5 Benthic Ecology

5.1 Introduction

5.1.1.1 This section presents the approach to and the findings of the benthic ecology baseline assessment and the Project Impact assessment.

5.1.1.2 The aim of the benthic ecological impact assessment is to examine the benthic ecological conditions within the assessment area in order to protect, maintain or rehabilitate the natural environment.

5.2 Objectives

5.2.1.1 The benthic ecological assessment has been undertaken in accordance with the criteria and guidelines in Annexes 8 and 16 respectively of the EIA-TM, and with reference to the requirements of Clause 3.4.2 of the EIA Study Brief.

5.2.1.2 The key objectives are as follows:

- Review the findings of relevant studies/surveys and collate the available information regarding the ecological characters of the assessment area;
- Evaluate information collected and identify any information gap relating to the assessment of potential ecological impact;
- Conduct ecological field surveys and investigations of at least six months duration covering both wet and dry season to fill in the information gaps identified in Sections 3.4.2.4 (ii) of the ESB to include coral communities and marine benthic communities.
- Establish the general ecological profile of the Study Area taking into account seasonal variations, and describe the characteristics of each habitat found. Major information shall include *inter alia* the types / locations of habitats and species of conservation interest such as hard coral, octocorals and black coral communities; and notable marine benthic / littoral communities, in particular amphioxus *Branchiostoma spp*.
- Identify and quantify as far as possible impacts such as deterioration or disturbance to corals, and removal or disruption of potentially valuable benthic communities such as amphioxus, *Branchiostoma* spp.
- Evaluate the significance and acceptability of the ecological impacts during Project construction and operation, including management and maintenance requirement.

- Recommend all possible alternatives and practicable mitigation measures to avoid adverse ecological impacts during Project construction and operation upon corals and amphioxus.
- Evaluate the feasibility and effectiveness of any recommended mitigation measures, quantify as far as practicable the residual impacts of mitigation measure implementation and evaluate the acceptability of any residual impacts using the criteria in Annex 8 of the TM.
- Review any requirements for ecological monitoring.

5.3 Legislation, Standards & Guidelines

5.3.1.1 Reference has been made to the following local legislation governing conservation of marine ecological resources:

- ***Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)*** controls the local possession of any endangered species of animals and plants listed in its schedules. These include various types of coral, including Stony (hard) corals (order Scleractinia) and Black corals (order Antipatharia). Soft coral is not protected under this Ordinance.
- ***Fisheries Protection Ordinance and Regulations (Cap. 171)*** regulates fishing practices, aims to prevent activities detrimental to the fishing industry and aims to protect fishes and other marine biota in HKSAR waters.
- Relevant Mainland regulations include the Wild Animals Protection Law that inter alia protects the habitats of all wild fauna, including the creation of Class I /II protected species lists (Class I species being of greater concern).
- International / regional conservation regulations, standards and guidelines of relevance include the Convention on International Trade in Endangered Species (CITES) [of Wild Flora and Fauna] and the international Convention on Biological Diversity under which there are provisions for the protection of corals. Black corals gained protection under Appendix II of CITES in 1981.
- The International Union for Conservation of Nature and Natural Resources (IUCN) Red List is a comprehensive global inventory of species of conservation concern, with species listed according to conservation risk criteria.

5.4 Assessment Approach

5.4.1 Desktop Review

5.4.1.1 A review of available data and information has been conducted. The most relevant updated sources of data / information for corals / epifauna included inter alia:

- HATS Corals Survey Report, 2003.
- Ecological Status and Revised Species of Hong Kong's Scleractinian Corals, 2004.
- Field Guide to Hard Corals of Hong Kong, 2005.
- Further Development of Tseung Kwan O Feasibility Study, 2005, and
- Distribution and Community Structure of Octocorals in Eastern Waters of Hong Kong, unpublished data from May 2006 survey.

5.4.1.2 The key data source on benthic infauna communities of the HKSAR and Eastern Waters was the *Consultancy Study on Marine Benthic Communities in Hong Kong,* 2002.

5.4.2 Marine Geophysical Survey

5.4.2.1 A side scan sonar survey was conducted during August 2006, with one of the objectives being to identify areas of rocky outcrop or angular dumped materials (e.g., boulders or concrete) that may be suitable for coral establishment.

5.4.2.2 As displayed by Figure 5.1, the marine geophysical survey results led to the seabed in the Study Area being divided into four zones corresponding with the general bathymetry:

5.4.2.3 Zone A - Inshore Junk Bay: relatively shallow embayment, up to 10m deep. Coastal areas largely disturbed by development, but remnants of fringing rocky / boulder coastal areas exist around a generally silty mud seabed. Some potential to encounter scattered colonies of encrusting hard corals on the west coast of the former Junk Island and along the southwest coast of Junk Bay.

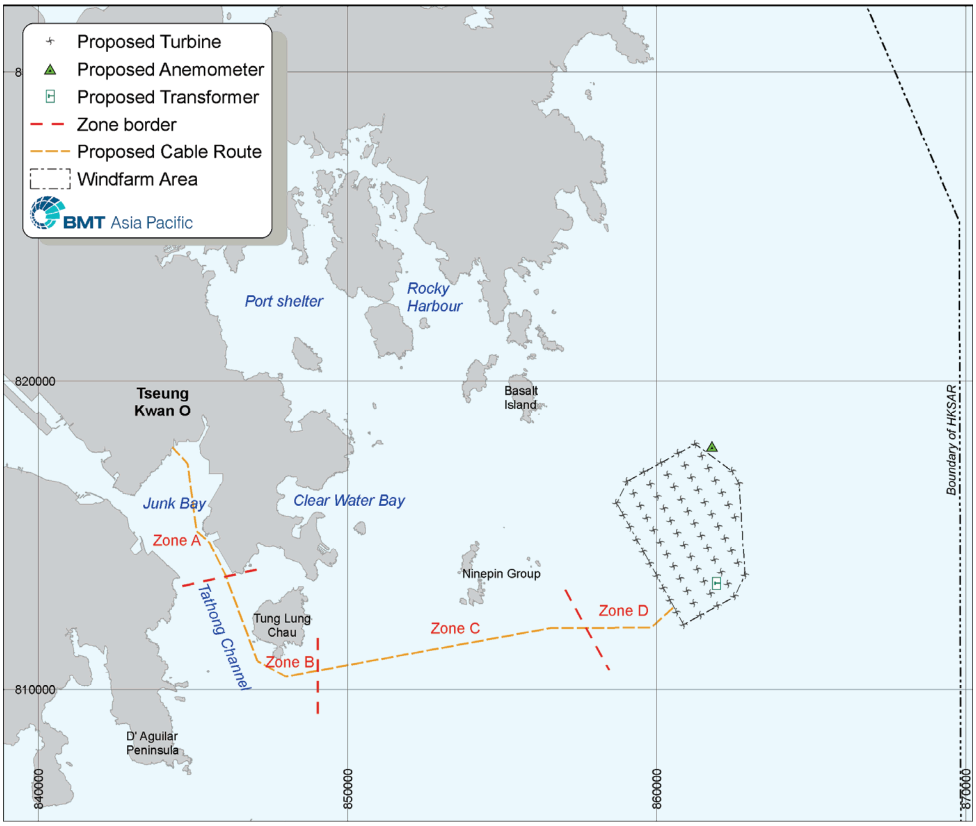
5.4.2.4 Zone B - Tathong Channel: deeper water to ~15 - 20m deep over silty mud seabed, but with widespread submerged and emergent boulders / rocky outcrops west and south of Tung Lung Chau and some potential for coral growth along the southeast of the Channel.

5.4.2.5 Zone C - Nearshore Eastern Waters: waters some 20-25m deep to the east of Tung Lung Chau and the south of the Ninepin Islands group. Seabed generally characterised by silty mud, with low potential for hard substrate.

5.4.2.6 Zone D - Offshore Eastern Waters: waters east of the Ninepins with depths to -30mPD. Seabed in the windfarm area characterised by silty mud, with low potential for hard substrate.

5.4.2.7 Reconnaissance dives at 3 locations in the windfarm area ultimately confirmed the absence of suitable substrate in an environment dominated by silty material. Figure 5.15 shows typical marine conditions at the wind farm site. Dives at two locations in the Tathong Channel with potential consolidated seabed material could not be completed due to safety reasons, given the locations were in the marine navigation channel.

Figure 5.1 General Bathymetric Zonation of the Study Area



5.4.3 Coral / Epifauna Survey

5.4.3.1 Baseline surveys of the coral / epifauna community were conducted using standard dive survey methodology involving:

5.4.3.2 Spot-check (reconnaissance) dives: used for the initial assessment of depth zones and the suitability of a location for detailed transect surveys.

5.4.3.3 Rapid Ecological Assessment (REA) method: following DeVantier *et al* (1998, 2000), REA involves the standardised collection of semi-quantitative data concerning reef development, various environmental attributes and details of coral community structure.

5.4.3.4 Prior to positioning of transects for the REA assessment, a series of reconnaissance dives were systematically conducted to identify suitable survey areas at each location. Following each reconnaissance dive, observations were discussed and an appropriate depth zone and number / length of transects was apportioned for each suitable location.

5.4.3.5 At the inshore survey locations each transect was placed parallel to the shoreline, comprising a survey line of up to 200m long and 2m wide. For deeper offshore locations, such as Victor Rock, the transect length was reduced to 100m and 2m wide due to a relatively constrained area of potential interest around these underwater pinnacles.

5.4.3.6 Video footage was recorded first at each location to avoid potential disturbance of fine sediment, followed by REA survey and data collection. All REA transect surveys were recorded using a mini DV format video camera, with footage transferred to DVD using an MPEG compression programme. Footage was reviewed to verify the REA data. A photographic record was also compiled for each location.

5.4.4 Infauna Survey

5.4.4.1 Baseline surveys of the infauna community were conducted using standard methodology involving the collection of 5 replicate sediment samples at each station using a 0.1 m^2 van Veen Grab. In addition, one extra sample was taken for particle size distribution and total organic matter (TOM) analyses.

5.4.4.2 To increase the survey coverage the replicates were no closer than 50m, as verified by GPS. A centre point was determined at each station and additional replicates were sampled radially 50m from the centre at equal-degree angles. The sequence of replicate sampling was randomly determined. Water depth at each station was measured by echo sounder.

5.4.4.3 Each grab sample, once collected, was inspected to ensure that the volume of sediment obtained was not less than 2 litres and that there were no signs of uneven penetration by the grab during lowering. A photographic record of sediment colour at each station was taken prior to sample processing.

5.4.4.4 For faunal analysis, the sediment sample was gently washed with seawater through a stack of 1.0mm and 0.5mm diameter sieves, and large animals visible from the residue were handpicked into a small plastic vial. All remains were then washed and transferred into a plastic container and preserved with 5% borax-buffered formalin and stained with 1% Rose Bengal. Sediment samples for TOM analysis were stored in ice on board the survey vessel before transfer to the laboratory freezer.

5.4.4.5 Sorting of all residues remaining on the 0.5 mm sieve was completed at the laboratory by trained technicians prior to taxonomic identification and biomass (wet weight) determination. To achieve the lowest taxonomic resolution, examination of the morphological features of the specimens was undertaken using both stereoscopic and compound microscopes. To record the number of individuals, only the anterior portions of the animals were counted. Total biomass of the benthic animals at each sampling location was determined as preserved wet weight, after blotting the animals on filter paper for three minutes before weighing to the nearest 0.01 g.

5.4.4.6 Determination of sediment particle size distribution was conducted for one replicate per sampling station by wet sieving through a stack of sieves of 2,000 to 63 μm. For TOM analysis, all sediment samples were pre-treated with 35% hydrogen peroxide overnight to remove calcium carbonate and percentage TOM was calculated as the loss in weight of sediment after combustion at 500°C for 8 hours, as compared with samples dried at 100°C. Two replicates were analysed for TOM per sample.

5.4.4.7 A variety of Quality assurance / quality control measures were implemented consistency in the species identification process. In processing all faunal samples in both surveys, no animals were missed during the sorting and identification stages. Field data were entered to a database prior to statistical analyses.

5.5 Ecological Baseline Profile – Literature Review

5.5.1 Benthic Epifauna

5.5.1.1 With regard to hard corals, much of the *inshore* Study Area (i.e., west of Tung Lung Chau) is characterised by exposed rocky coastline against a generally silty seabed, and with turbid marine waters. As such, most hard coral communities in the area are limited to small colonies.

5.5.1.2 The communities with the highest diversity, density and most hard coral accretion in the HKSAR are generally found in offshore eastern waters, and generally belong to one of three community types (AFCD, 2004):

- *Platygyra – Favia* community: clear shelter waters with low turbidity and sediment and high salinity;
- *Acropora solitaryensis – Montipora peltiformis* community: more exposed areas of moderate to high water clarity and salinity and low sediment; and
- *Porites deformis – Cyphastrea* community: deeper communities – moderate water clarity and sediment deposition.

5.5.1.3 Octocorals / soft corals prefer deeper and more turbid sites where hard coral cover is generally low. Coverage averaged 1% in the hard coral dominated sites, while Victor Rock reportedly had a soft coral coverage of ~70% (*ibid*). From the HATS Coral Survey (Oceanway, 2003), the best octocoral diversity and percentage coverage in the study area was at Ngan Wan (Tseung Kwan O / Cape Collinson) where some 14 genera were recorded. The nearest REA survey location for this EIA Study is Fat Tong Chau.

5.5.1.4 Local literature on black coral is extremely limited. Zhou and Zhou (1984) first documented three species of *Antipathes* and three species of *Cirripathes* from the Sai Kung Peninsula, including a new record for one species of *Cirripathes*. It was noted that most of these antipatharians grew in a depth range of -10m to -20m CD, although no further details of collection sites were recorded.

5.5.1.5 Other more recent records of black coral in the HKSAR include:

- South Ninepin: occasional black coral found at -6m to -15m C.D. (Binnie Consultants Ltd, 1995)
- Tolo Channel: extensive black coral communities growing in shallow waters on both sides of the Channel, particularly towards Mirs Bay (Asiatic Marine, 2002)

5.5.1.6 The Chinese University of Hong Kong is currently conducting an HKSAR-wide black coral survey on behalf of AFCD, but no data is publicly available at this time.

5.5.1.7 The dominant *Antipathes* species in Hong Kong has been identified as *Antipathes sp. aff. A. curvata van Pesch 1914* (Asiatic Marine, 2002). This species has not been reported from other localities, although similar species have been described from Hawaii and the Indian Ocean. As black corals have historically been poorly described, positive identification for any species is difficult.

5.5.1.8 A literature review yielded more specific information regarding coral distribution, as presented below. Figure 5.2 displays these and other locations of interest.

A. Southwest coast of Junk Bay (Chiu Keng Wan)

5.5.1.9 Although only a very low abundance of hard corals has been recorded, the coastal area close to Lei Yue Mun has been found to have high abundance of soft and gorgonian corals (Maunsell, 2005). These soft and gorgonian corals are especially prevalent in the mid-depth and deep zones where up to 50% coverage has been noted, but a relatively high mortality of up to 30% has also been observed (Oceanway, 2003).

B. Junk Island

5.5.1.10 Very few hard corals have been recorded in the shallow waters (only one single colony of *Acanthastrea echinata* was recorded in HATS Study). In contrast, soft corals and gorgonians have been identified as moderately abundant and occurred more frequently in middle zone (25-50% cover).

C. Ngan Wan

5.5.1.11 A rich and diverse soft / gorgonian coral community dominated by *Echinomuricea* sp. has been found extending from the shallows into deeper waters, with certain groups of fauna such as sea fans, sea whips and soft corals being markedly larger in the shallow waters than in the middle and deep depths. This group of soft coral community has been perceived to be one of the best in Hong Kong coastal waters, with 14 taxa and a coverage of 18% (*ibid*).

D. Tung Lung Chau

5.5.1.12 Low cover (<5%) of both hard and soft corals has been recorded along the south and west coast of Tung Lung Chau. However, the north Tung Lung Chau has been found to have a good hard coral cover (10-25%) occurring in the shallow waters.

E. Ung Kong Wan

5.5.1.13 Ung Kong Wan is described as being among the top 12 most important coral sites in Hong Kong due to the formation of incipient reefs (AFCD, 2004). Both % cover and species diversity of hard corals were notably high at Ung Kong Wan, with >50% cover in some areas and with over 35 species of hard coral recorded. The regionally restricted hard coral *Micromussa minuta* has also been recorded at Ung Kong Wan.

F. Ninepin Group

5.5.1.14 The AFCD (2004) study suggests that both North and South Ninepin Islands support a high average percentage cover of hard corals. Although South Ninepin has been identified to also have a high level of coral injury due to natural exposure to the South China Sea, it does support a high density of live coral cover at ~50%. Some species at South Ninepins (and Ung Kong Wan) have been found to grow rapidly and are able to create large colonies.

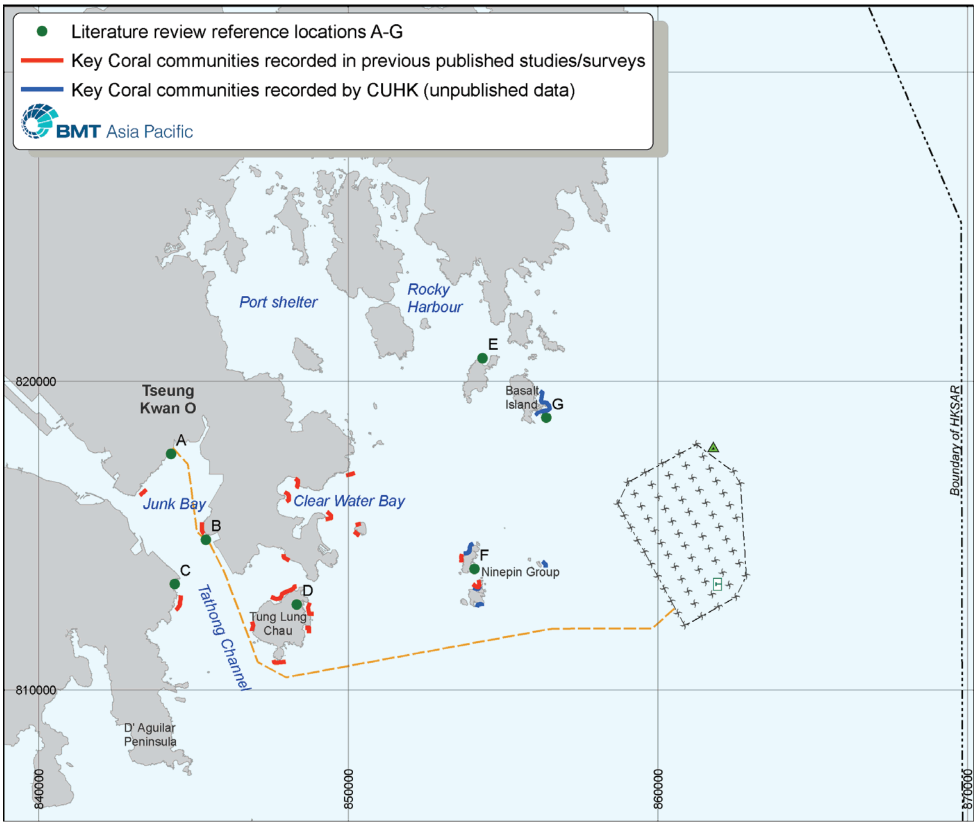
5.5.1.15 The most recent survey conducted by Chinese University of Hong Kong in Eastern Waters involved approximately 100 dives at some 30 locations, including the Ninepin Islands. From interview, the unpublished findings indicate that both North Ninepin (Tuen Keng and Ma Wan) and East Ninepin (Tuen Chau Tsai) support communities of soft corals / gorgonians with up to 70% cover, and generally support very rich and diverse communities of coral and associated epifauna.

5.5.1.16 In South Ninepin waters, a relatively high abundance of hard and soft corals has been recorded at Kwo Chau Wan (north of South Ninepin), while gorgonians have been found to be moderately abundant on the southern side of South Ninepin.

G. Southeast of Basalt Island

5.5.1.17 Researchers from Chinese University recorded that soft coral / gorgonians were moderately abundant around the southeast coast of Basalt Island.

Figure 5.2 Distribution of Key Coral Communities in the Study Area



5.5.2 Benthic Infauna

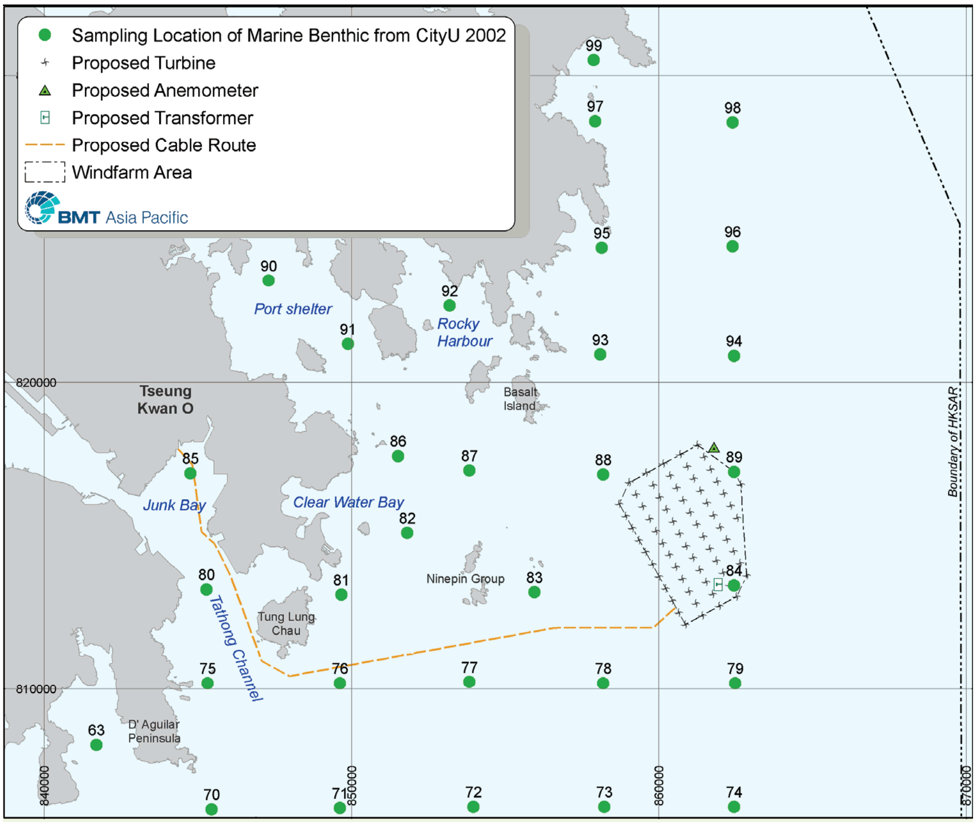
5.5.2.1 As regards benthic infauna, the largest field survey conducted in the HKSAR in recent years was '*The Consultancy Study on Marine Benthic Communities in Hong Kong*' conducted by City University on behalf of AFCD (CityU, 2002). The study comprised a two-season investigation of infauna composition at 120 stations across the HKSAR. A total of 603 species were recorded, with 287 species commonly found in both seasons. Polychaete annelids, crustaceans and bivalves were reportedly the most common species.

5.5.2.2 Some 179 species were found only in the wet season, and 137 species were found solely from the dry season survey. Despite this, the study concluded there was no distinct seasonality in Deep Bay or Tai Long Wan (*ibid*).

5.5.2.3 A number of the survey stations were located in Eastern Waters in the vicinity of the proposed project. Figure 5.3 displays the coverage of the CityU 2002 work in relation to this EIA Study Area.

5.5.2.4 Species diversity (*H'*) is a joint representation of species richness (*d*) and the evenness (*J*) of species distribution, and is usually high (e.g., *H'* >3) in an undisturbed community and low (e.g., *H'* <1) in a heavily disturbed community.

Figure 5.3 Historic Sampling Locations in Eastern Waters from CityU 2002



5.5.2.5 Shin (1989) reported previous benthic surveys in Eastern Waters revealed diversity (*H'*) values of 2.21 – 3.50 and evenness (*J*) values of 0.80 – 0.91. In contrast, diversity and evenness off East Kowloon may be in the order of 0.91 – 1.23 and 0.25 – 0.34, respectively (CityU, 2002). Table 5.1 indicates key biodiversity indices across the Study Area. It is apparent these values are broadly consistent with the earlier study by Shin (1989).

Table 5.1 Key Biodiversity Indicators for the Study Area from CityU 2002

Area	Species diversity (*H'*)	Species evenness (*J*)
Cable landing (Junk Bay)	2.43 - 2.73	0.77 - 0.87
Nearshore cable (Tathong Channel)	3.21 - 3.29	0.72 - 0.75
Offshore cable (South Ninepin)	2.31 - 3.10	0.90 - 0.92
Windfarm	2.99 - 3.58	0.84 - 0.92

Notes: Data for project locations with reference to CityU (2002) stations 85, 80, 77 and 88.

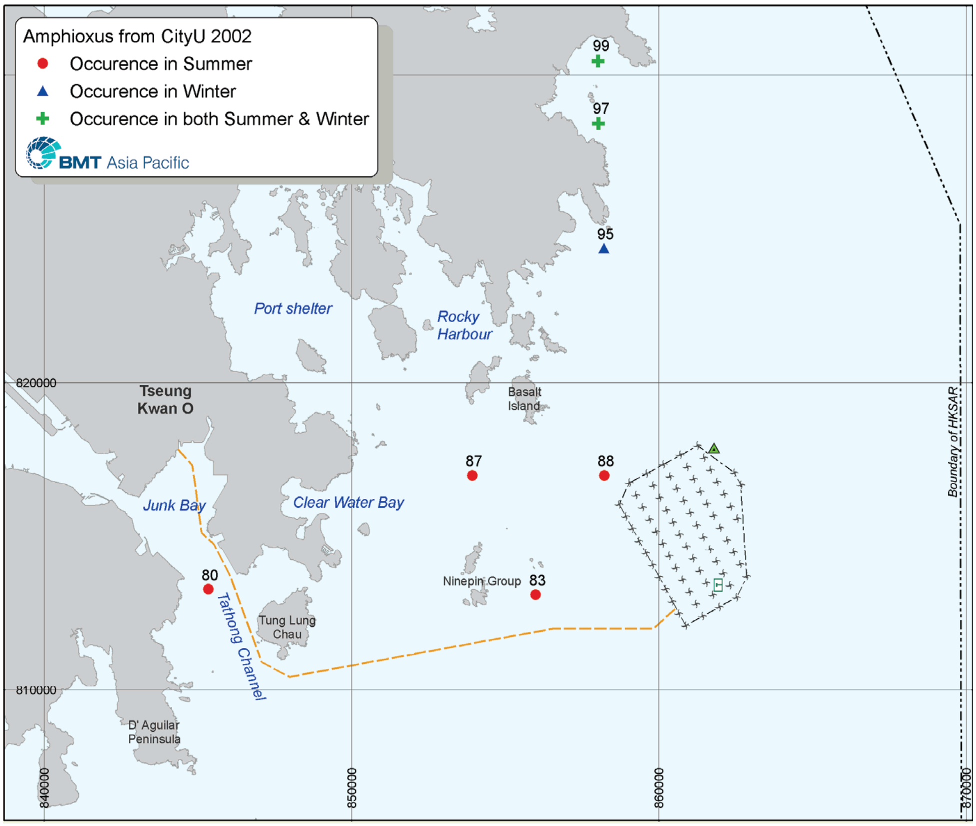
5.5.2.6 Maunsell (2005) conducted supplementary sub-tidal grab samples at three soft substrate stations in Junk Bay, and found the infauna community to be dominated by polychaetes: 36 species from 22 families, 83.1% of all specimens and 55.8% of total biomass. The polychaetes *Pseudopolydora kempi* and *Glycinde kameruniana* accounted for ~25% and 17% of all infauna 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*.

5.5.2.7 Overall, the survey results indicated these 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.

5.5.2.8 CityU (2002) also reported the presence of the cephalochordate (amphioxus) *Branchiostoma belcheri* in the Study Area, with records of 1 or 2 individuals collected from the vicinity of the nearshore cable route in the Tathong Channel, East Ninepins and the Windfarm footprint in the wet season only.

5.5.2.9 There also appears to be a resident population of Amphioxus at Tai Long Wan where densities of 50 – 100 per m^2 recorded in both wet and dry seasons, although signs of seabed disturbance from human activity are of potential concern as regards marine conservation (*ibid*). Figure 5.4 presents the locations of Amphioxus within the Study Area.

Figure 5.4 Distribution of Amphioxus in Eastern Waters from CityU 2002



5.5.2.10 Amphioxus is of conservation significance because of its primitive morphology and because of its over-exploitation as a fishery resource in coastal waters of the South China Sea, especially near Xiamen (Lu et al., 1998). Amphioxus is classified as a Class II protected species in China (Huang, 2006).

5.6 Field Survey Results

5.6.1 Benthic Epifauna

5.6.1.1 Following literature review and interpretation of side scan sonar, dive surveys were conducted at thirteen locations that together provide spatial representation across the study area. Table 5.2 presents the names and co-ordinates of the survey locations. Figure 5.5 displays the locations.

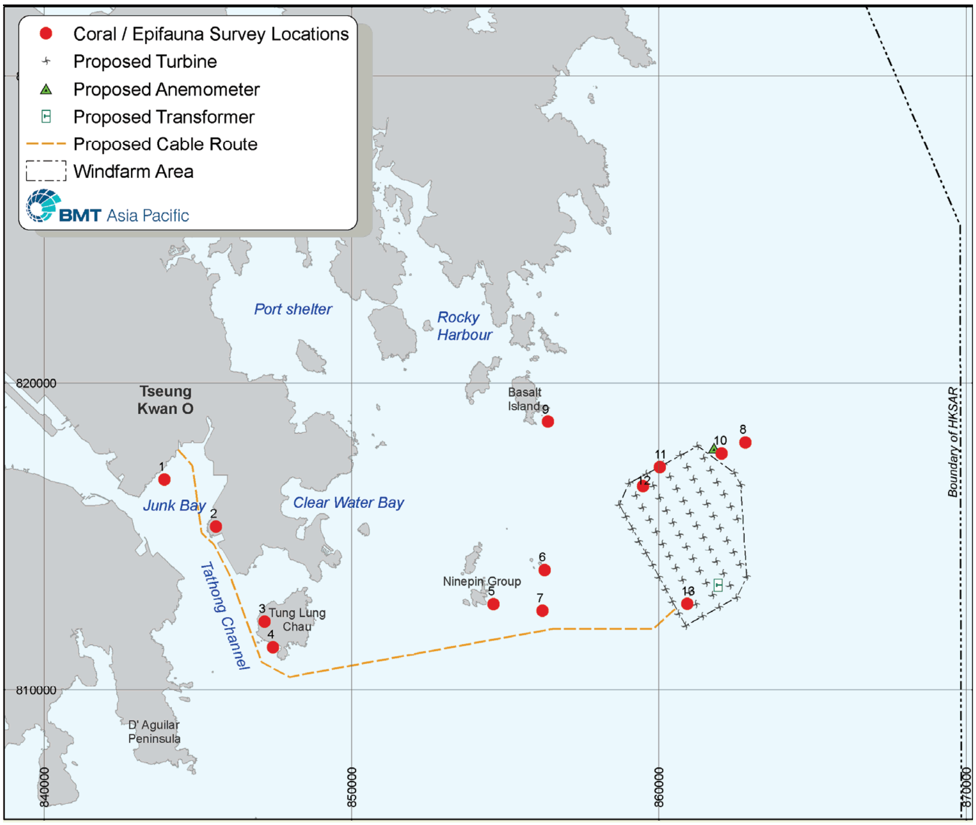
Table 5.2 Coral / Epifauna Survey Locations

Station	Location	GPS Position
1	Chiu Keng Wan	N 22 17 527 E 114 14 936
2	Fat Tong Chau	N 22 16 704 E 114 15 909
3	Tung Lung Chau West	N 22 15 019 E 114 16 826
4	Tung Lung Chau South	N 22 14 569 E 114 16 982
5	South Ninepins	N 23 15 327 E 114 21 161
6	East Ninepins	N 22 15 924 E 114 22 121
7	One Foot Rock	N 22 15 207 E 114 22 080
8	Victor Rock	N 22 18 163 E 114 25 927
9	Basalt Island	N 22 18 532 E 114 22 189
10	Mast Area	N 22 17 978 E 114 25 482
11	Wreck #1	N 22 17 723 E 114 24 355
12	Wreck #2	N 22 17 399 E 114 23 991
13	Un-identified object	N 22 15 320 E 114 24 823

5.6.1.2 Six stations (1 - 5 and 7) were selected to cover the proposed cable route area. Four stations (10 - 13) were selected to provide representative spatial coverage within the windfarm area against known areas of potential interest.

5.6.1.3 East Ninepin (6) was selected as it has been documented as a site of interest mid-way between the cable route and the turbine area. Surveys were also conducted at Victor Rock (8) - the submerged rocky pinnacle at about 0.9km to the north east of the proposed windfarm - and at Basalt Rock (9) some 4km west-northwest of the proposed windfarm.

Figure 5.5 Distribution of Coral / Epifauna Survey Stations



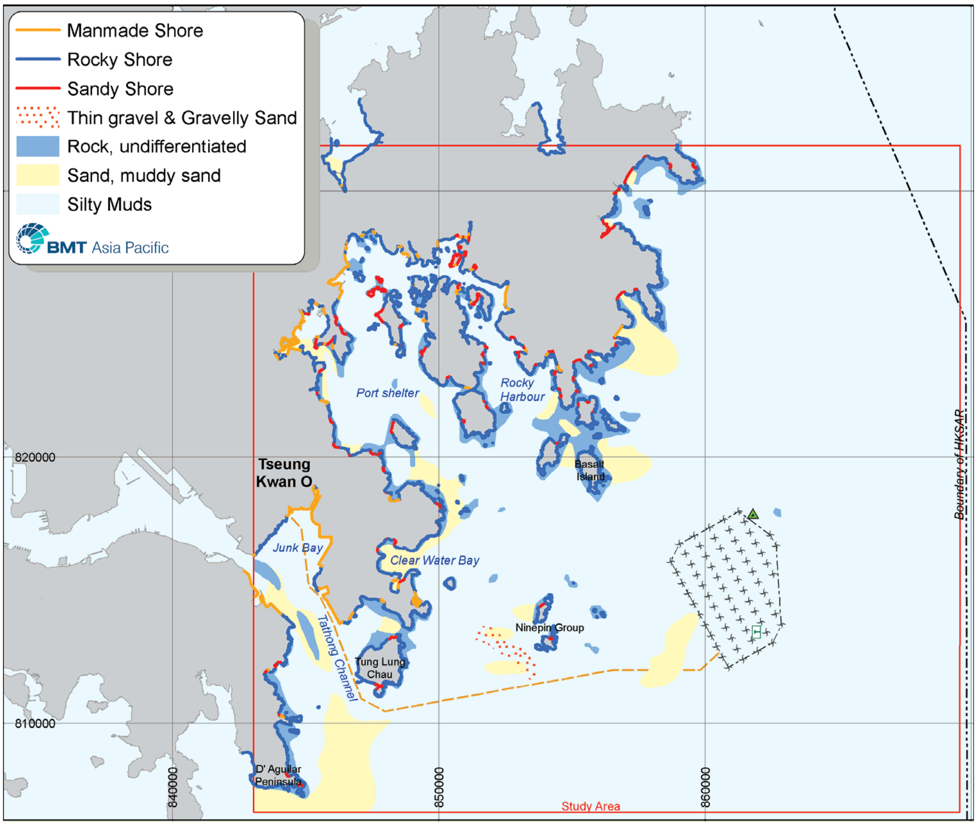
5.6.1.4 A total of 30 REA transects were surveyed, with the shallow depth zone and deep depth zone accounting for 15 transects each.

5.6.1.5 The dive surveys were carried out between March and June 2007 in generally calm sea surface conditions, although underwater visibility was generally poor inshore due to anthropogenic influence and offshore due to the prevailing wind and the fine nature of the seabed sediment. Horizontal underwater visibility was typically in the range of 0.5 – 5.0m, reducing rapidly in the deeper waters of sites 10 – 13 where seabed visibility was effectively zero.

5.6.1.6 Within Junk Bay and Tung Lung Chau the majority of the coastline was a boulder / granite-faced shoreline, occasionally broken by a pebble beach or a small sandy / muddy bay. The Ninepins are steep sided cliffs dropping into the sea. Basalt Island is an isolated rocky island with steep submerged cliffs, while both Victor Rock and One Foot Rock are rocky submerged pinnacles. Figure 5.6 presents a habitat map for the Study Area.

5.6.1.7 A description of the physical and ecological characteristics of each of the 13 survey locations is presented below. Appendix 5A presents further details of habitat site conditions for the benthic communities at these locations, including a selection of photographs of key features.

Figure 5.6 Habitat Map in the Study Area



1. Chiu Keng Wan

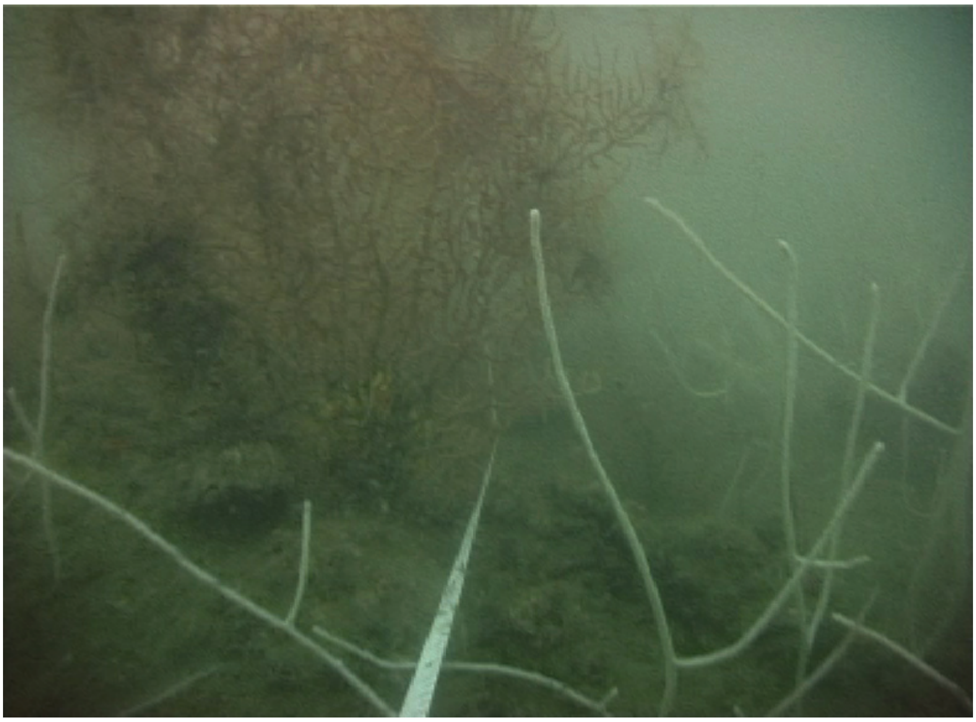
5.6.1.8 Chiu Keng Wan dive site was located along the western coastline of Junk Bay just before the reclaimed area begins. The shallow depth zone -4 to -6m was mostly composed of big rocks while the benthic substratum shifted to a sandy base towards the deeper depth zone of -7 to -9m.

5.6.1.9 The shallow zone consisted of both hard coral (<2%) and octocoral (5-10%), but with the latter being more dominant. The deep zone was colonised mainly by octocoral (20-25%) and black coral (<1%). The occasional *Hippocampus kuda* (seahorse) was also noted attached to some of the gorgonians. Figure 5.7 displays a typical view of the marine environment at this location.

5.6.1.10 A total of four hard coral species were recorded in the shallow zone (*Favites pentagona*, *Turbinaria peltata*, *Psammocora superficialis* and *Oulastrea crispata*). All colonies were small in size (<20cm) and of low abundance. No hard coral species were recorded in the deep zone.

5.6.1.11 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*).

Figure 5.7 *Anthogoria* at Chiu Keng Wan



5.6.1.12 The station was dominated by the gorgonian *Echinomuricea*, ranging between 15 and 30 cm tall and accounting for 20-25% of total benthic cover. A high abundance of *Euplexaura* and *Paraplexaura* were also recorded, as well as the uncommon genus *Carijoa* that was found growing on the dead axis of a gorgonian.

5.6.1.13 Several black coral colonies of *Cirripathes* were also recorded.

2. Fat Tong Chau

5.6.1.14 Fat Tong Chau on the eastern coastline of Junk Bay (adjacent to the reclamation) is a semi-sheltered area with a thin layer of fine sediment cover over a rocky seafloor. The shallow survey zone was defined as the area between -2 and -4m, with notable re-suspended sediment from a muddy seabed in the deep zone at -6 to -8m. Figure 5.8 displays a typical view of the marine environment at this location.

5.6.1.15 The shallow zone supported very little coral growth, with both hard coral and octocoral recorded at <1% level. The deep zone recorded an octocoral cover of 35%.

5.6.1.16 A total of three hard coral species were recorded in the shallow zone, namely; *Goniopora stutchburyi*, and two favites: *Leptastrea purpurea* and *Cyphastrea serailia*. The *Goniopora* and *Leptastrea* species colonies were > 60cm in diameter, while the *Cyphastrea* was only 30cm in diameter. All of the hard corals were uncommon to the site. The deep zone did not support any hard coral growth.

Figure 5.8 Epifauna Community at Fat Tong Chau

5.6.1.17 In the shallow zone, four colonies of the octocoral *Euplexaura* sp. were recorded, with four genera in the deep zone (*Paraplexaura, Echinomuricea, Euplexaura and Dendronephthya*). The common gorgonian genera *Echinomuricea* and *Paraplexaura* dominated the deep zone community, accounting for 30-35% of total benthic cover. A few soft coral colonies of *Dendronephthya* (30 cm tall) were found attached to some of the rocky surfaces.

5.6.1.18 No black coral colonies were found in this site.

3. Tung Lung Chau West

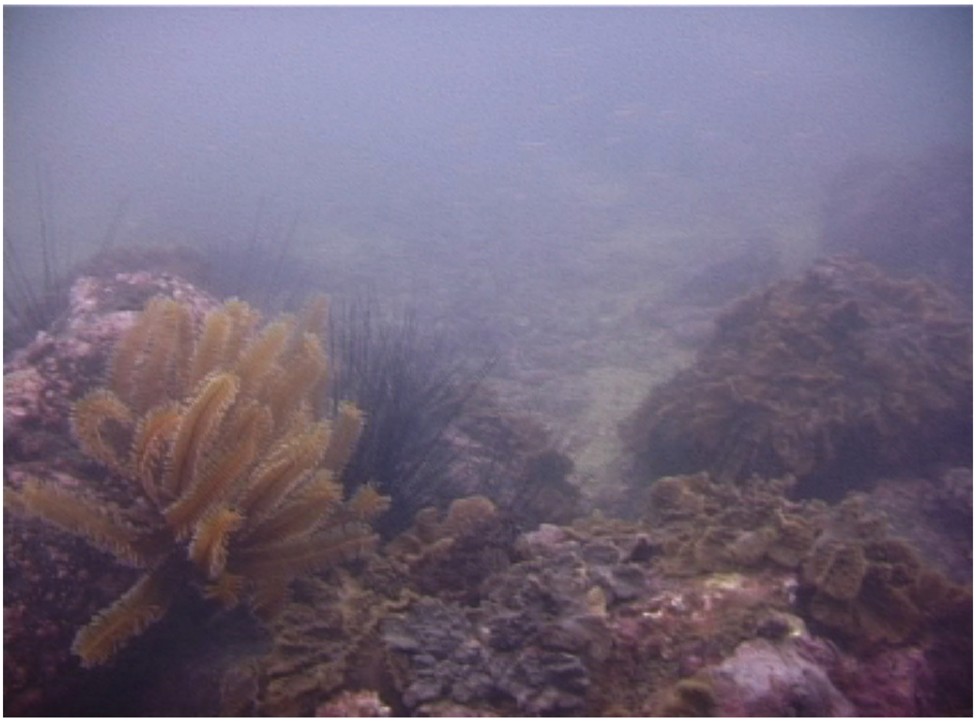
5.6.1.19 Tung Lung Chau is a semi-exposed site, with a boulder/cliff coastline. The shallow zone was about - 4 m deep, composing mainly of large rocks and coarse sand. The deep zone was mainly sand at -7 to -8m, heavily scoured by trawler marks.

5.6.1.20 Overall the shallow zone had very little coral cover with only about <1% of hard coral coverage and 5% of octocoral coverage. A total of four hard coral species were recorded in the shallow zone. These were *Porites lutea*, *Plesiastrea versipora*, *Turbinaria peltata* and one *Favites* sp. All of the species were uncommon to this area and were small, <30cm in diameter. In the deep zone, no corals were recorded besides *Dendrophyllia*, an ahermatypic hard coral sometimes misidentified as *Tubastrea*.

5.6.1.21 Two genera of octocorals were recorded in the shallow zone: the soft coral *Sinularia* and the gorgonian *Euplexaura*. Only one gorgonian colony of *Echinomuricea* sp. was found in the deep zone. Figure 5.9 displays a typical view of the marine environment at this location.

5.6.1.22 No black corals were recorded.

Figure 5.9 Epifauna Community at Tung Lung Chau West



4. Tung Lung Chau South

5.6.1.23 The shallow zone of Tung Lung Chau was an exposed site around Nga Ying Pai rocky outcrop ranging between -6 to -8m deep. The deep zone was -10 to -12m deep. The substratum was mainly composed of large rocks. The shallow zone supported 5-10% hard coral, whilst the deep zone supported a hard coral cover of up to 25%.

5.6.1.24 Two hard coral species were recorded in the shallow zone: *Goniopora stutchburyi* and *Psammocora superficialis*. Both were small in size, being 10-15cm in diameter. Eleven species of hard corals were recorded in the deep zone: *Plesiastrea versipora*, *Cyphastrea serailia*, *Cyphastrea japonica*, *Favia helianthoides*, *Favia speciosa*, *Goniopora djiboutiensis*, *Goniopora stutchburyi*, *Porites lutea*, *Psammocora superficialis*, *Psammocora haimeana* and *Coscinaraea* n. sp.

5.6.1.25 *Coscinaraea* n. sp. remains undescribed but the coral species associates itself with low light habitats in western, eastern and southeastern waters. *Favia helianthoides* is described as uncommon, mainly from locations in eastern waters.

5.6.1.26 All of the hard coral colonies were smaller than 25cm diameter, with *Psammocora superficialis*, *Plesiastrea versipora* and *Cyphastrea serialia* being the most abundant species.

5.6.1.27 A total of seven genera of octocorals were found in the shallow zone. The total coverage was only about 5% of the total benthic cover. Besides *Dendronephthya, Euplexaura* and *Menella*, the other genera recorded in this site were *Nephthyigoria, Chironephthya, Muricella* and *Anthogorgia*. All are classified as being uncommonly recorded octocoral genera with respect to their distribution and abundance in Northeastern waters. The sizes of the colonies were comparatively small (10-20cm). No octocorals were found in the deep zone.

5.6.1.28 A small number of black coral *Cirripathes* were found in the shallow zone.

5. South Ninepins

5.6.1.29 South Ninepins was a very exposed site with shallow zone transects at -5m to -7m and deep zone transects at -13m to -15m. The substratum mainly comprised large rocks at the base of a steep sided cliff. The exposed shallow zone of South Ninepins supported very little coral growth. The deep zone consisted mainly of octocorals (5-10% cover) and hard corals (5-10% cover).

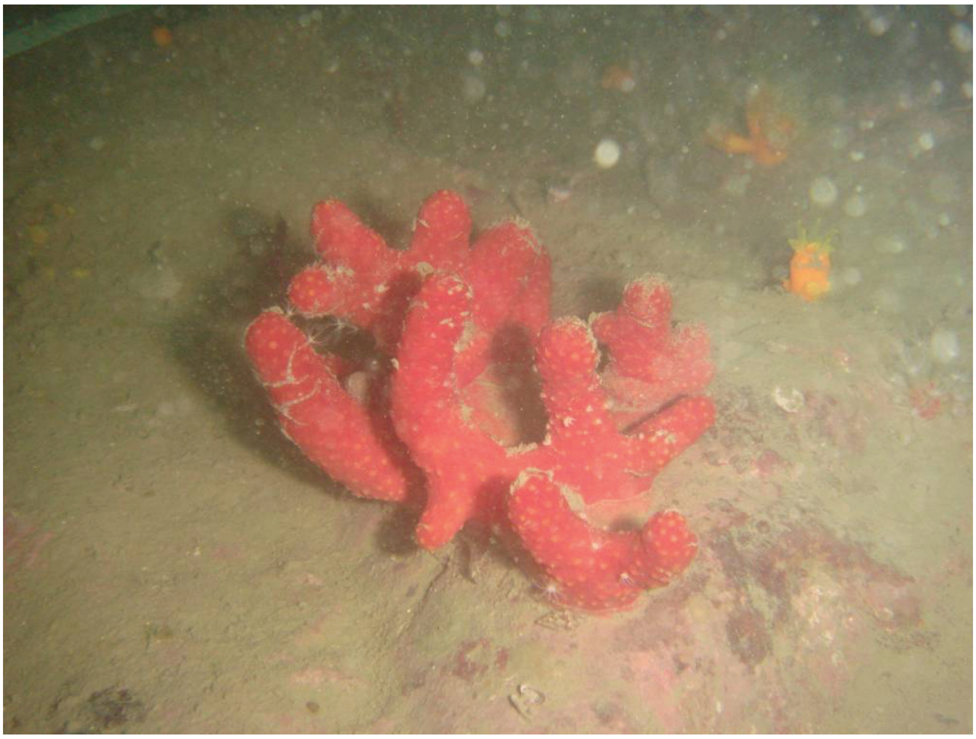
5.6.1.30 No hard coral species were recorded in the shallow zone, although three species were found in the deep zone: *Plesiastrea versipora*, *Montipora peltiformis* and *Psammocora superficialis*. All of these species were common to this site, but all were small in size at 10-15cm diameter.

5.6.1.31 Two genera of octocorals were recorded in the shallow zone: the gorgonian *Euplexaura* and the soft coral *Carijoa*. *Carijoa* is classified as uncommon in Hong Kong waters. Eight octocoral genera were recorded in the deep zone: *Dendronephthya, Paraplexaura, Euplexaura, Anthogorgia, Acanthogorgia, Scleronephthya, Paraminabea* (lobate orange SP1 & branching red SP2) and *Echinomuricea*, contributing to 5-10% of the total benthic cover.

5.6.1.32 Dendronephthya was the most common genus found in this site, with colony sizes ranging 5 – 15cm high. A small number of Paraminabea, classified as uncommon in Hong Kong, were found at a depth of -23m with the overall size being bigger than the commonly found lobate orange SP1. Figure 5.10 displays a typical view of the marine environment at this location.

5.6.1.33 A few colonies of black coral Cirripathes were recorded in the deep zone.

Figure 5.10 Paraminabea Lobate Orange SP1 at South Ninepins



6. East Ninepins

5.6.1.34 East Ninepins was a semi-exposed site with a strong current. A sloping cliff of medium to large sized rocks extended to a flat silty seabed. The shallow zone transect ranged from -5 to -7m, with the deep zone transect at -20 to -22m.

5.6.1.35 The shallow zone supported little hard coral growth (5-10%) while the deep zone had slight octocoral growth (<5%) and little hard coral cover (5-10%).

5.6.1.36 Five hard coral species were recorded in the shallow zone: *Montipora peltiformis*, *Montipora turgescens*, *Montipora mollis*, *Psammocora superficialis* and *Favia speciosa*. Both Montipora and Psammocora were common to this area, with some colonies being 40cm in diameter. *Montipora turgescens* is classified as rare in eastern and north-eastern HKSAR waters. The deep zone did not support any apparent hard coral growth.

5.6.1.37 A few colonies of three octocoral genera were found in the shallow zone: *Carijoa, Dendronephthya* and *Euplexaura*. Six genera were recorded in the deep zone: *Dendronephthya, Menella, Acanthogorgia, Echinomuricea, Paraminabea* and SP3 (a genus of an unknown encrusting soft coral, being the same as found at Victor Rock). Figure 5.11 displays a typical view of the marine environment at this location.

5.6.1.38 A number of black coral *Cirripathes* were recorded in the deep zone, growing on the flat bedrock channel and contributing 5-10% to total benthic cover.

Figure 5.11 *Paraminabea* SP3 at East Ninepins

7. One Foot Rock

5.6.1.39 One Foot Rock - a submerged rocky pinnacle - was a very exposed site with smooth bedrock around its surface and small rocks/rubble on a silty / sandy seabed in the deep zone. The shallow transect was placed at -10m to -11m, and the deep transect was placed at -23m. The degree of sediment re-suspension was notably high at this location.

5.6.1.40 The shallow zone supported a fairly good hard coral cover of up to 10% and slight octocoral growth (<5%). In the deeper zone, up to 40% octocoral coverage was recorded.

5.6.1.41 Three hard coral species were recorded: *Pleasiatrea versipora*, *Montipora peltiformis* and *Psammocora superficialis*. All were common to this area, and were mostly small in size, ranging from 5 to 20cm diameter. No hard coral species were recorded in the deep zone.

5.6.1.42 Only colonies of the soft coral *Dendronephthya* were recorded in the shallow zone, accounting for up to 10% of the total benthic cover. There was higher octocoral diversity in the deep zone, with thirteen genera recorded: *Nephthyigorgia, Dendronephthya, Muricella, Echinogorgia, Menella, Astrogorgia, Scleronephthya, Viminella, Anthogorgia* (could be 1 of 3 species), *Paraminabea, Acanthogorgia, Euplexaura* and *Echinomuricea*.

5.6.1.43 The soft corals *Dendronephthya, Scleronephthya* and the sea fan *Muricella* generally dominated the community. *Nephthyigorgia* is an uncommon octocoral genus in Hong Kong, but was abundant at this site. Colonies of the gorgonian *Viminella*, another uncommon Hong Kong genus, were also recorded. Figure 5.12 displays a typical view of the marine environment at this location.

5.6.1.44 The black coral genera *Antipathes* and *Cirripathes* were recorded, with the latter generally being more abundant.

Figure 5.12 *Muricella* at One Foot Rock

8. Victor Rock

5.6.1.45 Victor Rock is a submerged and very exposed pinnacle that comes to about -7m from the sea surface. The rock is a combination of rounded bedrock at the surface and steep-sides cliffs that drop to the seabed at around -28m.

5.6.1.46 The main benthic fauna composition was octocorals and black corals. In the shallow zone octocoral covered some 20-30% with very little hard coral growth. The deep zone supported a very extensive octocoral cover of around 70%.

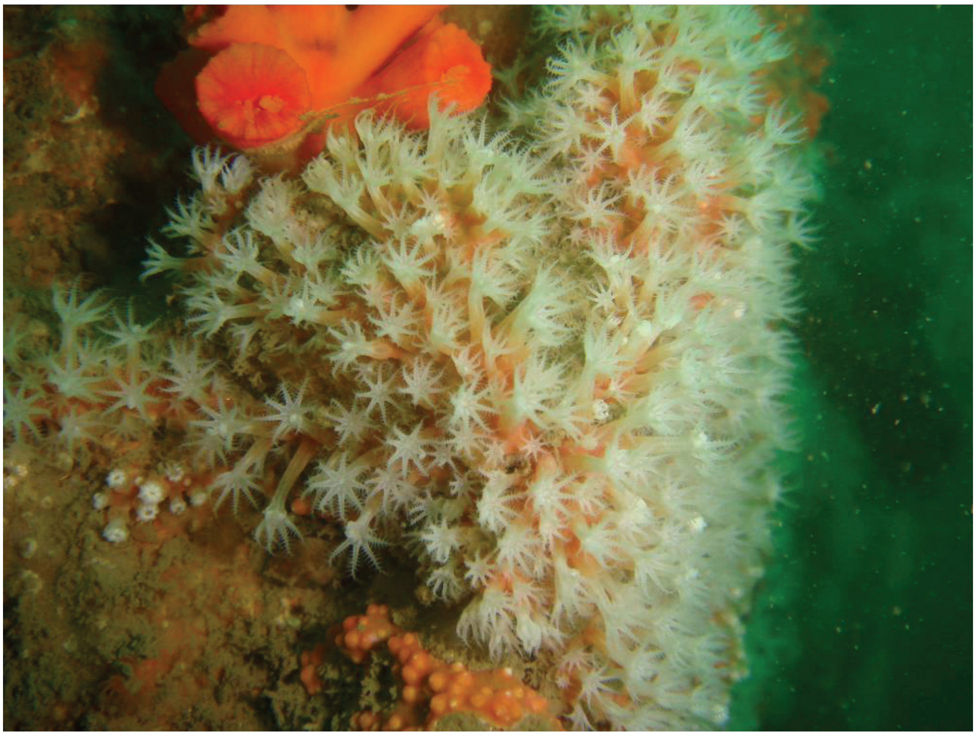
5.6.1.47 In the shallow zone a single specimen of hard coral *Montipora peltiformis* was recorded, which is commonly found in this area. Four octocoral genera were also recorded in the shallow zone: *Dendronephthya, Scleronephthya, Muricella* and *Chrionephthya*. The genus *Chironephthya* is classified as uncommon in Hong Kong. Large patches of *Dendronephthya* (>30cm) and *Scleronephthya* (>10cm) were observed and together contributed 20-30% of the total benthic cover.

5.6.1.48 In the deep zone, fifteen octocoral genera were recorded: *Scleronephthya, Astrogorgia, Muricella, Dendronephthya, Anthogorgia, Acanthogorgia, Echinomuricea, Paraplexaura, Paraminabea, Menella, Nephthyigorgia, Echinogorgia, Euplexaura, Viminella* and SP 3 (one genus of unknown encrusting soft coral). These octocorals made up between 60-70% of the total benthic cover. The dominant species were the soft coral *Dendronephthya* (30-40cm), *Scleronephthya* (15cm) and sea fan *Muricella* (20-30cm).

5.6.1.49 The soft coral genera *Paraminabea* (uncommon) and *Nephthyigorgia* (common) were also abundant at this site. In addition small patches of encrusting orange-coloured soft corals (SP3) were found at -23m. This species has been recorded in Hong Kong once before (Breakers Reef), but is yet to be formally identified. Figure 5.13 displays a typical view of the marine environment at this location.

5.6.1.50 The black coral genera *Antipathes* and *Cirripathes* were recorded in the deep zone, with *Cirripathes* colonies of 60-100cm diameter recorded at deeper depths.

Figure 5.13 *Paraminabea* at Victor Rock



9. Basalt Island

5.6.1.51 Basalt Island was a semi-exposed site around the rocky pinnacle of Lam Wan Kok. Steep sided over-hanging cliffs and a very silty seafloor were the main physical features.

5.6.1.52 The shallow zone transect at -7 to -9m recorded very little hard coral growth (5-10%), whilst the deep zone at -17m to -18m) recorded 5% cover of both octocorals and black corals.

5.6.1.53 A total of six hard coral species were recorded: *Psammocora superficialis, Goniopora stutchburyi, Cyphastrea serailia, Plesiastrea versipora, Favites pentagona* and *Montipora peltiformis*. The species *P.superficialis, C.serailia, P.versipora* and *M. peltiformis* were very abundant, with colonies of the latter being up to 40cm diameter.

5.6.1.54 Three genera of octocorals were recorded in the shallow zone: *Dendronephthya, Cladiella and Euplexaura*. The genus *Cladiella*, a zooaxnthellate soft coral, is classed as uncommon in Hong Kong waters. Eight octocoral genera were recorded in the deep zone: *Anthogorgia, Dendronephthya, Scleronephthya, Viminella, Muricella, Paraplexaura, Echinomuricea* and *Euplexaura*. Despite the moderate species diversity, these genera collectively accounted for only 5% of total benthic cover. Figure 5.14 displays a typical view of the marine environment at this location.

5.6.1.55 The black coral genera *Antipathes* and *Cirripathes* were recorded, with the latter generally being more abundant in deeper areas.

Figure 5.14 *Scleronephthya* at Basalt Island

10 . The Windfarm Footprint

5.6.1.56 The prevalence of deep and highly fluidised silty mud within the windfarm footprint precluded the establishment of an epifauna community at locations 10 - 13. Figure 5.15 displays a typical view of the marine environment at the wind farm site.

Figure 5.15 Typical Marine Environment at the Windfarm Site

5.6.2 Benthic Infauna

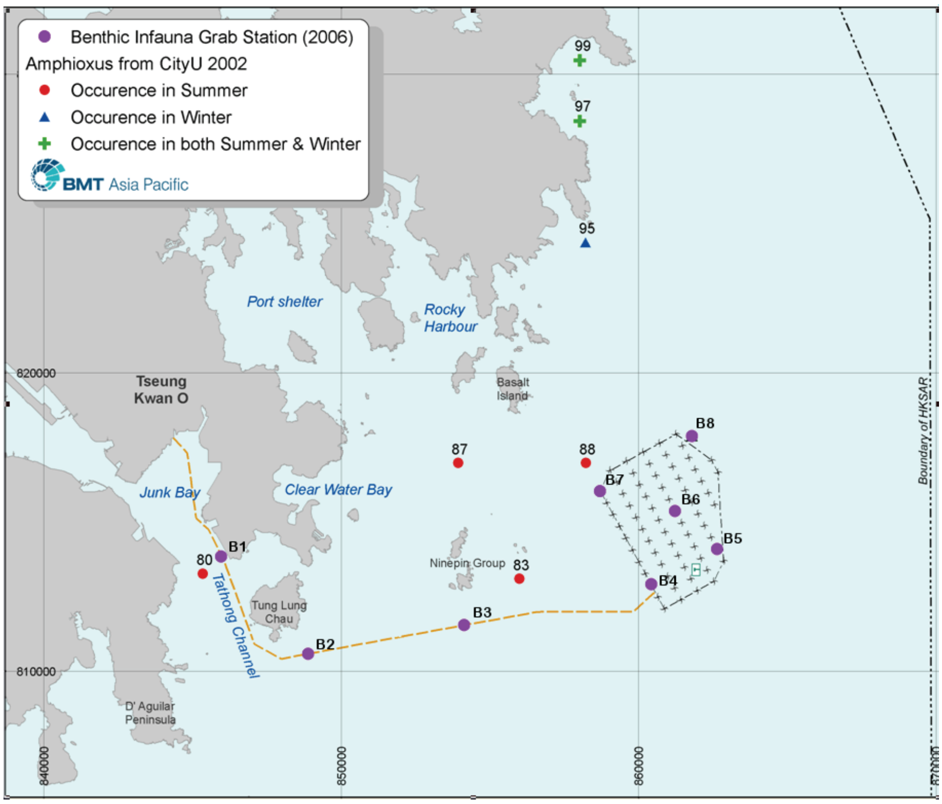
5.6.2.1 The wet season survey was undertaken in August 2006 and the dry season survey in January 2007. Eight sampling stations were adopted for the benthic infauna survey. Table 5.3 summarises the general characteristics of each station, while Figure 5.16 presents their locations.

5.6.2.2 Table 5.3 displays that the mean Total Organic Matter (TOM) content in the wet season ranged from 2.43% (Station 2) to 6.78% (Station 1), with an average across the 8 stations of 4.99%. Mean TOM was at statistically significantly higher levels at all stations in the dry season, ranging from 2.73% (Station 2) to 7.70% (Station 1) and with an average of 6.03%. Sediment samples collected at all stations in both wet and dry season surveys were pale grey in colour and did not emit pungent smell.

Table 5.3 Characteristics of Benthic Infauna Sampling Stations

Station	Latitude	Longitude	Depth (m)	Mean TOM (%)		MDϕ	
				Wet Season	Dry Season	Wet Season	Dry Season
B1	22° 15.808' N	114° 16.266' E	16 - 18	6.78	7.70	6.19	6.02
B2	22° 14.040' N	114° 17.962' E	28 - 31	2.43	2.73	5.39	3.19
B3	22° 14.557' N	114° 21.016' E	29 - 32	3.69	4.43	3.31	5.55
B4	22° 15.296' N	114° 24.678' E	27 - 31	5.36	6.44	6.14	6.21
B5	22° 16.622' N	114° 25.146' E	27 - 32	4.84	7.40	6.20	6.20
B6	22° 17.978' N	114° 25.482' E	27	5.31	7.13	6.18	6.20
B7	22° 16.987' N	114° 23.679' E	28 - 30.5	6.55	7.18	6.21	6.23
B8	22° 15.928' N	114° 25.969' E	28 - 30	4.98	5.20	6.12	6.16

Figure 5.16 Distribution of Infauna Survey Stations



5.6.2.3 From the wet season survey, only Station 3 had particle size (MDϕ) less than 4ϕ, indicating the presence of coarser materials. All other stations had MDϕ over 5ϕ, suggesting they were composed mostly of very find sand and silt/clay. From the dry season survey only Station 2 indicated coarser sediment, with all other stations indicating a seabed of predominantly very find sand and silt/clay. Although varying MDϕ values from Stations 2 and 3 in both seasons could suggest heterogeneous sediment, there was no statistical difference.

5.6.2.4 In terms of infauna composition, the wet season survey produced a total of 1,498 specimens with 92 species in 8 phyla, while the dry season survey produced a total of 1,856 specimens with 85 species in 9 phyla. Polychaete annelids, crustaceans and bivalves were the dominant taxa, in both seasons comprising >55%, >20% and >9% of the total species respectively. Of all species, 71 (66.3%) were recorded in both surveys, with 22 species (20.6%) only recorded in the wet season and 14 species (13.1%) only recorded in the dry season survey.

5.6.2.5 Appendix 5B presents the complete species list and data on other characteristics of all common species in the benthic infauna community (i.e., those present in ≥50% of the 8 sampling stations).

5.6.2.6 Table 5.4 summarizes the number of species, individuals and biomass at each sampling station in wet and dry seasons.

Table 5.4 Summary of species, individuals and biomass recorded at each station in wet and dry season surveys

Station	No. of species (/0.5 m^2)		No. of individuals (/m^2)		Wet weight (g/m^2)	
	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
B1	18	14	468	40	1.77	0.27
B2	46	46	538	332	39.83	8.37
B3	41	53	546	378	7.38	19.55
B4	34	19	264	182	16.99	2.69
B5	37	26	326	288	4.80	15.65
B6	29	24	296	196	4.98	3.68
B7	31	17	276	204	7.35	1.69
B8	32	22	282	236	11.79	13.79

5.6.2.7 In the wet season there were an average of 33.5 species 0.5 m^{-2}, 374.5 individuals m^{-2} and a biomass (wet weight) of 11.86g m^{-2} per station. In the dry season there were an average of 27.6 species 0.5 m^{-2}, 232.0 individuals m^{-2} and 8.21g m^{-2} per station. A significantly higher number of individuals were recorded in wet season (*t*-test, $p<0.05$).

5.6.2.8 A total of 28 species were commonly found in the wet season survey, with the most common being the sipunculan *Apionsoma trichocephalus* and nemertean species that were present at all 8 stations. These were followed by the polychaetes *Magelona* sp., *Aglaophamus dibranchis* and the crustacean (ghost shrimp) *Callianassa japonica* which occurred at 7 stations. In the dry season there were 20 species commonly found, with the sipunculan *Apionsoma trichocephalus* and nemertean species again being present at all stations. The crustaceans *Callianassa japonica* and amphipod species also occurred at all 8 stations, while the polychaetes *Aglaophamus dibranchis* and *Cossurella dimorpha* and the echinoderm (brittle starfish) *Amphiura hexactis* were found at 7 stations.

5.6.2.9 Field survey data analysis was conducted to assist the interpretation of community attributes and ecological baseline value. Table 5.5 displays index values for species richness (*d*), diversity (*H'*) and evenness (*J*) for each sampling station and seasonal survey.

Table 5.5 Univariate statistics for the infauna community (CityU, 2007)

Station	Species richness (d)		Species diversity (*H'*)		Species evenness (*J*)	
	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
B1	2.76	3.52	0.97	2.53	0.34	0.96
B2	7.16	7.75	3.05	3.32	0.80	0.87
B3	6.35	8.76	2.65	3.43	0.71	0.86
B4	5.92	3.46	2.59	2.19	0.73	0.74
B5	6.22	4.41	2.66	1.91	0.74	0.58
B6	4.92	4.36	2.41	2.32	0.71	0.73
B7	5.34	3.01	2.70	1.85	0.79	0.65
B8	5.49	3.84	2.80	1.81	0.81	0.59

5.6.2.10 In the wet season survey, the values of *d* ranged from 2.76 (station 1) to 7.16 (station 2), *H'* from 0.97 (station 1) to 3.05 (station 2) and *J* from 0.34 (station 1) to 0.81 (station 8). Of these 8 stations, the highest species diversity was found at station 2, followed by station 8. Station 1 had the lowest species diversity and evenness, being dominated by shrimp larvae and nemertean spp.

5.6.2.11 In the dry season survey, the values of *d* ranged from 3.01 (station 7) to 8.76 (station 3), *H'* from 1.81 (station 8) to 3.43 (station 3) and *J* from 0.59 (station 8) to 0.96 (station 1). Highest species diversity was found at station 3, followed by station 2. Stations 5, 7 and 8 had the lowest species diversity and evenness, being dominated by the sipunculan *Apionsoma trichocephalus* and crustacean *Callianassa japonica*.

5.6.2.12 From both surveys, except for station 1 in the wet season survey and stations 5, 7 and 8 in the dry season survey, the remaining stations had *H'* > 2.00, with the highest value of 3.43. This data concurs with the findings of the desktop review that benthic infauna in the study area is relatively diverse compared with the other HKSAR waters.

5.6.2.13 Spatial and seasonal patterns among the 8 sampling stations were determined using cluster analysis and multi-dimensional scaling analysis.

5.6.2.14 In the wet season it was noted that there is general similarity in spatial pattern between the communities at stations 2 and 3, represented by *inter alia* several polychaete species, nemertean spp. and the sipulcuan *Apionsoma trichocephalus*. There is also similarity in the wet season communities at stations 4 – 8 where *inter alia* the polychaete *Aglaophamus dibranchis*, crustacean copepod spp. and *Callianassa japonica* were dominant. Shrimp larvae, in contrast, dominated station 1. There were also similarities in the spatial pattern of dry season communities at stations 2 – 3 and across stations 4 – 8, while the standalone station 1 revealed impoverished infauna.

5.6.2.15 Seasonal analysis also showed the same clustering of stations into 3 groups, i.e., stations 2 - 3, stations 4 – 8, and station 1. Stations 2 - 3 were dominated by the polychaete worms *Prionospio malmgreni*, *Glycera chirori*, *Tharyx* sp., *Marphysa sanguinea*, *Loimia ingens*, *Magelona* sp. and *Paralacydonia paradoxa*, sipunculan *Apionsoma trichocephalus*, the crustacean amphipod spp. and nemertean spp. This group was most diverse among the three station groups.

5.6.2.16 Stations 4-8 were characterized by the sipunculan *Apionsoma trichocephalus*, nemertean spp., polychaete *Aglaophamus dibranchis*, and crustacean (ghost shrimp) *Callianassa japonica*. Station 1 was represented by the polychaetes *Lumbrinereis shiinoi* and *Aglaophamus dibranchis*, sipunculan *Apionsoma trichocephalus*, and nemertean spp. Overall, the data suggested that seasonal changes at these sampling stations were minimal.

5.6.2.17 Abundance and biomass comparison (ABC) plots were also prepared for the stations to provide an indication of sediment disturbance. According to Warwick and Clarke (1994), a negative *W* value suggests a “disturbed” community while a *W* value <0.1 suggests moderate disturbance. In the wet season survey it was found that all stations except 1 were “undisturbed”, while in the dry season all stations except 7 were “undisturbed”.

5.6.2.18 Apart from water depth, the spatial pattern of the benthic composition in the wet season survey was best correlated with the inclusive graphic standard deviation (σ), or the degree of sorting, of the sediments. However, the spatial pattern of the benthic composition in the dry season sampling was best correlated with total organic matter of the sediments. Overall, when both survey results were analyzed, water depth and sorting of sediments were best correlated with the community pattern.

5.6.2.19 The most notable finding from the surveys was the presence in the wet season of the cephalochordate (amphioxus) *Branchiostoma belcheri* at stations 2 and 3. Figure 5.16 presents station locations. At station 2, 3 individuals were collected in the 5-pooled grab samples whereas at station 3, 32 individuals (or 64 m^{-2}) were collected. The body length of these specimens was 5.5 - 7.0 mm, with a mean length of 6.1 mm. Based on unpublished data of CityU, this body length was estimated at less than half year of age and considered to represent juveniles in the ~2.5 - 3.0 year life span of *B. belcheri*. There were no records of *B. belcheri* from all the sampling stations in the dry season.

5.6.2.20 Past studies have revealed densities of amphioxus up to 100 m^{-2} at sampling stations near Tai Long Wan (CityU, 2002). A further study by Shin *et al* (2006) further confirmed amphioxus densities of 100 - 400 m^{-2} in sediments at Tai Long Wan and adjacent areas in both wet and dry season surveys.

5.6.2.21 The occurrence of small juveniles at station B3 in the wet season is possibly due to random settlement via the planktonic larval stage of the species. It is understood that amphioxus reproduces in the wet season, when higher levels of larval recruitment would thus be expected. Their absence in the dry season suggests less than optimal conditions for their continual survival after settlement. A 2007 CityU study on amphioxus which noted that, "clear oceanic water combined with sand sediment with low organic content are the most important habitat requirements for amphioxus (CityU, 2007)." The present findings suggest that the silty sediments of the seabed in the vicinity of the transmission cable route south of the Ninepins is not a major habitat for amphioxus.

5.6.3 Habitat Evaluation

5.6.3.1 The ecological evaluation of benthic habitats has been conducted in accordance with Annex 8 of the TM on the EIAO Process.

5.6.3.2 Tables 5.6a to d present a general baseline evaluation of each major habitat type within the Study Area (Figure 5.6 displays the habitat types).

5.6.3.3 Table 5.7 presents a more specific evaluation of each benthic habitat survey location in order to present the variability within a broad habitat type.

Table 5.6a Ecological Evaluation of Subtidal Seawall Habitat

Criteria	Seawall
Naturalness	Artificial hard substrate
Size	The total seawall length is about 30 kilometres
Diversity	Low/moderate epifauna diversity and no infauna
Rarity	Habitat is common in harbour areas. Localised presence of uncommon octocoral *Carijoa.* No rare coral species found.
Re-creatability	Readily re-creatable (artificial structure)
Fragmentation	Widespread variable lengths of wall
Ecological Linkage	Some linkage with adjacent hard shore habitat
Potential Value	Low
Nursery/ Breeding Ground	Nothing of note identified
Age	Not applicable (Artificial)
Abundance/ Richness of Wildlife	Low epifauna abundance and no infauna
Overall Ecological Value	Low

Coral rarity ratings, (AFCD, unpublished)

Table 5.6b Ecological Evaluation of Subtidal Rocky Shore

Criteria	Rocky Shore
Naturalness	Natural with some recreational disturbance.
Size	The total shoreline length is about 300 kilometres
Diversity	Moderate/high epifauna diversity and no infauna.
Rarity	Habitat is common in eastern waters. Highly localised presence of uncommon octocoral *Carijoa* and dominant black coral *Cirripathes* sp
Re-creatability	Re-creatable
Fragmentation	Widespread variable lengths of shoreline
Ecological Linkage	Limited linkage with adjacent soft seabed habitat
Potential Value	Limited potential, as baseline value already high
Nursery/ Breeding Ground	Nothing of note identified
Age	Not applicable
Abundance/ Richness of Wildlife	Moderate epifauna abundance and no infauna
Overall Ecological Value	Moderate

Coral rarity ratings, (AFCD, unpublished)

Table 5.6c Ecological Evaluation of Subtidal Silty Seabed Habitat

Criteria	Silty Seabed
Naturalness	Largely natural, localised mud disposal
Size	Total seabed area of about 45,000 hectares
Diversity	Low/moderate epifauna diversity and moderate infauna
Rarity	Habitat is common in eastern areas. Localised presence of restricted Amphioxus
Re-creatability	Difficult to recreate
Fragmentation	Continuous seabed
Ecological Linkage	Good linkage with adjacent soft seabed habitat
Potential Value	Low
Nursery/ Breeding Ground	Nothing of note identified
Age	Not applicable
Abundance/ Richness of Wildlife	Low/moderate epifauna abundance and high infauna abundance
Overall Ecological Value	Low/Moderate

Table 5.6d Ecological Evaluation of Subtidal Rocky Pinnacle

Criteria	Rocky Pinnacle
Naturalness	Natural with some recreational disturbance.
Size	The total height is about 15-20 meters
Diversity	High epifauna diversity and no infauna.
Rarity	The rocky pinnacle is an uncommon feature. 4 uncommon species of octocoral present. No rare coral species found.
Re-creatability	Moderate to difficult re-creatability
Fragmentation	Scattered clusters in eastern waters
Ecological Linkage	Some linkage with adjacent soft seabed habitat
Potential Value	Limited potential, as baseline value already high
Nursery/ Breeding Ground	Localised nursery for reef associated fish
Age	Not Applicable
Abundance/ Richness of Wildlife	Moderate/high epifauna abundance and no infauna
Overall Ecological Value	Moderate/High

Coral rarity ratings, (AFCD, unpublished)

Table 5.7 Specific Subtidal Habitat Evaluation of EIA Study Baseline Survey Locations

Criteria	Chiu Keng Wan	Fat Tong Chau	Tung Lung Chau West	Tung Lung Chau South	South Ninepins	East Ninepins	One Foot Rock	Victor Rock	Basalt Island	Windfarm footprint
Subtidal Habitat Type(s)	Seawall	Rocky Shore / Silty Seabed	Rocky Shore	Rocky Shore / Silty Seabed	Rocky Shore / Silty Seabed	Rocky Shore	Rocky Pinnacle	Rocky Pinnacle	Rocky Shore	Silty Seabed
Survey	E	E / I	E	E / I	E / I	E	E	E	E	E / I
Naturalness	Adjacent to reclamation	Adjacent to reclamation / landfill	Natural rocky shore	Natural rock outcrop near light beacon	Natural steep rocky shore	Natural rocky shore	Submerged rocky pinnacle	Submerged rocky pinnacle	Natural rocky shore	Soft silty mud
Diversity	HC low; SC high	Epifauna low / Infauna low	Epifauna low	Epifauna moderate / Infauna high	Epifauna moderate / Infauna moderate-high	HC in the shallow zone. OC in the deep zone	OC high in deep zone	SC high in deep zone	HC in shallow zone. BC in deep zone	Epifauna low / Infauna moderate
Rarity	Uncommon OC *Carijoa* in the deep zone	No rare species recorded	No rare species recorded	Uncommon OC *Coscinarea* n. sp. Uncommon *Favia helianthoides*	OC *Carijoa* in shallow zone. Dominant BC *Cirripathes* sp in deep zone. Juveniles of Amphioxus (restricted) in wet season.	Rare HC *Montipora turgescens* in shallow zone. Two uncommon OC species recorded	One uncommon OC species recorded	Two uncommon OC species recorded	One uncommon OC species recorded. BC in deep zone	No rare species recorded
Abundance	Abundant OC in deep zone	Epifauna low / Infauna moderate	Epifauna low	Moderate HC / Infauna high	Epifauna low / Infauna high	*Cirripathes* abundant in deep zone	Up to 40% OC cover	Up to 70% OC cover	Abundant BC in deep zone	Epifauna low / Infauna high
Overall value	Low	Low	Low	Moderate / High	Moderate / High	Moderate/ High	Moderate / High	Moderate / High	Moderate / High	Low

Notes: E = Epifauna; I = Infauna; HC = Hard Coral; SC = Soft Coral; OC = Octocorals; BC = Black Coral

Coral rarity ratings, (AFCD, unpublished)

5.7 Construction Phase Impact Assessment

5.7.1 Introduction

5.7.1.1 Two key sources of potential impact upon the marine benthic community have been identified during project construction:

- Direct impacts on the project 'footprint' from the installation of project components resulting in temporary or permanent loss of seabed habitat.
- Induced impacts through deteriorating water quality during installation of project components, most notably potential for mobilisation and deposition of suspended sediment upon sessile benthic epifauna.

5.7.1.2 The potential the impacts to arise, and their implications on the benthic community in the Study Area, are discussed below.

5.7.2 Direct Impacts on Benthic Infauna

5.7.2.1 No construction activities are proposed in the vicinity of any hard substrate habitat where corals are present. There will however be a loss of soft seabed habitat from the following construction activities:

- Nearshore transmission cable dredging: temporary habitat loss in Junk Bay
- Offshore transmission and array cable jetting: temporary habitat loss in Eastern Waters
- Offshore foundation construction: permanent habitat loss from installation of wind turbine and transmission station foundations

5.7.2.2 Regarding nearshore transmission cable dredging, a summary of these works is presented in sub-section 2.8.5. Approximately 135,000m^3 of soft marine muds are proposed to be dredged over a period of ~6 weeks. The total surface area of dredging works shall be some 80,000 m^2, with this area of seabed infauna habitat temporarily lost. The upper part of the dredged trench will be filled with rock armour to the same level as the adjacent seabed. It can be expected that the voids around the rock armour will re-fill with soft sediment under the natural hydrodynamic regime within a short period of time.

5.7.2.3 The significance of the dredging works on the benthic infauna community in Junk Bay is considered to be low, as the community is disturbed, is dominated by polychaetes, and as recent past survey has revealed the absence of infauna species of conservation interest in the immediate area (Maunsell, 2005).

5.7.2.4 Previous study suggests that the disturbed seabed will naturally be re-colonised by species recruited from adjacent seabed areas within a short period. For example, Valente *et al* (1999) found that 2-3 years after cessation of dredged material disposal in Eastern Waters a benthic epifauna community had established that possessed a significantly greater abundance and diversity than those at nearby reference stations. The results suggest that the variety of dredged material disposed at the site effectively increased habitat diversity relative to the adjacent homogenous seabed habitat.

5.7.2.5 A summary of the procedure for offshore transmission and array cable jetting is presented in sub-section 2.8.6. These proposed works would involve the displacement of soft sediment under high-pressure jets of ambient water, resulting in the temporary loss of an approximately 0.4m wide strip of seabed per cable. It is estimated that some 21 km of transmission cable shall be installed over a period of approximately 2 months at a maximum installation rate of 150m / hour. There shall also be approximately 40 - 50 km of array cable installation, resulting in a cumulative area of temporary habitat loss of ~28,000 m^2.

5.7.2.6 As seabed jetting is proposed from the relatively shallow Tathong Channel, through increasingly deep and exposed waters south of Tung Lung Chau and the Ninepin Islands group to offshore Eastern Waters, variations in habitat character inevitably occur.

5.7.2.7 The baseline ecological surveys and data analysis presented under sub-section 5.5 were able to distinguish three ‘groups’ of infauna community according to similarity in key sediment character and species composition criteria, with baseline field survey suggesting that the grouping of stations 2 - 3 was the most biodiverse. Figure 5.16 presents station locations.

5.7.2.8 Stations 2 - 3 also represent an area of some conservation significance due to the wet season presence of juvenile amphioxus *Branchiostoma belcheri*. Three individuals of amphioxus were recorded from 2 of 5 replicate samples at station 2, with 32 individuals from 4 of 5 replicate samples at station 3. Amphioxus was not recorded from these (or any other) survey stations during the dry season. As stations 2 - 3 are remote from the core amphioxus habitat area at offshore Tai Long Wan it is considered that the small number of individuals present arose through the random settlement of planktonic larvae. A 2007 CityU study on amphioxus which noted that, “clear oceanic water combined with sand sediment with low organic content are the most important habitat requirements for amphioxus (CityU, 2007).” Accordingly, it is concluded that the silty sediment of the seabed at stations 2 - 3 is not a major habitat for amphioxus. No adverse impact is predicted to Amphioxus during construction and operation.

5.7.2.9 During cable jetting benthic infauna may be damaged by the water jet, and / or may be exposed to predation while suspended in the water column. Such impacts will be highly localised given the jetting width of just 0.4m. As the water jet passes over the seabed the cable shall sink through the fluidised mud under its own weight, with the sediment consequently reconsolidating as the jetting machine passes.

5.7.2.10 It is noted that the proposed jetting zone has a high edge / area ratio, in the order of 2.5:1.0. Various ecological studies, for example the Coral Growth at High

Island Dam study (Binnie Consultants Ltd, 1996), have proven that such areas are likely to be re-colonised more rapidly than those with a small ratio because of the greater area of adjacent donor sites available from which to recruit, although a longer period may be required for full 'recovery'.*

5.7.2.11 With reference to past studies of benthic re-colonisation of seabed areas subject to mechanical disturbance, pollution or anoxia, it can be expected that initial re-colonisation will occur with a period of weeks to months following jetting (WBM, 2004; Santos and Simon, 1980). Field survey data for this EIA Study indicates that the characteristics of the benthic infauna community are broadly consistent across the five replicate samples at each survey station. As such, the narrow width of the jetting zone disturbed by jetting zone will thus facilitate re-colonisation by species from adjacent seabed areas.

5.7.2.12 Overall, impacts on the benthic infauna community from cable installation are anticipated to be moderate / low in the vicinity of stations 2 - 3, and of little or no significance elsewhere along the cable route.

5.7.2.13 As regards offshore foundation construction, these proposed works differ from the proposed dredging and jetting activities in that there would be a direct loss of habitat due to the presence of permanent (~20 year lifespan) of fixed structures. These proposed works would occur in exposed offshore water where surveys conducted for this EIA Study indicate a moderately biodiverse infauna community may exist, although no species of conservation significance were recorded (sub-section 5.5 refers).

5.7.2.14 At this planning stage it is assumed there shall be no more than 67 turbines and one offshore transformer station. Each of these components shall have a single foundation system comprised of four suction caissons each with a diameter of approximately 15 metres. This generates a cumulative area of permanent benthic habitat loss of: $4 \times (\pi \times (7.5\text{m})^2) \times 68 = \sim 48{,}000\text{m}^2$

5.7.2.15 Compared with cumulative soft sub-tidal habitat area in the wind farm of ~1,500 hectares, this represents an insignificant habitat loss of ~0.3% of total seabed in the wind farm area. The total area of soft sub-tidal habitat in the Study Area is > 45,000 ha. Given the habitat area to loss ratio, and the absence of any specific conservation value, the impact on the benthic infauna community is low to acceptable.

5.7.3 Indirect Impacts on Benthic Epifauna

5.7.3.1 Through desktop review and baseline field survey work it is known that the Study Area is of general conservation importance for epifauna, and particularly coral communities, mainly due to the prevalence of rocky offshore islands and submerged rocky pinnacles in Eastern Waters.

* Following Wilson (1998), 'recovery' is defined as a lack of temporal change of biological variables at impact sites relative to control sites.

5.7.3.2 Given the general sensitivity of the Eastern Waters, the approach for construction of the Project has been to avoid or at least minimise marine sediment handling where practicable. This philosophy has led, in turn, to the development of construction methodologies that avoid marine dredging / excavation activities in offshore waters.

5.7.3.3 There are, however, cable jetting and foundation construction activities proposed in the offshore waters, and also cable dredging and jetting activities in nearshore waters. The potential impacts of these works have been assessed cumulatively to present a worst-case scenario for project development, and details of the methodology for the assessment of indirect (water quality induced) impacts on benthic epifauna are presented in sub-section 4.6.

5.7.3.4 Table 5.8 presents the degree of impact associated with sediment release, transport and deposition at those benthic communities nearest to the Project.

Table 5.8 Predicted peak Suspended Sediment concentrations above baseline (in mg/L) at representative Coral Sensitive Receivers: Unmitigated Scenario

ID	Coral Community	Allowable Elevation		Unmitigated peak concentration above baseline* / Scenario				
		Dry	Wet	1	2	3	4	5
CC26	Junk Bay	2.24	2.03	**3.03**	**3.03**	0	0	0
CC27	Junk Island	2.24	2.03	**4.79**	0	0	0	0
CC11	Fat Tong Chau West	2.24	2.03	**2.97**	0	**10.26**	**7.29**	**7.29**
CC8	West Tung Lung Chau	1.82	1.82	0	0	0	0	0
CC7	South Tung Lung Chau	2.24	1.87	0	0	0	0	0
CC14	South Ninepin in	3.08	2.15	0	0	0	0	0
CC16	East Ninepins	2.52	1.84	0	0	0	0	0
CC19	One Foot Rock	2.52	1.84	0	0	0	0	0
CC18	Basalt Island	2.52	1.84	0	0	0	0	0
CC20	Victor Rock	2.52	1.84	0	0	0	0	0

Note: ** Worst-case results predicted during unmitigated wet season dredging. Impact levels in bold.*

5.7.3.5 The results in Table 5.8 indicate that adverse impacts are anticipated at the coral communities of Junk Bay during dredging works thereat. The maximum predicted concentration of suspended sediment is at the coral community of Fat Tong Chau West. Section 4.9.1 presents mitigation measures to ensure no adverse impacts from dredging activities at these coral sensitive receivers.

5.7.3.6 Adverse impacts may also arise by the deposition of suspended sediment upon corals. Table 5.9 summarises the predicted deposition rate at representative coral communities during the dry season. The assessment criterion of 100g / m^2 / day is used following CAPCO, 2006.

Table 5.9 Predicted Sediment Deposition Rates (in g/m^2/day) at Coral Communities in Dry Season – Unmitigated Scenarios 1 to 5

ID	Coral Community	Scenario				
		1	2	3	4	5
CC26	Junk Bay	35.8	35.8	0	0	0
CC27	Junk Island	0	0	0	0	0
CC11	Fat Tong Chau West	35.4	0	**248.4**	**212.9**	**212.9**

Note: *Impact levels in bold*

5.7.3.7 Given the predicted high sediment deposition rates at Fat Tong Chau coral community in the dry season, mitigation measures are required to ensure no adverse impacts from concurrent dredging and jetting activities.

5.7.3.8 Table 5.10 presents the predicted deposition results for the wet season scenario. Adverse impacts are anticipated to be greatest at the coral community at Fat Tong Chau from concurrent dredging and jetting. Adverse impacts are also anticipated at other nearby coral communities, and hence mitigation is required. Section 5.11 presents details of analysis with mitigation measures to ensure no adverse impacts from dredging and jetting activities at these coral sensitive receivers

Table 5.10 Predicted Sediment Deposition Rates (in g/m^2/day) at Coral Communities in Wet Season – Unmitigated Scenarios 1 to 5

ID	Name	Scenario				
		1	2	3	4	5
CC26	Junk Bay	**130.9**	**130.9**	0	0	0
CC27	Junk Island	**206.9**	0	0	0	0
CC11	Fat Tong Chau West	**128.3**	0	**443.2**	**314.9**	**314.9**

Note: Impact levels in bold.

5.8 Operational Phase Impact Assessment

5.8.1.1 Section 4.8 identified that normal project operation will cause no significant changes in water quality, which indicates that there will be no adverse impacts on benthic communities during normal project operation. Sections 5.8.2 to 5.8.4 present a summary of key findings.

5.8.2 Current Speeds, Accumulated Flows and Hydrodynamics

5.8.2.1 The location of the wind farm is in open waters and the spacing between the substructure elements is large (approximately 450 m – 600 m). Water flows freely across the entire site.

5.8.2.2 Changes in current speeds outside the wind farm site, due to the presence of the wind turbines, were negligible and unmeasurable (maximum change of 0.006m/s). No significant changes in accumulated flows were predicted at any of the modeled locations. Local changes (increases) in flow at the seabed near the foundation structure will occur within the area of the top of the suction caissons – hence no additional scour of the seabed is expected.

5.8.2.3 Given these minute changes, it is anticipated that flushing capacities and sediment transport within major channels and semi-enclosed areas will remain unchanged from existing conditions and there will be no effect on benthic communities due to these issues.

5.8.3 Storm water and Maintenance Vessels

5.8.3.1 No adverse impacts due to storm water generation are expected as the exposed surfaces of the wind turbine components contain no contaminants. Detailed information on maintenance vessel frequencies and activities is presented in Section 2. Wastewater generated from machinery spaces would be contained within the vessels. Sewage generated from workforce would be disposed of by licensed waste collectors. No water quality impacts arising from routine maintenance operations are anticipated.

5.8.4 Oil Spill

5.8.4.1 Vessel collision risk is very low as the designation of the wind farm footprint as a controlled water space, as detailed in Section 8.8.2.4, will reduce vessel traffic below low current levels.

5.8.4.2 If a collision does occur, the Operator’s marine craft and Marine Department oil spill control vessels will be easily able to reach the Ninepins within 4 hours, and will quickly contain any fuel oil spills. Hydrodynamic flow modelling of the study area for oil spills (Section 4) showed that all spills at the project site remain in open waters and do not approach or strand on any coastlines within this time. An Oil Spill Management Plan is presented in Appendix 4H.

5.8.5 Enhancement

5.8.5.1 There is some potential for benefits associated with project operation through the provision of additional surface area for natural benthic colonisation and hence development of artificial reef systems.

5.8.5.2 The cumulative surface area of the anticipated 68 jacket substructures between seabed and the water surface shall be approximately 100,000m^2 (based on the Base Case Development Scenario, presented in Section 2.6, of 67 tripod structures with legs nominal 5m diameter in 30m water depth) and taking account of the fact that although the surface area shall not be solid, the faces of the metal grid sub-structure will offer a substantial cumulative surface area.

5.8.5.3 This available surface area will more than make up for the loss of benthic infauna habitat of low ecological value. Based on previous studies it is anticipated this artificial hard substrate shall enable natural colonisation by a range of epifauna, producing a net benefit at the wind farm footprint area.

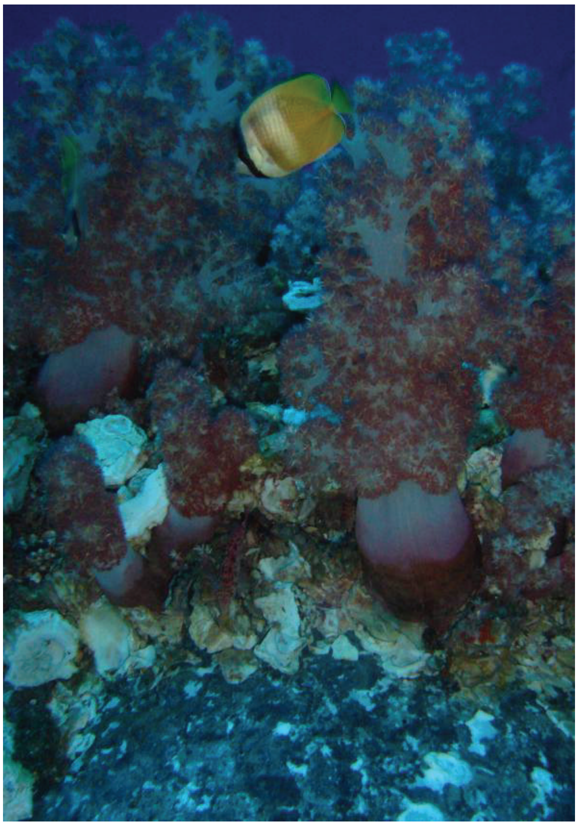
5.8.5.4 Recent investigations into the rate and extent of marine growth on new marine structures in the South China Sea recorded a biomass of almost 0.9 kg / m2 approximately 3 months after installation, with growth recorded at all depths (Yan *et al*, 2006). Biodiversity was found to have further increased at 6 and 12 months, by which time the a community of barnacles, anemones, pearl oysters, polychaetes and bryozoans has become established at ~20m depth. The community in more shallow waters (~3m) also supported algae, bivalves, decapods, annelids and amphipods (ibid.).

5.8.5.5 A parallel study, also in south-eastern waters, of communities of at least 5 years old recorded a total of 105 taxa, with molluscs (bivalves), arthropods and annelids being the most abundant. Surveys at depths from 3 to 38 metres recorded a mean biomass of ~20 kg / m2 (ibid.).

5.8.5.6 A series of qualitative observations of benthic colonization of marine structures has also been made by recreational divers at oil platforms in waters about ~100 metres deep in the South China Sea. The location, some 90 km southeast of the Study Area, has regularly been visited by divers since year 2000 (Asiatic Marine, 2007). The community age is unknown, but is assumed to be < 10 years.

5.8.5.7 An epifauna community ~15cm thick primarily comprising oysters and barnacles has been recorded at one oil platform site, with this community forming a hard substrate for coral growth. Coral observations of note include the dominance of the octocoral *Dendronephthya* spp on metal structures at -10 to -50m. Small colonies of the black coral *Carijoa* sp were noted, as were colonies of the hard coral *Acropora* sp. A variety of marine life has been observed associated with the benthic community, including reef fishes, lobsters and moray eels (*ibid.*). Figure 5.17 indicates the diversity and richness of the benthic community on the structure.

Figure 5.17 Epifauna Community at South China Sea Oil Rig Structure



Source: Asiatic Marine Limited

5.9 Cumulative Impacts

5.9.1.1 No cumulative water quality impacts are anticipated as a result of the operation of the East Ninepins and East Tung Lung Chau Sediment Disposal Areas, or from construction activities associated with Further Development of Tseung Kwan O.

5.9.1.2 EIA's for the Cruise Terminal at Kai Tak project and the Wan Chai Development Phase II project have suggested that coral colonies be translocated from their current locations to small sites in Junk Bay. Figure 4.1 a), in Section 4, shows that these potential coral translocation sites are approximately 1.6 kilometers away from the cable corridor. Given this ample separation and the results of the water quality analysis, summarized in Section 5.8, no adverse impacts are anticipated at the potential coral translocation sites during either construction or operation phases.

5.9.1.3 No cumulative impacts are anticipated during operation of the proposed wind farm.

5.10 Mitigation Measures & Best Practice

5.10.1 Marine Dredging

5.10.1.1 Although it has been identified that the coral communities at Fat Tong Chau and Junk Island are generally of low ecological value, the water quality impact assessment identified that unmitigated dredging works would potentially result in adverse impacts.

5.10.1.2 Accordingly, the following controls on marine dredging activities are proposed:

- Working rate for dredging in Junk Bay should not exceed a cumulative total of 6,300 m3 / day between two dredgers.
- Closed grab dredgers should be used for sediment dredging in Junk Bay. The mechanical grabs should be properly maintained to minimise spillage of sediment.
- Silt curtains should be provided closely surrounding the dredging point to minimise dispersion of sediment plumes.
- Barges for disposal of dredged marine sediment:
  - Should be fitted with tight seals to prevent leakage of sediment during transport.
  - Should not be filled beyond a level that would result in spillage or being washed overboard by wave action during transport to the disposal site.
  - Should be kept clear of excess material on the deck and the exposed barge fitting should be cleaned before transport to the disposal site.

5.10.2 Jetting

5.10.2.1 The assessment of the proposed jetting works for submarine cable burial in the near-shore environment of Junk Bay predicts this activity will contribute to elevated sediment deposition upon nearby coral communities. Accordingly, in order to avoid direct impacts upon benthic epifauna it is proposed control the jetting speed as follows:

- Not exceeding 75 metres / hour in the section between Junk Bay and South Tung Lung Chau. This Jetting Control Zone is shown in Figure 4.18.
- Not exceeding 150 metres / hour in all other locations.
- The project proponent will best endeavour to program jetting at the southern section of the cable alignment in the dry season to avoid/minimize impact on amphioxus.

5.10.3 Enhancement

5.10.3.1 The sub-structure of the wind turbine foundations shall provide a net increase in the surface area of hard substrate available as an artificial reef for colonization by reef dwelling organisms. Artificial Reef enhancement options shall be investigated in parallel with the detailed foundation design. Further details are provided in Section 8.

5.11 Residual Impact Assessment

5.11.1.1 Table 5.11 presents the predicted suspended sediment levels at potentially impacted coral communities following the implementation of dredging controls and other mitigation measures.

Table 5.11 Predicted Suspended Sediment concentrations (in mg/L) at representative Coral Sensitive Receivers: Mitigated Scenario

ID	Coral Community	Allowable Elevation		Mitigated peak concentration above baseline* / Scenario				
		Dry	Wet	1	2	3	4	5
CC26	Junk Bay	2.24	2.03	0.91	0.91	0	0	0
CC27	Junk Island	2.24	2.03	0.94	0	0	0	0
CC11	Fat Tong Chau West	2.24	2.03	0.02	0	0.80	0.77	0.77

Note: * Worst-case results predicted during unmitigated wet season dredging.

5.11.1.2 Accordingly, Table 5.11 indicates that no residual adverse impacts are anticipated at representative receivers with the adoption of controls measures.

5.11.1.3 Table 5.12 and Table 5.13 present the predicted sediment deposition results for dry and wet season construction activities, respectively. The effectiveness of the proposed controls on marine activities and the deployment of silt curtains in Junk Bay will be adequate to ensure no adverse impacts arise from dredging and jetting works.

Table 5.12 Predicted Sediment Deposition Rates (in $g/m^2/day$) at Coral Communities in Dry Season – Mitigated Scenarios 1 to 5

ID	Name	Scenario				
		1	2	3	4	5
CC26	Junk Bay	7.8	7.8	0	0	0
CC27	Junk Island	0	0	0	0	0
CC11	Fat Tong Chau West	0	0	25.9	25.9	25.9

Table 5.13 Predicted Sediment Deposition Rates (in $g/m^2/day$) at Coral Communities in Wet Season – Mitigated Scenarios 1 to 5

ID	Name	Scenario				
		1	2	3	4	5
CC26	Junk Bay	39.30	39.30	0	0	0
CC27	Junk Island	40.60	0	0	0	0
CC11	Fat Tong Chau West	0.86	0	34.60	33.30	33.30

5.12 Environmental Monitoring & Audit Requirements

5.12.1.1 No environmental monitoring & audit (EM&A) programme is proposed for the benthic infauna community, as no significant adverse impacts are anticipated.

5.12.1.2 For the benthic epifauna, particularly corals, it is proposed that water quality monitoring be conducted at Fat Tong Chau during dredging activities in Junk Bay to ensure levels of suspended solids outside the silt curtain enclosure do not exceed the Water Quality Objectives. The details of water quality monitoring are presented in the stand-alone EM&A Manual.

5.12.1.3 It is also proposed that the positioning of the silt curtains be checked prior to implementation of marine dredging and jetting activities off Fat Tong Chau as this location is the closest sensitive receiver to the works.

5.12.1.4 Literature reviews and dive surveys undertaken as part of the EIA identified the site adjacent to the transmission cable at Tung Lung Chau South as of moderate to high ecological value due to the abundance and diversity of coral found at the sites.

5.12.1.5 Although adverse impacts to any corals are not predicted to occur as a result of the mitigation measures adopted during cable installation, the project proponent has offered to conduct coral impact monitoring at those sites with the most valuable coral communities identified in proximity to the cable alignment (value > moderate & distance < 400m (about 3 time mixing zone) to verify that the project will have no adverse ecological impacts.

5.12.1.6 In addition, the EIA has predicted that no impacts will occur at Victor Rock and South Ninepins sites given that they lie about 1km from works areas. However, as a further precaution given their moderate to high value, the project proponent has also offered to conduct coral monitoring at one site at Victor Rock when turbines are installed within 1km and at one site at the South Ninepins when cable Jetting is conducted within 1km.

5.12.1.7 The measures proposed for this project are similar to those in, "*The proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong*" (EIA 089/2003) submitted by the Hong Kong Gas China Gas Company Ltd. Details of the coral monitoring are presented in the stand-alone EM&A Manual.

5.13 Conclusions & Recommendations

5.13.1.1 Desk-top review and field survey has reaffirmed that the Eastern Waters of the HKSAR are of generally high marine conservation interest with regard to its epifauna community and, at a more localised level, infauna community. The conservation value of the benthic community in the more sheltered waters of Junk Bay and the Tathong Channel is relatively low.

5.13.1.2 Field surveys were conducted from August 2006 to June 2007, and covered wet and dry seasons. From dive surveys conducted at 13 survey locations it was recorded that the benthic epifauna communities of the highest conservation significance were at the East Ninepin, Basalt Island and the underwater pinnacles Victor Rock and One Foot Rock. The infauna community to the south of Tung Lung Chau and South Ninepin was identified as being of the highest conservation value of the eight survey locations. The benthic community in the wind farm footprint was found to be of low conservation value.

5.13.1.3 The key potential impact from Project development was identified as being sediment release and resettlement associated with marine dredging and cable jetting activities. Numerical simulation was conducted to assess water quality impacts, and the model predicted adverse impacts at coral communities in Junk Bay. Simulations also confirmed that with the implementation of the proposed mitigation measures, no exceedance of the WQO criteria was found at all coral sites. No adverse impact is predicted to amphioxus during both construction and operation phases of the project. .This demonstrates that the adoption of proposed mitigation measures combined with construction phase monitoring shall ensure no adverse impacts will arise.

5.13.1.4 Adverse direct impacts on seabed habitat from temporary dredging and cable jetting activities shall be of short duration and reversible, with anticipated re-colonisation of the affected areas within a short period of time.

5.13.1.5 The presence of the turbine foundations at the wind farm area will provide an artificial habitat for potential colonisation by benthic epifauna. The cumulative surface area of over 100,000 m^2 shall more than make up for the permanent loss of 48,000 m^2 of silty mud of low ecological value, producing significant net ecological benefits in the area of the wind farm.

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