible
Magnitude	Low-moderate	Low
Overall Impact Conclusion	**Low to moderate (without mitigation measures)**	**Low**

6.7 Evaluation of Cumulative Impacts

6.7.1 The construction activities of the Project are tentatively scheduled to be within the time frame from January 2016 to October 2020. Based on the latest available information, the following projects in the vicinity would be constructed concurrently with the Project:

- Marine-based works of Cross Bay Link (CBL) (Civil Engineering and Development Department, May 2017 – August 2018);
- Trunk Road T2 (Civil Engineering and Development Department, end of 2015 – end of 2020); and
- CLP Windfarm (China Light and Power, Jan 2017 – Sept 2017).

6.7.2 Marine-based construction works of CBL would be undertaken within Junk Bay concurrently with the Project. According to the CBL EIA study report (CEDD, 2013), a small area of seabed of less than 0.3 ha would be permanently lost and approximately 9.6 ha would be temporarily lost during the nine month construction phase. Together with the marine habitat loss of the Project (3.6 ha of permanent and 19 ha of temporary loss for less than five years), the cumulative permanent and temporary marine habitat loss within Junk Bay would be approximately 3.9 ha and 28.6 ha respectively. Given the small area of permanent loss and the timeframe for the temporary loss, the cumulative habitat loss arising from the Project and CBL is considered to be acceptable.

6.7.3 Marine-based construction activities such as, dredging, reclamation and suction cassion would be required in the above projects. The key issues of concern would be the cumulative effect of the deterioration of water quality in Junk Bay and the marine waters off the coast of Cha Kwo Ling. As stated in **Section 6.6.24**, cumulative water quality modeling including all three projects listed above has been undertaken and no exceedance of water quality parameter (SS levels) is predicted under the mitigated scenario (refer to **Section 5**).

6.7.4 Another potential cumulative impact would be the cumulative disturbance to marine habitats and associated wildlife (particularly marine mammal) arising from the increased level of marine traffic and human activities during construction phase. However, this is unlikely to be of concern as Junk Bay and coastal waters of Cha Kwo Ling are not within the known habitat range of local resident marine mammal. Such cumulative impact of increasing marine traffic in Junk Bay area is therefore considered insignificant.

6.7.5 Concurrent terrestrial-based project consists of the ventilation buildings of Trunk Road T2. These ventilation buildings would be located within the proposed alignment of the Project at the interchange area near Cha Kwo Ling, as such potential impacts would be concentrated within the same construction areas. Furthermore, the existing habitats of these proposed ventilation buildings are comprised of plantation and development area, both of which are of low ecological value. Therefore, no adverse cumulative terrestrial impacts are expected.

6.8 Mitigation of Adverse Environmental Impacts

6.8.1 According to the EIAO-TM Annex 16 and EIAO Guidance Note. 3/2010, ecological impacts on important habitats and the associated wildlife caused by the proposed development should be mitigated by, in order of priority, avoidance, minimization, and compensation approaches to the maximum practical extent.

Avoidance

6.8.2 The alignment option and design of the Project has been substantially evaluated and revised to avoid and minimize the impact on the ecological resources via the following modifications:

- Avoided the clearance of vegetation in the disturbed woodland located between the Kwong Tin Estate and Lei Yue Mun Road by relocating the tunnel portal to urbanized developed area with lower ecological value.
- Avoided and minimized the marine ecological impact by reducing the reclamation area and using non-dredge method. The alignment option of TKO-LT Tunnel, particularly on the extent of reclamation for the protection of P2 road and landing area for the elevated slip roads connecting the interchange with CBL, has been substantially evaluated and revised. The option with minimal reclamation extent (approximately 3 ha at Road P2) has been selected. Therefore, the direct habitat loss as well as indirect water quality impact would be substantially avoided / reduced from 12 ha to 3 ha.
- The selected alignment option also avoided the direct impact and disturbance to the natural habitats (rocky shore and stream) along the coastline of Chiu Keng Wan where fish of conservation interest (i.e. Philippine Neon Goby and Grass Puffer Fish) were previously recorded. With the natural coastline along Chiu Keng Wan preserved, there would be no blockage to the passage between the stream habitat and coastal water where potential migration of Philippine Neon Goby may occur.
- Avoided the subtidal habitat with relatively higher coral coverage and increase the coral translocation feasibility by adjusting the pier locations further offshore where bottom substrate is dominated by sand and mud/silt. As refer to **Figure 6.10 and Table 6.8**, the substratum types changed from bedrock/boulder/big rocks (preferable habitat for hard coral) to mud/silt (less preferable habitat for hard coral) moving offshore with increased coral translocation feasibility increased (from T8 to T10). By adjusting the pier locations offshore, the number of coral colonies requiring translocation is expected to decrease.

Minimization

Minimization of Terrestrial Ecological Impacts

6.8.3 Detailed vegetation survey would be conducted by suitably qualified botanist/ecologist for the works area of portal prior to the commencement of construction activities to confirm the presence of flora species of conservation interest. To minimize the direct loss of these species, transplantation would be recommended as far as possible. Transplantation proposal for the affected individuals would be prepared if necessary.

6.8.4 In general, the indirect disturbance impacts to terrestrial habitat and associated wildlife arising from the land-based construction activities could be minimized by adopting the following mitigation measures:

- Use of Quiet Mechanical Plant during the construction phase should be adopted wherever possible.
- Hoarding or fencing should be erected around the works area boundaries during the construction phase. The hoarding should screen adjacent habitats from construction phase activities, reduce noise disturbance to these habitats and also to restrict access to

habitats adjacent to works areas by site workers.

- Regular spraying of haul roads to minimize impacts of dust deposition on adjacent vegetation and habitats during the construction activities.

6.8.5 Standard good site practices should be implemented throughout the construction phase in all the land-based construction sites. The measures should include:

- Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural habitats.
- Construction activities should be restricted to works areas that should be clearly demarcated. The works areas should be reinstated after completion of the works.
- Waste skips should be provided to collect general refuse and construction wastes. The wastes should be properly disposed off-site in a timely manner.
- General drainage arrangements should include sediment and oil traps to collect and control construction site run-off to avoid from entering the nearby streams (particularly Stream 4).
- Erect of hoarding to prevent construction-related activities to encroach adjacent habitats.
- Open burning on works sites is illegal, and should be strictly prohibited.
- Measures should also be put into place so that litter, fuels and solvents do not enter the nearby watercourses.

6.8.6 To minimize the groundwater inflow due to tunnel construction, the drained tunnel construction method with groundwater inflow control measures would generally be adopted. During the tunnel excavation, pre-excavation grouting could be adopted to reduce the groundwater inflow and ensure that the tunnel would meet the long-term water tightness requirements.

Minimization of Marine Ecological Impacts

6.8.7 Recent dive surveys revealed that the hard substrata subtidal habitats to be directly affected by the temporary marine works area and reclamation were of low diversity and sparse coverage (<1%) of common hard coral colonies. The colonies were largely dominated by a pioneer species *Oulastrea crispata* (Spot-check Area 1 and Area 2, and REA transects T1 to T3, T5 and T7 refer) with relatively low ecological value. The bridge pier construction would additionally affect a small area (0.6 ha) of hard substrate subtidal habitat with relatively diverse coral assemblage.

6.8.8 In order to minimize the direct loss/damage and shading effect to the coral colonies, it is recommended to translocate the affected coral colonies, except the locally common *Oulastrea crispata*, within the temporary marine works and reclamation areas and the footprint of the bridge section to suitable receptor site(s) as far as practicable. The coral translocation should be conducted during the winter season (November-March) in order to avoid disturbance to the translocation coral colonies during the spawning period (i.e. July to October). A detailed coral translocation plan with brief description on methodology for pre-translocation coral survey, translocation methodology, identification/proposal of coral recipient site, monitoring methodology for post-translocation should be prepared during the detailed design stage of the Project. The coral translocation plan should be subject to

approval by relevant authorities (e.g. EPD and AFCD) before commencement of the coral translocation. All the translocation exercises should be conducted by experienced marine ecologist(s) who is/are approved by AFCD prior to commencement of coral translocation.

6.8.9 Mitigation measures to be recommended in the water quality impact assessment for controlling water quality impact would serve also to minimize the marine ecological resources from indirect water quality impacts, particularly coral communities. The mitigation measure for water quality impact to be undertaken by the contractor includes the installation of single floating silt curtains at the opening of the newly installed seawall during the reclamation for Road P2. For more detailed mitigation measures regarding water quality refer to **Section 5**.

6.8.10 To minimize the contamination of wastewater discharge, accidental chemical spillage and construction site run-off to the receiving water bodies, mitigation measures such as diverting the site runoff to silt trap facilities before discharging into storm drain, proper waste and dumping management and standard good site practice for land-based construction.

Compensation

6.8.11 The Project would result in permanent loss of approximately 3.8 ha of vegetated habitats including grassland/shrubland mosaic habitat and plantation with low / low to moderate ecological value. The overall impact of terrestrial habitat loss resulting from this Project is therefore considered to be minor. A tree survey will be conducted to identify any trees potentially affected. For tree preservation, the felling of trees would be avoided as far as possible and tree compensation will be made according to ETWB No. 3/2006 as far as practicable. In addition, vegetation at the temporarily affected area should be reinstated with species similar to the existing condition.

6.8.12 The habitat loss of hard substrata subtidal and artificial seawall intertidal habitat during the proposed marine works the Project would be largely compensated through the provision of new artificial seawall of 762 m long with surface for recolonization of intertidal fauna and corals. Additional compensation mitigation measures for marine ecological impact are considered unnecessary.

6.9 Evaluation of Residual Impacts

Terrestrial Ecological Impact

6.9.1 The identified residual impacts would be the loss of approximately 16.3 ha of terrestrial habitats with limited ecological value (2.0 ha of grassland/shrubland mosaic habitat, <0.1 ha of village/orchard. 1.8 ha of plantation, 12.1 ha wasteland/developed area, 0.2 ha of artificial seawall and 0.1 ha of natural rocky shore). In view of the generally low ecological value of the affected habitats, the residual impact is considered acceptable.

Marine Ecological Impact

6.9.2 Residual impacts on marine ecology would include the loss of marine habitats (3.6 ha of subtidal habitat), and the associated wildlife (including benthic organisms, hard corals attached on immovable boulders / rocks, and intertidal species) within the reclamation area and bridge pier of the Project. However, a surplus of 311 m artificial seawall would provide a surface for recolonization of intertidal fauna and corals. The benthic, subtidal and intertidal organisms are expected to re-colonize in the Project area after construction works.

In view of the limited ecological value of the lost habitats and species, the residual impact is considered acceptable.

6.9.3 The untranslocable coral colonies which would be lost due to reclamation and affected by shading effect are largely dominated by pioneer species *Oulastrea crispata* which is able to colonize a wide range of substrata, particularly newly submerged structures (Lam, 2000a & 2000b). *Oulastrea crispata* can recruit and settle rapidly on available substrate, particularly in marine water of high current movement and particulate matter. Rapid recruitment and settlement of the species is therefore expected to occur on the available substrates of the newly formed seawalls after completion of construction activities. Other untranslocable hard coral colonies include locally common and widespread species such as *Goniopora stutchburyi* and *Cyphastrea serailia*, which were found in low quantities and of small size (7 – 15 cm). Therefore, the residual impact due to inevitable loss of some of these isolated coral colonies attached to immovable boulders / rocks is considered to be acceptable.

6.9.4 With the implementation of appropriate mitigation measures, residual impact on marine ecology due to the deterioration in water quality as a result of the Project works would be minimized. In considering the limited ecological value of marine habitats within or in the vicinity of the affected area and the temporary nature of the impact, the residual impact is considered acceptable.

6.10 Environmental Monitoring and Audit Requirements

Terrestrial Ecological Impact

6.10.1 As only minor impacts on terrestrial ecology are identified, no monitoring programme specific for terrestrial ecology is required. However, the implementation of all mitigation measures for terrestrial ecological impact described in **Section 6.8** should be subject to regular audit.

Marine Ecological Impact

6.10.2 Water quality monitoring and audit designed to detect and mitigate any unacceptable impact on water quality will also serve to proactively protect marine ecological resource against water quality deterioration. Regular site audits should be carried out to ensure the effective implementation of mitigation measure stated in **Section 6.8**.

6.10.3 To avoid and minimize potential loss of small and sparsely distributed coral colonies found within the directly impacted area as well as minimize the shading effect, it is recommended to translocate the directly impacted corals except *Oulastrea crispata* attached on the movable (< 50 cm in diameter) boulders / rocks within the proposed temporary marine works area, reclamation area, barging point and bridge footprint, as far as practicable, to a nearby suitable recipient habitat where similar hydrographic condition and healthy coral communities of the same coral species were recorded. Coral translocation should be carried out during the winter season (November-March) in order to avoid disturbance to the transplanted colonies during the spawning period (i.e. July to October). A detailed translocation plan with brief description on pre-translocation coral survey, translocation methodology, identification of coral recipient site and post-translocation monitoring methodology should be prepared during the detailed design stage of the Project. Pre-translocation survey of coral within the proposed temporary marine works area and reclamation area would be focused on identifying and mapping the coral colonies that would be directly impacted by the proposed marine works and investigating the translocation feasibility of these coral colonies (e.g. health status

of coral colony and nature of the attaching susbtrata). The detailed translocation plan and marine ecologists involved in coral translocation should be approved by relevant authorities (e.g. EPD & AFCD) prior to commencement of the translocation exercises.

6.10.4 Information gathered during each post-translocation monitoring survey should include observations on the presence, survival, health condition and growth of the translocated coral colonies. These parameters should then be compared with the baseline results collected from the pre-translocation survey.

6.10.5 No direct impacts on the coral communities from the hard substrata subtidal habitat along the natural coastline of western Junk Bay are anticipated. However, they could potentially be indirectly impacted by the change in water quality arising from the proposed marine and reclamation works. Therefore, it is recommended to monitor these nearby coral communities along with the water quality monitoring programme during the construction phase with a view to protect the natural coral communities in vicinity of the proposed marine works areas.

6.11 Conclusion

6.11.1 An ecological impact assessment for the TKO-LTT has been conducted. The assessment methodology follows the guidelines of the EIAO-TM Annex 8 and Annex 16.

6.11.2 There is no recognized terrestrial/marine site of conservation interest (e.g. as Country Parks, Sites of Special Scientific Interest, Coastal Protection Areas, Conservation Areas, Marine Parks) within the assessment area. The ecological resources identified included mixed woodland, disturbed woodland, grassland/shrubland mosaic, village/orchard, plantation, pond/stream, natural rocky shore, sandy shore, artificial seawall, hard substrata subtidal habitat, soft substrate subtidal habitat and pelagic subtidal habitat. Of which, hard substrata subtidal habitat has low-to-moderate to moderate ecological value. Fifteen hard coral, two black coral and 17 octocoral species were recorded within and in vicinity of marine works area. The remaining habitats were of low to low-to-moderate value.

6.11.3 Potential direct impacts on significant ecological resources of conservation importance (e.g. natural coastline along Chiu Keng Wan, natural coral communities with moderate to high ecological value on western coast of Junk Bay, coral recipient sites for translocation under other development projects, natural streams, and potential habitats of Philippine Neon Goby and Grassy Puffer Fish) has been largely avoided or minimized in the alignment option selection process.

6.11.4 The land-based construction works would cause a loss of approximately 3.8 ha of vegetated habitats (grassland/shrubland mosaic and plantation) with low and low to moderate ecological value. The associated flora and fauna recorded from these affected habitats are predominantly common and widespread species in Hong Kong. Terrestrial ecological impacts arising from the Project are considered low. A small stream, Stream 4, (63 m) of low ecological value would experience indirect impacts during construction phase.

6.11.5 A total of 22.6 ha of coastal subtidal habitat (19 ha of temporary loss and 3.6 ha of permanent loss) and 540 m artificial seawall at TKO would be lost to reclamation, construction of temporary barging points and bridge pier construction works. However, the construction of new artificial seawall under the Project would provide about 310 m surplus of this habitat. Direct impact on sparse coverage (<1%) of coral community would be minimized through coral translocation measures as far as practicable.

6.11.6 Potential indirect impact due to change in water quality resulting from the proposed marine works and reclamation would be temporary and localized. Possible mitigation measures for water quality impact, such as reducing filling rate, closing the new seawall before reclamation and refining of construction schedules between concurrent projects, would also be serve to protect nearby marine ecological resources. With the proper implementation of appropriate mitigation measures, the potential impact on marine ecology due to water quality deterioration would be acceptable and water quality parameter (SS level) would be in compliance with WQOs.

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