5. Marine Ecological Impact Assessment

5.1 Introduction

In accordance with EIA Study Brief No. ESB-198/2008, the potential marine ecological impacts arising from the dredging works for providing sufficient water depth in Kwai Tsing Container Basin and its approach channel were assessed and are presented in this section. The assessment examined the ecological attributes of the Study Area with an aim to protect, maintain or rehabilitate the existing ecological conditions of the Study Area, in the event of any resulting impacts.

The main objectives of this assessment are to: examine the flora, fauna and other components of the ecological habitats within the Study Area; evaluate the marine habitat and ecological resources found within the Study Area; identify, predict and evaluate any direct or indirect and on-site or offsite impacts to marine ecology in accordance with the criteria stipulated in Annexes 8 and 16 in Technical Memorandum on Environmental Impact Assessment Ordinance (EIAO-TM); and recommend practicable alternatives, if any, or mitigation measures to prevent or minimise adverse impacts on the marine ecology to an environmentally acceptable level. The findings of the assessment are structured as follows:

Section 5.2: Provides discussions on existing environmental legislation, standards, guidelines and criteria;

Section 5.3: Describes the assessment methodology adopted for this EIA;

Section 5.4: Provides a description on the baseline conditions & marine ecological sensitive receivers;

Section 5.5: Provides discussions on the ecological importance;

Section 5.6: Describes the prediction and evaluation of environmental impacts due to the Projects;

Section 5.7: Proposes mitigation measures to address the adverse environmental impact;

Section 5.8: Provides discussions on the cumulative impact;

Section 5.9: Evaluates the residual impacts;

Section 5.10: Proposes appropriate environmental monitoring and auditing programme; and

Section 5.11: Summarises the key findings of this section.

Assessments have been conducted in accordance with the requirements of the Study Brief and Annexes 8 and 16 of the Technical Memorandum on the Environment Impact Assessment Process. Potential impact of loss of soft-bottom seabed habitat, indirect disturbance impact to off-site habitat, direct collision and indirect disturbance to the marine mammals have been assessed. It was found that both the potential impact of loss of soft-bottom seabed habitat due to the dredging works and indirect disturbance impacts to off-site habitats induced by the elevation of suspended solid concentration in the water column and the increase in sedimentation rate are expected to be minor. The potential impacts regarding the direct collision and indirect disturbance to the marine mammals during the dredging activities and operation are anticipated to be negligible. Details of the assessment are further elaborated in the following subsections.
The potential cumulative impact of the increase in suspended solids at marine ecology sensitive receivers including coral communities at Green Island and Kau Yi Chau is considered to be minor with the implementation of frame type silt curtain and water quality control measures. The loss of the soft-bottom sub-tidal habitat will be temporary and benthic fauna will be recolonized after the dredging works cease. The residual impacts on marine ecology are considered to be negligible. With the implementation of water quality mitigation measures and environmental monitoring and auditing programme during the construction phase, no mitigation measures specific for marine ecology is required.

5.2 Environmental Legislation, Standards, Guidelines and Criteria

A number of international conventions, local legislation and guidelines provides the framework for the protection of species and habitats of ecological importance. Those related to the Project are as follows:

- **Wild Animals Protection Ordinance (Cap 170);**
- **Protection of Endangered Species of Animals and Plants (Ordinance (Cap 586);**
- **Town Planning Ordinance (Cap 131);**
- **The Technical Memorandum on Environmental Impact Assessment Process under the Environmental Impact Assessment Ordinance (EIAO-TM);**
- **EIAO Guidance Note No. 11/2004 Methodologies for Marine Ecological Baseline Surveys;**
- **United Nations Convention on Biodiversity (1992);**
- **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);**
- **Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention);**
- **IUCN Red Data Books; and**
- **PRC Regulations and Guidelines.**

Under the **Wild Animals Protection Ordinance (Cap.170),** designated wild animals are protected from being hunted, whilst their nests and eggs are protected from destruction and removal. All birds and most mammals including all cetaceans are protected under this Ordinance, as well as certain reptiles, amphibians and invertebrates. The Second Schedule of the Ordinance that lists all the animals protected was last revised in June 1992.

The **Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)** was gazetted on 10 March 2006 to replace the previous **Animals and Plants (Protection of Endangered Species) Ordinance.** The new Ordinance was effective on 1 December 2006, which aims to regulate the import, introduction from the sea, export, re-export and possession or control of certain endangered species of animals and plants and parts and derivatives of those species; and to provide for incidental and connected matters.

The **Town Planning Ordinance (Cap. 131)** provides for the designation of areas such as “Coastal Protection Areas”, “Sites of Special Scientific Interest (SSSIs)”, “Green Belt” and “Conservation Area” to promote conservation or protection of significant habitat.
Annex 8 of the EIAO-TM recommends the criteria that can be used for evaluating ecological impacts, while 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. 11/2004 Methodologies for Marine Ecological Baseline Surveys elaborates on Annex 16 of the EIAO-TM to provide information on the requirements of marine ecological baseline study. The Note provides general guidelines for conducting a marine ecological baseline survey in order to fulfil the requirements stipulated in the EIAO-TM in respect of marine ecological assessment for the proposed development.

The Peoples’ Republic of China (PRC) is a Contracting Party to the United Nations Convention on Biological Diversity of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. The Government of the Hong Kong Special Administrative Region has stated that it will be “committed to meeting the environmental objectives” of the Convention (PELB 1996).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between Governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The Convention on Migratory Species of Wild Animals (Bonn Convention) aims to develop international cooperation with a view to the conservation of migratory species of wild animals. This includes the conservation of terrestrial, marine and avian migratory species throughout their range. Migratory species threatened with extinction are listed as Appendix I of the Convention. Migratory species that needs or would significantly benefit from international cooperation are listed in Appendix II of the Convention. Hong Kong was a Party of this Convention since 1985.

The PRC in 1988 ratified the Wild Animal Protection Law of the PRC, which lays down basic principles for protecting wild animals. The Law prohibits killing of protected animals, controls hunting, and protects the habitats of wild animals, both protected and non-protected. The Law also provides for the creation of lists of animals protected at the state level, under Class I and Class II. There are 96 animal species in Class I and 156 in Class II. Class I provides a higher level of protection for animals considered to be more threatened.

### 5.3 Assessment Methodology

The Study Area for marine ecological impact assessment is defined as the same assessment area for the Water Quality Impact Assessment and any other areas likely to be impacted by the Project in accordance with Condition 3.4.7.2 as set in EIA Study Brief No. ESB-198/2008. It includes the Victoria Harbour Water Control Zone (WCZ), Western Buffer WCZ, North Western WCZ and Southern WCZ, as designated under the Water Pollution Control Ordinance (WPCO), as shown in Figure 5.1. Sensitive areas potentially impacted by the Project such as the sensitive coral sites in the above WCZs are also included in this assessment.

A combination of desktop literature reviews and ecological surveys was conducted in order to establish an ecological profile for impact assessment in accordance with the Condition 3.4.7.4 (iv) set in EIA Study Brief No. ESB-198/2008. Existing wildlife uses of various habitats with special attention to those wildlife groups and habitats, including coral communities, important benthic communities and inter-tidal habitats and marine mammals in the context of the Project were investigated and described. The importance of marine
ecological resources identified within the Study Area and the potential impacts due to the dredging works were assessed in accordance with the criteria and guidelines for evaluating and assessing ecological impact stipulated in Annexes 8 and 16 of the EIAO-TM.

5.3.1 Literature Reviews

Extensive information on the marine ecological resource within the Study Area was reported in various studies. Relevant baseline information was gathered in order to establish an ecological profile of the Study Area through reviewing the relevant literature including previously approved Environmental Impact Assessment reports, scientific publications and environmental studies.

5.3.2 Field Surveys

In addition to the general review of marine ecological information in the Study Area, updated site specific information was also obtained through field surveys to secure an accurate impact assessment, particularly in those areas that are likely to be subject to direct loss or indirect impact. For this purpose, inter-tidal field surveys, benthic grab sampling and sub-tidal dive surveys were conducted between September 2009 and January 2010 to fill information gaps in the baseline information, in accordance with Condition 3.4.7.4(iii) as set in the EIA Study Brief.

5.3.2.1 Inter-tidal community survey

Qualitative walk through and quantitative transect methods were used to survey the inter-tidal communities of the surveyed sites (refer to Figure 5.2 for locations of sites) in September and October 2009 for the wet season and January 2010 for the dry season. Walk through surveys were conducted for seven selected sites at Tsing Yi, Kwai Chung, Stonecutters Island, Green Island and Kau Yi Chau, covering mostly vertical and boulder-mounted seawalls, artificial dolosse, exposed rocky shores and a small section of cobble beach and sandy beach. During the walk through surveys, the community attributes were recorded through direct sighting by qualified ecologists with an aid of binoculars. All flora and fauna within the area were recorded on their relative abundance in two tidal levels – high and low tidal level – considering that the zoning of the inter-tidal community is quite vertically compressed in the exposed shore. The surveys were conducted at considerably low tide periods (<1mC.D.) when a larger area of inter-tidal habitats is exposed during low tides.

The semi-sheltered rocky shore interspersed with cobble beach on Green Island and the rocky shore and sandy beach on Kau Yi Chau were surveyed by the vertical transect method. Owing to the inaccessibility of the artificial dolosse at Stonecutters Island and southern Tsing Yi, and vertical seawalls in Kwai Chung and Tsing Yi, the transect method was difficult to be applied on these areas; only qualitative walk through surveys were conducted at these locations. Also, given the compressed vertical distribution of the coastal communities on artificial seawall, vertical transect method may not be able to fully present the distribution of inter-tidal communities on these areas. As such, the vertical transect method was only conducted at the hard shore on the rather gentle gradient at Green Island and Kau Yi Chau. At each survey location on Green Island and Kau Yi Chau, four transects were placed from the high tide mark extended to the low tide level at 1m CD or below. Quadrat samples (0.5m x 0.5m) were taken at 1m interval along the transects. All fauna observed within the quadrat were identified and counted. For sessile organisms such as oysters, barnacles and small snails, the percentage coverage within the quadrat was estimated. Other inter-tidal fauna found outside the quadrat were recorded qualitatively to establish a species checklist for the rocky shore habitat.
5.3.2.2 Benthic grab sampling

Nine sites in the Kwai Tsing Container Basin, Northern Fairway and Western Fairway were chosen as shown in Figure 5.2, to assess the soft-bottom benthic community using grab sampling in January 2010 during the dry season. The selected sampling sites were within or in proximity of the proposed dredging area where direct habitat loss or indirect impact may arise.

At each site, three grabs of 0.1m² were collected using a modified van Veen Grab. Collected samples were washed with seawater in a 0.5mm sieve onsite and then stained in 20% buffered formalin solution, using Rose Bengal as the staining medium. Samples were then rinsed with freshwater over a 0.5mm mesh in the laboratory. Organisms were sorted from the sediments and preserved in 70% ethanol solution. Subsequently, benthic organisms were identified to the lowest practicable taxonomic level by marine benthic specialists. Species composition, abundance and biomass were recorded, with Diversity index and evenness index provided for evaluating and ranking the ecological values.

5.3.2.3 Sub-tidal dive survey

Spot dive surveys were conducted in December 2009 in and around the areas that have the potential for coral assemblage. The proposed dredging area in Kwai Tsing Container Basin, and the hard-bottom sub-tidal zones along the Rambler Channel, Green Island and Kau Yi Chau in the vicinity of the proposed dredging area were surveyed (survey locations refer to Figure 5.2). Both qualitative spot dive and quantitative Rapid Ecological Assessment (REA) were also carried out during the survey.

Spot Dive Survey

Characteristics of the coral communities encountered were recorded by suitably trained and qualified SCUBA divers swimming at random depths along predetermined transects. Surface parameters including temperature, time and date information were recorded before the dive began. Parameters including the estimated number of species, coral cover, partial mortality and the presence of any rare corals were then recorded during the actual dive.

In particular, any aspect which was significantly different about the coral areas encountered was noted, including non-typical reef structures, unusual coral species associations, unique or peculiar assemblages of the local Incipient Reef formations, and reefs that are almost completely dominated by one particular species.

Dives surveys were conducted in representative locations as shown in Figure 5.2. Data was recorded on water proof paper during the dive in preparation for a later consolidation in a Preliminary Survey Report. Once all of the Spot Dive Survey data was collected on an area, this information was then summarized and a subsequent Rapid Ecological Assessment (REA) survey was conducted.

CoralWatch Survey

The CoralWatch was also carried out to determine the current health of the coral communities encountered. This survey technique provides a simple method of monitoring the condition of hard corals by the use of simple graded colour charts underwater. The University of Queensland, Australia, was responsible for developing this survey methodology. The colour charts are used as standards, based on the actual colours of bleached and healthy corals. Each colour square corresponds to a concentration of
symbionts (zooxanthellae) contained in the coral tissue and relates directly to the coral’s condition. The process is simple, accurate and non-invasive. Individual coral colony stress may then be identified rapidly.

All recorded corals were surveyed using the CoralWatch Chart. A total of ten coral colonies were examined in-situ and the lightest and darkest colour match was determined. Data was recorded on prepared underwater sheets for later analysis. Care was taken to avoid recording the colour of the tips of the corals since there can be a delay in the colouration due to the required up-take time for zooxanthellae to enter the coral tissue.

CoralWatch data was collected for each transect. The numerical difference, the colour score, was calculated for each colony. The data was presented for each colony, and then grouped into the corresponding blanching categories with the percentage of corals in each category determined. The data was then averaged so that the figure for Cumulative Average could be calculated.

**Rapid Ecological Assessment (REA) Survey**

The Rapid Ecological Assessment (REA) methodology was first detailed by DeVantier et al. 1998. The survey is a two tier approach for underwater survey to assess the sub-littoral substrata and benthic organisms in an area. This methodology has been modified to suit Hong Kong conditions (Oceanway 2002) and has become a standardized and widely adopted way to establish ecological baseline conditions. Two levels of information are recorded in a ~2m wide swath, 1m either side of a 100m long tape, as described below:

- Tier I assesses the relative cover of major benthic groups and substrata; and
- Tier II provides an inventory of sedentary / sessile benthic taxa, which are also ranked in terms of their abundance in the community at the survey site.

Data was recorded by experts who are experienced in the field identification of sedentary / sessile benthic taxa, particularly corals.

**Tier I : Categorisation of benthic cover**

For each transect, ecological and substratum attributes would be categorised and ranked. The required attributes are detailed as follows:

*Table 5.1: Tier I Benthic Attribute Categories*

<table>
<thead>
<tr>
<th>Ecological Attributes</th>
<th>Substratum Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Corals</td>
<td>Hard substrata</td>
</tr>
<tr>
<td>Dead coral</td>
<td>Bedrock / continuous pavement</td>
</tr>
<tr>
<td>Octocorals (Soft corals black and gorgonians)</td>
<td>Boulder blocks (diam. &gt;50cm)</td>
</tr>
<tr>
<td>Anemone beds</td>
<td>Boulder blocks (diam. &lt;50cm)</td>
</tr>
<tr>
<td>Dead standing corals</td>
<td>Rubble</td>
</tr>
<tr>
<td>Other benthos (sponges, zoanthids, ascidians and bryozoans)</td>
<td>Other</td>
</tr>
<tr>
<td>Macro-algae</td>
<td>Soft substrata</td>
</tr>
<tr>
<td></td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>Mud / Silt</td>
</tr>
<tr>
<td></td>
<td>Mud</td>
</tr>
</tbody>
</table>

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Table 5.2: Tier I Ordinal Ranks of Percentage Cover of Benthic Attributes

<table>
<thead>
<tr>
<th>Rank</th>
<th>Percentage Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None recorded</td>
</tr>
<tr>
<td>0.5</td>
<td>1-5%</td>
</tr>
<tr>
<td>1</td>
<td>6-10%</td>
</tr>
<tr>
<td>2</td>
<td>11-30%</td>
</tr>
<tr>
<td>3</td>
<td>31-50%</td>
</tr>
<tr>
<td>4</td>
<td>51-75%</td>
</tr>
<tr>
<td>5</td>
<td>76-100%</td>
</tr>
</tbody>
</table>

Note: For substratum attributes, it is preferable to record the actual estimates of cover. The percentage of hard substrata vs soft substrata can then be provided (e.g. 80% and 20% respectively). The percentage cover of the types of hard or soft substrata could also be presented (e.g. bedrock pavement 60%, rubble 20%, sand 15%, mud/silt 5%). Similarly, recording and presenting actual estimates of, for instance, hard and soft coral cover may be more informative (e.g. <1%) and is also the approach adopted by similar recent survey reports.

Table 5.3: Taxonomic inventory Identification

<table>
<thead>
<tr>
<th>Taxon Abundance Rank</th>
<th>Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>1</td>
<td>Rare</td>
</tr>
<tr>
<td>2</td>
<td>Uncommon</td>
</tr>
<tr>
<td>3</td>
<td>Common</td>
</tr>
<tr>
<td>4</td>
<td>Abundant</td>
</tr>
<tr>
<td>5</td>
<td>Dominant</td>
</tr>
</tbody>
</table>

The taxon categories were ranked in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks were visual assessments of its abundance, rather than the quantitative counts of each taxon. Representative photos of organisms were also taken.

The results of the REA Survey were presented in table form to allow an easy comparison between the different sites investigated. The details of all the marine ecological surveys conducted for this EIA are summarized in Table 5.4 in the next section.

5.4 Baseline Conditions & Marine Ecological Sensitive Receivers

The relevant marine ecological information collected from literature reviews and field survey studies is summarized in this section in order to provide baseline information on the inter-tidal communities, sub-tidal coral communities, soft-bottom marine benthic communities and marine mammals, in accordance with Condition 3.4.7.4 (v) set in EIA Study Brief No. ESB-198/2008. This assessment also presents the marine resources found within the four relevant WCZs (i.e. Victoria Harbour, Western Buffer, North Western and Southern WCZs), as well as summarises the physical environment and ecological resources within the Study Area, whilst details of the field survey records are presented in Appendices 5.1-5.3. Habitat maps of suitable scale showing the types and locations of the inter-tidal habitat, locations of coral, marine benthic communities and inter-tidal habitats, and distribution of marine mammals in the Study Area are presented in Figures 5.4-5.7 in accordance with Condition 3.4.7.4 (iv)(b) set in EIA Study Brief No.ESB-198/2008.
5.4.1 Water Quality

The proposed dredging area is situated at the Kwai Tsing Container Basin, Northern Fairway and Western Fairway, within the gazetted Victoria Harbour WCZ and Western Buffer WCZ. The central waters of Hong Kong including the Victoria Harbour WCZ and Western Buffer WCZ are important navigation channels and port areas. Water temperature typically ranges between 15°C and 30°C over an annual cycle with a mean of about 23°C. Salinity varies between 12 and 35 psu with a mean of about 31 psu. Recent marine water quality monitoring results from Environmental Protection Department (EPD 2008) show that the water quality of the Victoria Harbour has significantly improved following the implementation of the Harbour Area Treatment Scheme (HATS) Stage 1 in 2002. Under the HATS Stage 1 Scheme, about 75% of the sewage which previously discharged into Victoria Harbour now undergoes chemically enhanced primary treatment. The water quality around the KTCB is also influenced by discharges from the Rambler Channel area, which have been contributing to notably higher inorganic nitrogen levels compared to waters from the central Victoria Harbour area, leading to an overall exceedance of the WQO for total inorganic nitrogen (TIN). Other key parameters such as dissolved oxygen were also non-compliant for some stations in 2008, whereas the levels of unionised ammonia were compliant with the WQO. Levels of suspended solids (SS) at Rambler Channel have also tended to be higher than elsewhere around Victoria Harbour. Therefore, although water quality has been improving in recent years, in general, the marine waters around Rambler Channel and to the west of Victoria Harbour provide a relatively poor quality and disturbed marine habitat as compared to other water bodies in Hong Kong.

5.4.2 Sediment Quality

Findings of the Consultancy Study on Marine Benthic Communities in Hong Kong (CPSL 2002) regarding sediment characteristics in the Project area indicate that the existing seabed near the proposed dredging areas at the KTCB comprise very poorly sorted coarse sand. The total organic matter (TOM) content in the seabed sediment was relatively low (3.18% in summer and 4.00% in winter, compared to an average of 6.04% in Hong Kong). CPSL (2002) also revealed that the seabed was environmentally disturbed with low species diversity and evenness.

The seabed sediment of Victoria Harbour was described as grey, clayey, very silty and very gravelly sand with shell fragments in the 2002 sediment testing (Mouchel 2002), which was similar to the sediment testing results conducted for the Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun in September 2006 (Mott Connell 2007). Sediments collected close to the central and southern fairway indicated that the surface deposit at around 1m depth from the seabed was anthropogenic, black sediment which was oxidized to brown, slightly silty, fine to coarse sand with little sub-angular, fine to medium gravel of rocks (Mott Connell 2007). According to the study conducted by CityU, there were minimal seasonal changes in sediment characteristics for both summer and winter around Victoria Harbour (CPSL 2002). The seabed sediment in Victoria Harbour was often contaminated by heavy metals and polyaromatic hydrocarbons (PAH) as a result of vehicle exhaust, surface run-off contaminated by gasoline, diesel and lubricating oil, and other contaminants from industries in the past (EPD, 2008).

5.4.3 Inter-tidal Communities

5.4.3.1 Victoria Harbour WCZ

Artificial seawalls are the dominant coastal habitat along Victoria Harbour, while natural rocky shores and artificial boulder shore were identified at Green Island and Little Green Island located near the proposed dredging area (Figure 5.5b). The northern and western sides of the Green Island are predominantly
exposed rocky shore continuously receiving vigorous wave actions generated by natural exposure and heavy marine traffic. On the southern side of the island, the shoreline is partially sheltered, forming several small cobble beaches.

Findings from literature review indicated that the species diversity at the inter-tidal zone of Green Island was similar on both northern and southern shores, but different assemblages of inter-tidal fauna were recorded. Species recorded in Green Island include the commonly found Barnacle *Tetraclita squamosa*, Topshells *Monodonta labio*, Littorinidae *Echinolittorina trochoidea*, Chitons *Acanthopleura japonica*, the Limpets *Cellana grata* and a rare species of nerite *Nerita undata* (ERM 1998).

Surveys of the inter-tidal communities of Green Island, Little Green Island and a reference site in Hong Kong Island conducted by Mouchel in 1998 have been reviewed by ERM (ERM 1998) (Figure 5.3). A total of 22 species of fauna was recorded. The most abundant species recorded in the inter-tidal zone around the above Study Area were grazing gastropods such as Chiton (*Acanthopleura japonica*) and Limpets (*Cellana grata*, *C. toreuma*, *Patelloida pygmaea* and *P. saccharina*) recorded at the lower eulittoral zone, and Periwinkles (*Echinolittorina trochoidea*, *E. radiata* and *E. vidua*) recorded at the higher eulittoral zone. Predatory gastropods such as Dogwhelks (*Thais clavigera* and *T. luteostoma*) were also recorded in low density at the lower eulittoral zone. Sessile organisms including Stalked Barnacles and Acorn Barnacles were recorded in high abundance (ERM 1998). By comparing the three survey locations, the overall species abundance and species diversity were highest at the reference Hong Kong sites, followed by the Little Green Island and Green Island. The findings displayed the inter-tidal community to be of typical semi-exposed rocky shores. No rare species or species of conservation importance were recorded for these areas in this study.

During the inter-tidal community survey conducted for the Project, 18 species of invertebrates were found in the inter-tidal zone of Green Island (Tables 1a, 1b, 2a and 3a of Appendix 5.2). The result of the transect survey showed that Periwinkles *Echinolittorina radiata*, *Echinolittorina trochoidea* and *Littoraria articulata* were the dominant species in the low inter-tidal zone while Limpet *Patelloid pygmaea* and Lipped Top Shell *Monodonta labio* were found frequently in the mid inter-tidal zone. All species are common or very common in Hong Kong. It was noted during the field surveys that the inter-tidal fauna was harvested extensively by fishermen, which indicated that the inter-tidal community was receiving a certain level of human disturbance.

### 5.4.3.2 Western Buffer WCZ

The inter-tidal zone close to the proposed dredging area consists of vertical seawalls, boulder-mounted sloping seawalls and concrete dolosse at the Tsing Yi and Kwai Chung shorelines. Inter-tidal community surveys were conducted along the coastline close to the proposed dredging area at the Kwai Tsing Container Basin for this EIA study (locations are indicated in Figure 5.2). The coastline is dominated by artificial vertical seawall of varied types (presented in Figures 5.5a and b). The coastal shore is mostly homogeneous concreted seawall with reduced number of niches restricting the diversity of the flora and fauna. It was also noted that the dolosse along the southern entrance of the container basin appear to be recent features and were colonized by relatively low diversity and richness of fauna species.

The inter-tidal communities on both northern and southern entrance of the KTCB are of similar assemblages. From the high to low tidal level, the eulittoral zone is dominated by Acorn Barnacle *Tetraclita squamosa* and Rock Oyster *Saccostrea cucullata* whilst varied types of limpets are common. Chiton *Acanthopleura japonica* was recorded but is in low abundance compared to similar habitat type with longer history. The results of the inter-tidal survey are listed in Tables 1a and 1b in Appendix 5.2. All of the
species recorded are common and of similar type to those found on the wharves and embankments in the Victoria Harbour area.

Natural rocky shores and sandy shores were identified at Sandy Bay which is located to the west of Hong Kong Island, facing the proposed dredging area. The coastline consists of rocky shore, sandy shore, artificial boulder shore and vertical seawall. Inter-tidal surveys for the HATS EEFS (CDM 2004) were previously conducted at the inter-tidal rocky shore in September 2002 (survey locations shown in Figure 5.3). Two species were identified in the high eulittoral zone, while 9 and 13 species were found in the mid and high inter-tidal zone respectively. *Echinolittorina vidua* was the dominant species of the inter-tidal zone while *Echinolittorina trochoidea*, *Monodonta labio*, *Siphonaria siria* and *Acanthopleura japonica* were recorded in large abundance.

### 5.4.3.3 Southern WCZ

The inter-tidal zone of Kau Yi Chau near the proposed dredging area consists of rocky shores and sandy shores (Figure 5.5b). Similar habitats were recorded in the inter-tidal zone of Siu Kau Yi Chau. Inter-tidal community surveys were conducted at the coastline close to the proposed dredging area at Kau Yi Chau as indicated in Figure 5.2. The coastline is mainly composed of rocks and boulders of assorted sizes interspersed with sandy shore.

During the field survey for this Project, a total of 17 species of invertebrates was recorded in the inter-tidal zone of Kau Yi Chau (Tables 1a, 1b, 2b and 3b of Appendix 5.2). Periwinkles *Echinolittorina trochoidea* and *Echinolittorina vidua* were found frequently in the upper eulittoral zone and littoral fringe while at the lower eulittoral zone, the coastal community is dominated by Acorn Barnacle *Tetraclita squamosa*, Chiton *Acanthopleura japonica*, Dog Whelk *Thais clavigera*, False Limpet *Siphonaria japonica* and Limpet *Cellana grata*. All species found are common or very common on natural rocky shore including a few Green Mussel *Perna viridis* which usually appear in large colonies attached to hard substrate, in particular wharf piles in Victoria Harbour.

Inter-tidal surveys were conducted in Tai Lei, Peng Chau in 2002 to 2003 by BMT (Figure 5.3). The coastline is made up of granite bedrock outcrop with crevices and pools, with small boulders embedded in sand at the lower shore (BMT 2005). Surveys in both years recorded only common species in the area. On the rocky / boulder shore, common inter-tidal species such as Limpet *Patelloida saccharina*, Anemone *Haliphanella luciae*, Neritid Shell *Nerita albicilla* and hermit crabs were abundant. Periwinkle *Nodolittorina trochoidea*, Barnacle *Capitulum mitella* and Limpet *Patelloidea saccharina* were recorded at the upper shore while Barnacle *Tetraclita squamosa*, Limpets *Cellana toreuma*, *Patelloidea saccharina*, top shell *Monodonta labio*, Whelk *Thais clavigera* and Chiton *Acanthopleura japonica* were recorded in the mid-shore. Green anemone *Haliphanella luciae*, Barnacle *Tetraclita squamosa*, hermit crabs, *Monodonta labio*, *Patelloidea saccharina*, *Cellana toreuma* and *Capitulum mitella* were found abundant in the lower shore zone. All species are common and typical of hard shore environments (BMT 2005).

### 5.4.3.4 North Western WCZ

The North Western WCZ is a very large WCZ covering highly diversified inter-tidal habitats. Along the northern coastline from Sham Tseng to Lung Kiu Tang, it is dominated by artificial shoreline. Sandy shores are found sporadically along this coastline and are mostly being used for amenity purposes. The coastline along north and west Lantau, is dominated by rocky and pebble shores but fringed with thin layers of mangrove at river mouths with soft bottom mudflats. Some of the mudflats such as San Tau and Tai Ho are identified as having with high ecological value for their association with seagrass bed. The mudflat...
habitats of north Lantau are also regarded as important habitat for two species of horseshoe crabs. The coastlines at Sha Chau and Lung Kwu Chau are protected under the Marine Park designation.

5.4.4 Marine Soft-bottom Benthic Communities

The soft-bottom benthic communities in Hong Kong waters comprise mainly polychaetes – annelids, crustaceans and bivalves. The benthic communities in inshore waters are largely affected by sediment characteristics and hydrography. In 2001, a study on marine benthic communities in Hong Kong waters was conducted by the CityU Professional Services Limited (CPSL) commissioned by Agriculture, Fisheries and Conservation Department (CPSL, 2002). Sampling was conducted at 120 sampling stations, which covered the marine benthic habitat near the dredging area for this Project. The findings from 11 sampling stations (locations refer to Figure 5.3) are summarized in Table 5.4 which supplement the baseline information. The species diversity (H') of the marine benthos are generally not high (H'<3). Also, the W statistic obtained from the Abundance and Biomass Comparison (ABC) Plots showed negative value for sampling station 51 and very low for station 52, indicating the benthic communities were environmentally disturbed. No species of conservation concern were found in the Study Area.

In order to update and verify the ecological value of the benthic communities within the potentially affected area, site-specific marine soft-bottom benthic survey was conducted in January 2010. Grab sampling was conducted at 9 selected locations (locations refer to Figure 5.2), within and adjacent to the dredging area. The findings of the marine soft-bottom grab sampling are detailed in Appendix 5.3. In summary, the results indicated that the sediments at the 9 sampling stations are mostly greyish, muddy and sandy with shell fragments. Stations D and E at the Western Fairway (within the Project area) and Ma Wan Fairway (outside the Project area) respectively have a higher sandy sediment content, and recorded a relatively higher abundance of benthic fauna (dominated by polychaetes) amongst the 9 stations (extracted data is presented in Table 5.5). Station G recorded the fewest benthos and number of species. This could be due to the suspected hypoxic conditions at this station.

Compared to the survey findings conducted by the CPSL (2002), the current Study recorded a relatively higher species diversity and abundance. The soft-bottom benthos species recorded in this Study are dominated by annelids and crustaceans. No species of conservation concern were recorded which accords with the previous results presented by CPSL. Dominant species recorded within the Project area (Stations B, D, F, H and I) include Annelids (Cirratulidae, Nepthiidae, Paraoonidae, Parapriomospio pinnata, Spionidae, Syllidae, Terebellidae), and Crustaceans (Callianassa japonica, Clausidiidae), with annelids contributing the highest biomass content (Table B3 of Appendix 5.3). Oligochaetes (Thalassodrilides gurwitschyi) recorded in Stations H and I indicate that a relatively eutrophic environment exists within the Kwai Tsing Container Basin. Polychaetes Sigambra hanaokai recorded both within and in vicinity of the Project area, which were also recorded in previous CPSL study, are tolerant of sediments with low oxygen and high organic content.

Table 5.4: Findings of Soft-bottom Marine Benthic Sampling at Selected Stations – Summer & Winter (CPSL 2002)

<table>
<thead>
<tr>
<th>Station</th>
<th>Season</th>
<th>Species richness</th>
<th>Species diversity</th>
<th>Evenness</th>
<th>Taxonomic diversity</th>
<th>Taxonomic distinctness</th>
<th>W statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Summer</td>
<td>6.02</td>
<td>2.78</td>
<td>0.80</td>
<td>63.49</td>
<td>71.12</td>
<td>0.145</td>
</tr>
<tr>
<td>42</td>
<td></td>
<td>7.32</td>
<td>3.16</td>
<td>0.90</td>
<td>71.1</td>
<td>74.34</td>
<td>0.462</td>
</tr>
<tr>
<td>43</td>
<td></td>
<td>4.82</td>
<td>2.58</td>
<td>0.88</td>
<td>76.67</td>
<td>79.5</td>
<td>0.046</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>5.45</td>
<td>2.51</td>
<td>0.79</td>
<td>63.64</td>
<td>75.39</td>
<td>0.226</td>
</tr>
<tr>
<td>46</td>
<td></td>
<td>5.21</td>
<td>2.65</td>
<td>0.85</td>
<td>65.27</td>
<td>72.28</td>
<td>0.213</td>
</tr>
</tbody>
</table>
Table 5.5: Summary of Soft-bottom Marine Benthic Survey Findings for this Study (January 2010)

<table>
<thead>
<tr>
<th>Station</th>
<th>No. of Animals</th>
<th>No. of species</th>
<th>Mass (g)</th>
<th>Species Diversity (H')</th>
<th>Evenness (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>107</td>
<td>72</td>
<td>0.954</td>
<td>4.16</td>
<td>0.97</td>
</tr>
<tr>
<td>B</td>
<td>105</td>
<td>64</td>
<td>0.352</td>
<td>3.97</td>
<td>0.96</td>
</tr>
<tr>
<td>C</td>
<td>94</td>
<td>53</td>
<td>0.963</td>
<td>3.77</td>
<td>0.96</td>
</tr>
<tr>
<td>D</td>
<td>141</td>
<td>59</td>
<td>1.640</td>
<td>3.78</td>
<td>0.93</td>
</tr>
<tr>
<td>E</td>
<td>158</td>
<td>62</td>
<td>0.842</td>
<td>3.98</td>
<td>0.96</td>
</tr>
<tr>
<td>F</td>
<td>110</td>
<td>70</td>
<td>0.768</td>
<td>4.16</td>
<td>0.98</td>
</tr>
<tr>
<td>G</td>
<td>69</td>
<td>50</td>
<td>0.785</td>
<td>3.82</td>
<td>0.98</td>
</tr>
<tr>
<td>H</td>
<td>85</td>
<td>51</td>
<td>1.379</td>
<td>4.03</td>
<td>0.98</td>
</tr>
<tr>
<td>I</td>
<td>91</td>
<td>60</td>
<td>0.902</td>
<td>3.95</td>
<td>0.97</td>
</tr>
</tbody>
</table>
5.4.5 Sub-tidal Coral Communities

The coral communities of Hong Kong are known as incipient reefs. Incipient reef coral areas have no calcium carbonate framework as a foundation for the corals; instead, corals attach themselves directly onto boulders and bedrock, forming pseudo fringing coral communities. Hard (Scleractinian) coral communities occur patchily in rocky shores and over sand in Hong Kong, mainly in the northeast and eastern coasts, and to a much lesser extent at the southern and western waters. Compared to the northeast and eastern coasts, the western and southern waters are relatively low in coral richness and diversity. Local coral communities are dominated by favid species with massive, encrusting and foliaceous growth forms and 84 species from 28 genera have been recorded. Isolated patches of hard (Scleractinian) coral are commonly recorded in Victoria Harbour WCZ, Western Buffer WCZ and Southern WCZ, particularly for the pioneering species which can tolerate pollutant and thin layer of sediment.

Most of the shallow marine areas in Hong Kong with reasonable amounts of hard substratum have a veneer of corals attached. Soft corals and gorgonians sometimes occupy suitable hard substratum in deeper areas. The Study Area comprises a considerable size of hard sub-tidal area providing substratum for attachment of hard coral communities.

5.4.5.1 Green Island, Little Green Island, Kau Yi Chau and Siu Kau Yi Chau

Marine dive surveys were carried out at the sub-tidal zone around Green Island and Kau Yi Chau in December 2009 for this EIA project. On the western side of the Green Island, the seabed is quite varied with patches of sand and rubble in the shallow areas and mud with silt or sand in deeper areas. Rocks and boulders of assorted sizes are scattered throughout the area with some areas of modified shore. There was also a considerable amount of debris scattered around the area and a large number of ghosted fishing nets.

The sub-tidal habitat is established with sessile benthos, including 7 species of hard hermatypic coral recorded in this area. Colony sizes vary considerably and range from small (<10cm²) to large (>0.5m²). All corals are patchy with some dense areas recorded. Four species of gorgonians, one species of soft coral and one species of ahermatypic coral were recorded.

Green Island was also surveyed in 1997 for the Green Island Development Studies (Babtie BMT, 1998). Four species of soft corals and gorgonians were recorded in the Study Area around Green Island and Little Green Island. The soft coral species recorded are similar to those identified in the recent dive survey for this project except the Purple Sea Whip Ellisella gracilis, which was encountered at Little Green Island but not recorded in the recent survey.

On the eastern side of Kau Yi Chau, the seabed is dominated by sand and rubble in shallow areas with mud, silt or sand in deeper areas. Rocks and boulders of assorted sizes are scattered throughout the area. In addition, Debris was found to be scattered around the area including some metal pieces which could be the remains of a shipwreck.

The area is established with sessile benthos. Seventeen species of hard coral were recorded along the transect. Colony sizes vary considerably and range from small (<10cm²) to large (>0.5m²). The coral colonies were recorded to be in good condition. Three species of gorgonians, one species of soft coral and one species of ahermatypic coral were recorded.
5.4.5.2 Sandy Bay, Pak Kok, Shek Kok Tsui and Ap Lei Chau

The coastline on Sandy Bay is predominantly an artificial substrate receiving a certain level of disturbance. A spot check dive undertaken for the HATS recorded 14 taxa of hard coral and 5 taxa of soft coral at a depth around 12m (ENSR 2008). Soft corals *Echinomuricea* sp. and bryozoans *Schizoporella errata* were the most ubiquitous taxa recorded. Low coverage of soft corals and 9 hard corals were observed in Sandy Bay, with only small isolated *Echinomuricea* colonies and the more abundant *Psammocora superficialis* and *Porites lobata* recorded. For west Sandy Bay, the soft coral coverage is moderate (10 – 50%) at deep and middle transects including seven genera. Eleven hard corals with low coverage were also reported. The most abundant species recorded were Favids.

The western coast of Lamma Island was surveyed to verify the presence and condition of hard corals along the coast (Maunsell 2001). The coral cover was general low and the northwestern side was recorded with 18 hard coral colonies from 3 genus, namely *Psammacora*, *Cyphastrea* and *Goniastrea*.

In Luk Chau Wan a higher coral coverage was recorded compared to other sites on Lamma Island. In Luk Chau Wan, the shallow sub-tidal area recorded 23 species of hard corals with a percentage cover of 25-50% and recorded with high abundance of *Turbinaria peltata*. The coverage and diversity of corals at Luk Chau Wan and Sok Kwu Wan were high. In Luk Chau, both hard and soft corals were recorded. *Dendronephthya* spp. were the most abundant soft coral taxa while *Plesiastrea vesipora* was the most abundant hard coral.

5.4.5.3 Southern WCZ (Peng Chau, Sunshine Island and Hei Ling Chau)

The sub-tidal habitat at Peng Chau was recorded with moderate diversity of coral communities including hard, soft and black corals (CDM 2004). Hard (Scleractinian) coral, of common species, was recorded in small isolated patches. Damage on the live coral was observed. A soft coral community dominated by one genus *Echinomuricea* was located at silty environment. As a result, that area did not form part of a significant coral community.

In the Southern WCZ, there were many sites recorded with coral community. Stretching from Soko Islands at south Lantau to Beaufort Island, the coral species richness and diversity vary from place to place. The hard coral communities in Peng Chau, Sunshine Island, Hei Ling Chau and Cheung Chau are of similar type with low hard coral cover (1-5%) and dominated by Favidae species. Sham Wan was identified as a coral richness hotspot with a rare species *Stylocoeniella* spp. Cape D’ Aguilar was designated as a Marine Reserve, for its geological and geomorphological interest. Chung Hom Kok was recorded with low coverage of hard coral coverage (ERM 2000). Sok Kwu Wan (20-50%) and Luk Chau Wan (<25%) also support moderately-high coral coverage, with more than 20 hard coral species recorded. A rare hard coral species *Pseudosiderastrea tayami* was only found in the southern waters in Hong Kong, including the southern water in Lamma Island and South Soko (ERM 2006). In terms of species richness and biodiversity, coral communities in Sung Kong, Waglan, Sok Kwu Wan, Sham Wan, Tai Tam and Cape D’ Aguilar are considered as high-moderate.

5.4.5.4 Tsing Yi and Container Basin

Marine dive surveys were conducted along the coastline of Tsing Yi and KTCB for this project at 9 spot dive locations. The coastal habitat consists of varied types of modified seawall including quarry rock barrier and concrete vertical seawall. To the north of the Container Basin, five colonies of the gorgonian coral *Guaiagorgia* sp. and a single colony of *Dendronephthya* sp. were recorded at the concrete vertical seawall.
At the rock barrier, 6 species of Gorgonian form the genera *Echinogorgia* sp., *Echinomuricea* sp., *Euplexaura* spp. and *Guaiaagorgia* sp., two species of ahermatypic coral, *Tubastrea faulkneri* and *Paracycyathus rotundatus*, and two soft coral species from the genera *Dendronephthya* spp. were recorded.

Within the container port, two colonies of the gorgonian *Guaiaagorgia* sp. and four colonies of the soft coral *Dendronephthya* sp. were recorded on one pillar. The seawall dolosse at the southern entrance of the container port was surveyed but no coral was found. The full report on the marine dive survey together with the spot dive and REA dive raw data is presented in Appendix 5.1.

### 5.4.5.5 North Western WCZ

Hard (Scleractinian) coral community in this WCZ is generally low in species diversity and in abundance owing to the influence of freshwater discharges from the Pearl River. Scattered coral colonies of Gorgonacea and Scleratina were recorded in the sub-tidal hard substrate. In the EIA study for Tuen Mun – Chek Lap Kok Link (TM-CLKL) and Hong Kong – Zhuhai – Macao Bridge and Connection with North Lantau Highway (HZMB), marine dive surveys were conducted, in which some ubiquitous species such as green mussel *Perna viridis*, sponges, barnacles and oysters were recorded on north Lantau (AECOM 2009).

### 5.4.6 Marine Waters

The Assessment Area covers four WCZs stretching from North Western to Victoria Harbour Water Control Zones. The inshore hydrography is affected by fresh water arriving from two sources, namely, heavy rainfalls and the Pearl River. The North Western WCZ situated in the Pearl River Estuary is influenced by the freshwater flows from the Pearl River. During summer, the salinity and visibility are markedly decreased as a consequence of the large freshwater discharge which leads to significant vertical stratification.

The Pearl River also carries heavy loads of SS and nitrates. The effect of the Pearl River progressively reduces towards the southeast. The Victoria Harbour and Western Buffer WCZs are situated in a transition zone in which, in summer, surface waters of reduced salinity, higher temperature and rich in dissolved oxygen flow over the more saline and cooler oceanic waters which are low in dissolved oxygen. In winter, with a reduced flow from the Pearl River, the water of this region is vertically more uniform. The Western Buffer Water Control Zone covers the Ma Wan Channel, Kap Shui Mun Channel and other major navigation channels and anchorages in the Western Harbour. It has strong tidal flushing capacity and is used for disposal of effluent from the Stonecutters Island Sewage Treatment Works. The Southern WCZ covers the south of Hong Kong Island and to the east of Lantau Island, directly open to the South China Sea. The WCZ has a relatively good level of dissolved oxygen due to its connection to the open sea, but it is also partially affected by the discharge from the Pearl River further to the West. In the northern part it is influenced by the flow from Victoria Harbour. The major marine animals of conservation concern inhabiting the marine waters are cetaceans, and in particular, two dolphin species.

### 5.4.6.1 Marine Mammals

All the marine mammals in Hong Kong are protected under the Wild Animals Protection Ordinance (Cap. 170) and the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). Two cetacean species namely Chinese White Dolphin *Sousa chinensis* and Finless Porpoise *Neophocaena phocaenoides* are found regularly in Hong Kong waters.
Chinese White Dolphin (CWD) is listed as “Near Threatened” in IUCN Red Data List (IUCN 2009) on account of its decreasing trend in population. They have limited distribution in Hong Kong waters, due to their preference for shallow, coastal estuarine habitats (Clarke et al. 2000). They mainly occur at western and northwestern Lantau where the marine waters receive a large inflow of fresh water from the Pearl River. Several hotspots with consistent dolphin usage include the waters around Lung Kwu Chau, along Urmston Road, around the Brothers Island, and the stretch of waters from Tai O Peninsula to Fan Lau (AFCD 2009). Usage of the eastern Lantau, in which the Study Area of this project covers, by Chinese White Dolphin is rare.

Finless Porpoise is listed as “Vulnerable” in IUCN Red Data List (IUCN 2009) on account of its decreasing trend in population. This species is rather cryptic and is therefore difficult to survey. In Hong Kong, it generally occurs in southern waters, from Soko Islands to Po Toi Islands. The occurrence of Finless Porpoise displayed distinct seasonal variation in their distribution in Hong Kong. In winter and spring, porpoises mostly occur in South Lantau and Lamma waters but almost absent in these waters in summer and autumn (AFCD 2009). They have been recorded at Cheung Chau and south Lamma in the Western Buffer WCZ but with no sighting record further north.

5.4.7 Habits identified as Recognized Sites of Conservation Importance

A few locations in the Study Area have been identified as recognized sites of conservation importance, including the Cape D’Aguilar Marine Reserve, Sha Chau and Lung Kwu Chau Marine Park, Sham Wan SSSI in south Lamma Island, San Tau Beach SSSI and the potential marine park at Soko Islands. Cape D’Aguilar is a designated Marine Reserve for its special geological and geomorphological features whilst Sham Wan SSSI is the only remaining stable breeding ground for Green Turtle. The Soko Islands are regularly used by two species of dolphin and this area is regarded as a potential Marine Park for protection of marine ecological resources. All three sites are within Southern WCZ but are far from the Project area. The marine waters of Sha Chau and Lung Kwu Chau Marine Park are important CWD habitats whilst San Tau Beach SSSI is an important site of seagrass bed. These two sites are within the North Western WCZ but are also far from the Project.

5.5 Ecological Importance

With reference to the baseline conditions discussed above, the ecological importance of the marine habitats were evaluated and determined on the basis of the criteria set in the EIAO-TM Annex 8 Table 2.

The marine habitat was evaluated based on the marine ecological resources found in the inter-tidal communities, coral communities on hard substrate, soft-bottom marine benthic communities and the marine mammals in the marine waters. The marine habitat evaluation covers the water control zones which are likely to be affected by the dredging activities, including Victoria Harbour WCZ, Western Buffer WCZ, North Western WCZ and Southern WCZ.

5.5.1 Evaluation on Habitat

The coastline of Victoria Harbour WCZ is largely modified with varied types of artificial seawall. The inter-tidal communities and sub-tidal communities found in this highly disturbed habitat are mostly fouling species with low ecological value. One exception is at Green Island where the natural coastline has been retained and where coral communities have been sustained. There is no recent record of marine mammals in the zone, suggesting that it is not a natural habitat suitable for them. Based on the available literature and field study observations the ecological value in this WCZ is generally low, without taking account of the...
sub-tidal communities at Green Island, which would be of moderate-low ecological value if evaluated independently.

The dredging areas in the Kwai Tsing Container Basin, Northern and Western Fairways are situated within the Western Buffer WCZ. The coastline along this zone varies from artificial vertical seawall such as Kwai Tsing Container Basin to natural coastline such as Kau Yi Chau. Hard coral communities were found in Sandy Bay, but are of low coverage and are common species. Benthic sediment in this WCZ is highly disturbed without high ecological value benthic communities. CWD is rarely sighted in this zone, with only sporadic sighting records. The overall marine habitat in this WCZ is evaluated as low ecological value owing to its highly disturbed and modified shoreline and low coverage of coral communities in the artificially modified habitat.

Southern WCZ is a large water control zone covering high diversity of natural marine habitat, including conservation important sites. Soko Islands are important for CWD use; Sham Wan in southern Lamma is a major breeding site for the Green Turtle; whilst Cape’s D’aguilar is rich and diverse in inter-tidal and sub-tidal communities. In the northern part of the zone (around Peng Chau, Siu Kau Yi Chau and Kau Yi Chau), the marine ecological resources are comparative low in species diversity and ecological value owing to the scattered and low coverage of coral colonies and common inter-tidal communities. Rare hard coral species are only found in the southern part of the zone (*Platygyra yaeyamaensis* in Sham Wan and *Pseudodiderastera tayami* in Lamma and Soko) where the marine traffic and water perturbation in this region is lower. In respect of marine water habitat, the southern Hong Kong waters is regarded as a relatively important habitat for Finless Porpoises owing to the relative high encounter rate at south of Tai A Chau, near Shek Kwu Chau and Cheung Chau, and around Po Toi Islands (AFCD 2009). The southwestern water is also moderately used by CWD. The regional contrast in ecological importance is also true for benthic communities. Benthic environment in the northern side of the zone has been disturbed artificially by the heavy marine traffic which leads to a relative low diversity and richness of marine benthic organisms. To the contrast, the marine benthos in southern part is relatively high in species diversity and richness, which include a conservation concerned species *Branchiostoma belcheri* in Tung Wan on the east coast of South Soko Islands (ERM 2006).

Since the ecological resource in the southern part of the Southern WCZ is more prominent than that in northern part, it would be inappropriate to generalize on the habitat evaluation by regarding the whole southern WCZ as one uniform habitat. As the dredging activities potentially affect the northern part of the WCZ, the focus has been on that part of the WCZ (including Kau Yi Chau, Si Kau Yi Chau, Peng Chau, Sunshine Island and Hei Ling Chau) for habitat evaluation. In general, the inter-tidal and marine benthic communities in the northern part of the Southern WCZ are of common type without identified habitat of conservation concern. Coral communities are commonly found in this area, but are also in low coverage and without species of conservation interest. The ecological value of the northern part of the Southern WCZ is regarded as moderate-low.

The evaluations of inter-tidal, sub-tidal and marine benthic habitats and marine waters are presented in Tables 5.6-5.9 respectively.

Table 5.6: Evaluation of the Ecological Importance of the Inter-tidal Habitats

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ (Northern Portion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalness</td>
<td>Mainly artificial seawall along the Victoria Harbour. Natural rocky</td>
<td>Vertical artificial seawall and sloping boulder-mounted</td>
<td>Coastline in Sha Chau and Lung Kwu Chau Marine Park and west</td>
<td>Rocky shore and sandy shore at Kau Yi Chau and Siu Kau Yi</td>
</tr>
</tbody>
</table>

---

259053/TNI/ENL/23/E July 2010
P:\Hong Kong\MRT\259053 KTCB\01 Project Management\71 Deliverables\07 Environmental Impact Assessment Report\FINAL_PE\EIA_Rpt_Jul 10_Ch 5_M Ecol.doc
Criteria | Victoria Harbour WCZ | Western Buffer WCZ | North Western WCZ | Southern WCZ (Northern Portion)
---|---|---|---|---
shore in Green Island receiving disturbance due to busy navigation at Sulphur Channel. | seawall at Tsing Yi and Container Basin receiving extensive disturbances including pollution load and heavy marine traffic. | and northwest Lantau are mostly natural whilst other parts are highly modified. | Chau is comparatively natural. Coastline in other outlying islands is moderately modified.

### Size

- The natural inter-tidal shoreline at Green Island is approximately 2km.
- The rocky shore at Sandy Bay is approximately 1.6km.
- Large area of inter-tidal habitat.
- The natural inter-tidal shoreline at Kau Yi Chau, Siu Kau Yi Chau and Peng Chau is approximately 6.5km.

### Diversity

- The species diversity is low.
- The species diversity is low.
- High species diversity owing to the presence of mangrove and seagrass bed.
- The species diversity is low.

### Rarity

- The species recorded at Green Island are typical of other rocky shores in Hong Kong.
- The species recorded at Tsing Yi and Container Basin are common fouling organisms found on artificial seawalls in Hong Kong waters.
- The species recorded at Sandy Bay are typical of other semi-exposed rocky shores in Hong Kong.
- Four species of seagrass and two species of horseshoe crab are rare in Hong Kong.
- The species recorded at the natural shorelines in Kau Yi Chau, Siu Kau Yi Chau and other outlying islands are typical of other rocky shores and sandy shores in Hong Kong.

### Re-creatability

- The natural rocky shores are difficult to recreate.
- The artificial seawall is recreatable but the natural rocky shores are difficult to recreate.
- Natural shore is difficult to recreate.
- The natural rocky shores and sandy shores are difficult to recreate.

### Fragmentation

- Not applicable.
- Not applicable.
- Not applicable.
- Not applicable.

### Ecological Linkage

- Not functionally linked to high ecological value habitat.
- The existing habitats at artificial seawall are not functionally linked to high ecological value habitats.
- The inter-tidal community at the mudflat sites are ecologically linked.
- The coastal community at the northern part of this WCZ is not functionally linked to high ecological value habitat.

### Potential Value

- The rocky shores have low potential to develop nature conservation interest habitat.
- The artificial seawall habitats at Tsing Yi and Container Basin are unlikely to develop a nature conservation interest habitat.
- Sha Chau and Lung Kiu Chau are designated Marine Park. San Tau Beach is designated SSSI. Both sites have high ecological value.
- The rocky and sandy shores at Kau Yi Chau have low potential to develop into a nature conservation interest habitat.

### Nursery/Breeding Ground

- Not identified.
- Not identified.
- Mudflat at north Lantau is identified as breeding ground for horseshoe crab.
- Not identified.

### Age

- Not applicable.
- Not applicable.
- Not applicable.
- Not applicable.
Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel
Environmental Impact Assessment Report

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ (Northern Portion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance/</td>
<td>Low species richness</td>
<td>The species</td>
<td>High species</td>
<td>Moderate species abundance in</td>
</tr>
<tr>
<td>Richness of Wildlife</td>
<td>found in the artificial seawall.</td>
<td>abundance was low at vertical smooth structures, wharf piles and boulder-mounted seawall at Tsing Yi and Container Basin. Low species abundance found in natural rocky shores.</td>
<td>in north and west Lantau.</td>
<td>rocky shore.</td>
</tr>
</tbody>
</table>

Summary

The inter-tidal assemblages along the natural rocky shores at Green Island are of moderate-low ecological value, but of low value at other artificial seawall.

The inter-tidal assemblages along the shoreline of Victoria Harbour and Kowloon Bay are of low ecological value. The inter-tidal assemblages along the natural rocky shores at Sandy Bay are of Low ecological value.

The inter-tidal mudflat at north and west Lantau and the coastline at Sha Chau and Lung Kwu Chau Marine Park are high in ecological value.

The inter-tidal assemblages along the natural rocky shores in the northern part of this water zone are of moderate-low ecological value.

### Table 5.7: Evaluation of the Ecological Importance of the Hard-bottom Sub-tidal Habitats

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalness</td>
<td>Natural rocky shore at northern Lamma but artificially modified seawall at Ap Lei Chau.</td>
<td>The Green Island and Kau Yi Chau are fringed with natural rocky shoreline. The seabed is varied with patches of sand and rubble. Rubbish scattered around the area.</td>
<td>Varied type of concrete seawall receiving extensive disturbances including pollution load and marine traffic. The seashore is highly modified for marine traffic use.</td>
<td>Largely natural.</td>
</tr>
<tr>
<td>Size</td>
<td>The sub-tidal habitat within the Study Area is large.</td>
<td>The rocky shoreline is moderate in size.</td>
<td>The artificial seawall habitat is moderate in size.</td>
<td>Sub-tidal habitat in this WCZ is large</td>
</tr>
<tr>
<td>Rarity</td>
<td>The hard coral species recorded are not rare</td>
<td>The hard (hermatypic scleractinian) coral species recorded are not rare to Hong Kong. The ahermatypic scleractinian coral is a localized species in Hong Kong</td>
<td>The gorgonian coral Guiaagorgia sp. is a localized species in Hong Kong</td>
<td>No rare species recorded.</td>
</tr>
</tbody>
</table>

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5-19
--- | --- | --- | --- | --- | ---
Re-creatability | The natural rocky habitat is difficult to recreate | The rocky habitat is difficult to recreate | The natural habitat is difficult to recreate. | The highly modified sub-tidal habitat is recreatable. | Sub-tidal hard substrate for coral colonization is recreatable.
Fragmentation | Not applicable | Not applicable | Not applicable. | Not applicable. | Not applicable.
Ecological Linkage | The sub-tidal habitats are not functionally linked to high ecological value habitats. | The sub-tidal communities are not functionally linked to high ecological value habitats. | The existing habitats are not functionally linked to high ecological value habitats. | The existing habitats are not functionally linked to high ecological value habitats. | The sub-tidal communities are functionally linked to Sha Chau and Lung Kwu Chau Marine Park and San Tau Beach SSSI.
Potential Value | Low potential to develop to high ecological value area. | Low potential to develop to high ecological value area. | Low potential to develop to high ecological value area. | Low potential to develop to high ecological value area. | Low potential to develop to high ecological value area.
Nursery/Breeding Ground | Not identified | Not identified | Not identified. | Not identified. | Not identified.
Age | Not applicable | Not applicable | Not applicable. | Not applicable. | Not applicable
Summary | The coral communities found in these areas are generally in low cover, moderate diversity and not rare. The sub-tidal communities are of moderate-low ecological value. | The sub-tidal coral communities are of moderate-low ecological value. | The coral communities at the natural sub-tidal rocky shore in Green Island and Kau Yi Chau are of moderate-low ecological value. | The sub-tidal assemblages in the container port and the adjoining artificial habitat are of low ecological value since only low richness of gorgonian and soft corals are present. | The sub-tidal coral community in this water zone is low in ecological value given the low species richness and abundance.

Table 5.8: Evaluation of the Ecological Importance of the Soft-bottom Marine Benthic Habitats

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalness</td>
<td>Silt-clay bottom was highly disturbed.</td>
<td>Silt-clay bottom has been disturbed by marine traffic.</td>
<td>Silt-clay bottom have been subject to disturbance from Pearl River discharges, marine traffic and trawling pressure.</td>
<td>Relatively natural, but was disturbed by fishery activities.</td>
</tr>
<tr>
<td>Size</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
</tr>
<tr>
<td>Diversity</td>
<td>Similar diversity to the majority of other areas in Hong Kong.</td>
<td>Similar diversity to the majority of other areas in Hong Kong.</td>
<td>Similar diversity to the majority of other areas in Hong Kong.</td>
<td>Varied from low to high. Highest in southern Lantau</td>
</tr>
</tbody>
</table>
### Victoria Harbour WCZ
- **Naturalness**: Disturbed by busy shipping lanes and pollution.
- **Size**: Large

### Western Buffer WCZ
- **Naturalness**: Disturbed by busy shipping lanes and pollution.
- **Size**: Large

### North Western WCZ
- **Naturalness**: Disturbed by busy shipping lanes and pollution.
- **Size**: Large

### Southern WCZ
- **Naturalness**: Disturbed by busy shipping lanes and pollution.
- **Size**: Large, covers the Ma Wan Channel, Kap Shui Mun Channel and other major navigation channel and anchorages in the Western Harbour

### Table 5.9: Evaluation of the Ecological Importance of the Marine Waters

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalness</td>
<td>Disturbed by busy shipping lanes and pollution.</td>
<td>Disturbed by busy shipping lanes and pollution.</td>
<td>Disturbed by busy shipping lanes and pollution.</td>
<td>Disturbed by busy shipping lanes and fishery operation.</td>
</tr>
<tr>
<td>Size</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
<td>Large, 400km² to the south of Hong Kong Island.</td>
</tr>
</tbody>
</table>
### Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>No recent dolphin record.</td>
<td>Low densities of CWD were recorded.</td>
<td>High abundance of CWD were recorded.</td>
<td>Low density for CWD, whilst the density for Finless Porpoise is low but of relative importance in Hong Kong.</td>
</tr>
<tr>
<td>Rarity</td>
<td>No rare species recorded.</td>
<td>CWD is a species of conservation concern and protected under Hong Kong ordinances.</td>
<td>CWD is a species of conservation concern and protected under Hong Kong ordinances.</td>
<td>CWD and Finless Porpoises are species of conservation concern and are protected under Hong Kong ordinances.</td>
</tr>
<tr>
<td>Re-creatability</td>
<td>This habitat cannot be easily recreated.</td>
<td>This habitat cannot be easily recreated.</td>
<td>This habitat cannot be easily recreated.</td>
<td>This habitat cannot be easily recreated.</td>
</tr>
<tr>
<td>Fragmentation</td>
<td>Marine waters are not fragmented.</td>
<td>Marine waters are not fragmented.</td>
<td>Marine waters are not fragmented.</td>
<td>Marine waters are not fragmented.</td>
</tr>
<tr>
<td>Ecological Linkage</td>
<td>No ecological linkage to habitat of conservation importance.</td>
<td>No ecological linkage to habitat of conservation importance.</td>
<td>Linkage to the Sha Chau and Lung Kwu Chau Marine Park and coastal waters at western Lantau.</td>
<td>Linkage to coastal waters in southern Lantau, southern Lamma and southern Hong Kong Island which are utilized by Finless Porpoise.</td>
</tr>
<tr>
<td>Potential Value</td>
<td>Low</td>
<td>Low</td>
<td>High in respect of relative high abundance of CWD.</td>
<td>Moderate in respect of the presence of Finless Porpoise.</td>
</tr>
<tr>
<td>Nursery/Breeding Ground</td>
<td>Not significant</td>
<td>Not significant</td>
<td>Coastal water along Sha Chau and Lung Kwu Chau Marine Parks and western Lantau are known for nursery habitat for CWD.</td>
<td>Nursery activity for CWD in this water zone was mainly recorded near Fan Lau. No noticeable nursery and breeding activity for Finless Porpoise.</td>
</tr>
<tr>
<td>Age</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Abundance/ Richness of Wildlife</td>
<td>Low abundance</td>
<td>Low abundance of marine mammals.</td>
<td>High abundance of CWD.</td>
<td>Moderate abundance of marine mammals.</td>
</tr>
<tr>
<td>Summary</td>
<td>Low ecological value</td>
<td>Low ecological value</td>
<td>High-moderate ecological value owing to the high density of CWD in this water zone.</td>
<td>High-moderate ecological value owing to the presence of Finless Porpoise.</td>
</tr>
</tbody>
</table>

### 5.5.2 Evaluation on Species of Conservation Importance

The Chinese White Dolphin is the most regularly seen cetacean in Hong Kong. It is listed as “Near Threatened” in the IUCN Red Data List for its declining population. The population in Hong Kong is part of the population centred around the Pearl River Estuary. The hotspots for this species in Hong Kong are mainly in the northern and western Lantau such as the coastline of western Lantau, Lung Kwu Chau and The Brothers. Usage of eastern Lantau is rare and the WCZ is regarded as marginal habitat. The Finless Porpoise is less frequently sighted in Hong Kong, probably due to its cryptic behaviour. It is listed as “Vulnerable” in IUCN Red Data List for its declining population. Surveys in recent years found the dolphin...
species favour the southern waters with a strong seasonal pattern on occurrence. In the Southern WCZ, it has been recorded in Cheung Chau and south Lamma but not at further north (refers to Figures 5.6a, b and 5.7a, b).

Hard corals (Scleractinian) are protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). All corals in Marine Parks are protected under the Marine Park Ordinance (Cap. 476). All form of destructive fishing practices that could also affect the corals area are prohibited under the Fisheries Protection Ordinance (Cap. 171). The ecological importance of marine mammals and hard coral are summarized in Table 5.10.

Table 5.10: Evaluation on Species of Conservation Importance

<table>
<thead>
<tr>
<th>Species</th>
<th>Protection Status</th>
<th>Distribution</th>
<th>Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese White Dolphin</td>
<td>Protected under Hong Kong Ordinance (Cap. 170 and Cap. 586). CWD is listed in CITES Appendix I and protected in the People Republic of China</td>
<td>Mainly in estuarine habitat in Pearl River Delta - northwest and west Lantau waters</td>
<td>Roughly 200 individuals using Hong Kong waters on a regular basis.</td>
</tr>
<tr>
<td>Finless Porpoise</td>
<td>Protected under Hong Kong Ordinance (Cap. 170). Finless Porpoise is listed in CITES Appendix I and protected in the People Republic of China</td>
<td>Mainly distributed in waters off southern and eastern Hong Kong</td>
<td>Estimated at over 200 individuals in Hong Kong (Jefferson 2002).</td>
</tr>
<tr>
<td>Hard Corals</td>
<td>Hard coral (order Scleractinian) are protected under Hong Kong Ordinance (Cap. 586). All corals in Marine Parks are protected under Marine Park Ordinance (Cap. 476)</td>
<td>Scattered hard coral colonies are found at the hard sub-tidal substrate along the coastline within the Study Area.</td>
<td>The hard coral species found in the Study Area (Western Buffer WCZ and Southern Buffer WCZ) are mostly common and tolerable to pollution.</td>
</tr>
</tbody>
</table>

5.6 Prediction and Evaluation of Environmental Impacts

The following section identifies and evaluates the potential ecological impacts as a result of the project in accordance with the Condition 3.4.7.4 (vi) set in EIA Study Brief No. ESB-198/2008. The potential direct, indirect, on-site and off-site ecological impacts on marine ecological habitats and their associated species arising from the proposed dredging works have been identified, evaluated and assessed with reference to the criteria set in Annex 8 of the EIAO-TM. Significance of the potential impacts are evaluated using the 6 point range: “severe”, “severe-moderate”, “moderate”, “moderate-minor”, “minor” and “negligible”.

The proposed dredging area is approximately 446ha and the depth of the seabed will reach a level of approximately -17.5mC.D after dredging. The major impact on marine ecological resources within the Assessment Area is the direct impact of habitat loss of the seabed and the indirect impact due to increased SS levels and changes in receiving water quality. The water quality impacts arising from the proposed dredging activities include perturbation of the seabed, elevation of SS and changes in sediment transport regimes. The impact of changes of water quality during the dredging works was simulated by water quality modelling. Potential impacts associated with increased marine traffic include possible collisions with marine mammals and indirect acoustic disturbance effects.

According to the predicted result of sediment plume dispersion as indicated in the contours in the worst case scenario presented in Appendices A3.1 and A3.2, the predicted SS level in North Western WCZ are compliant with WQO requirement such that the potential impact to North Western WCZ is considered as negligible. Therefore the impact prediction and evaluation presented in this section would mainly focus on
5.6.1 Construction Phase

5.6.1.1 Impacts on Inter-tidal Communities

The natural inter-tidal habitats at Green Island, Little Green Island, Kau Yi Chau and Siu Kau Yi Chau could potentially be affected by the dredging works due to the possible perturbations in marine water quality. The increase of SS and decrease of dissolved oxygen (DO) may affect the inter-tidal habitats by increased sedimentation during the flood tide. Sedimentation of SS and the elevation of SS level in the water column may affect the respiration and feeding efficiency of the filter feeding fauna. This can alter the inter-tidal community structure that may cause some species to become dominant and out compete those more susceptible to the deterioration of water quality. Referring to the assessment of SS impact in Section 3.7.1.1, Appendix A3.3 in Chapter 3 Water Quality Impact Assessment, the predicted sedimentation rate at all coral sites such as Kau Yi Chau, Siu Kau Yi Chau, Peng Chau and Lamma Island, where natural inter-tidal communities were also found, are all within acceptable level. Therefore, it is anticipated that the dredging works of the Project will pose negligible impact towards the inter-tidal communities at the above waters.

The inter-tidal communities along Tsing Yi and the KTCB are mostly low density and coverage due to the newly installed artificial seawall. The species recorded are mostly bio-fouling organism and thus the ecological value of the habitat is considered as low. The exceedances of ambient SS levels at the Rambler Channel and waters near Tsuen Wan as stated in Section 3.7.1.1 would pose only minor impact on the inter-tidal communities. Evaluation of the impact on inter-tidal habitat is summarized in Table 5.11.

Table 5.11: Impact Evaluation of Inter-tidal Habitats

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Quality</td>
<td>The coastlines along the Victoria Harbour are mostly artificially modified as vertical seawall and breakwaters. Natural rocky shore at Green Island is disturbed by busy navigation at Sulphur Channel.</td>
<td>The coastlines along Tsing Yi and Container Basin are mostly artificially modified vertical seawall and sloping boulder-mounted seawall at receiving extensive disturbances including pollution load and marine traffic. Natural rocky shore of Sandy Bay is disturbed by the busy navigation at Sulphur Channel.</td>
<td>The coastline in north and west Lantau and Sha Chau and Lung Kwu Chau Marine Park are mostly natural.</td>
<td>The natural rocky shore and sandy shore are identified at Kau Yi Chau and Siu Kau Yi Chau, which are located near the proposed dredging area. Coastlines along other outlying islands within the WCZ are mainly hard shores and artificially modified seawall.</td>
</tr>
<tr>
<td>Species</td>
<td>Species recorded at Green Island are typical of other semi-exposed rocky shores and sandy shores in Hong Kong.</td>
<td>Species recorded at Tsing Yi and Container Basin are common fouling organisms found on artificial seawalls in Hong Kong waters. Species recorded at Sandy Bay are typical of other semi-exposed rocky shores and sandy shores in Hong Kong.</td>
<td>Seagrass bed and horseshoe crab breeding ground were identified in north Lantau.</td>
<td>Species recorded at the natural shorelines are typical of other semi-exposed rocky shores and sandy shores in Hong Kong.</td>
</tr>
</tbody>
</table>
### 5.6.1.2 Impacts on Hard-bottom Sub-tidal Coral Communities

The hard coral communities in Hong Kong are known as incipient reefs usually attaching themselves to hard substrate at shadow water zones, i.e. sub-tidal zone. Dredging activities at the Kwai Tsing Container Basin and Western Fairway would directly disturb 446ha area of seabed. As the seabed is predominantly sandy and silty soft-bottom substrates and as such, these conditions are not natural habitats for hard coral; direct impact or direct removal of hard coral communities is unlikely.

Disturbance to hard coral communities associated with dredging activities are usually induced by the elevation of SS in the water column. Deposition of sediment would cause the hard coral to suffocate and die or indirectly affect the potential of photosynthesis through blocking of sunlight reaching the sub-tidal habitat. The coral communities closest to the dredging zone are the most susceptible to the disturbance.

According to the survey results, the KTCB and Western Fairway were not recorded with hard coral species. Only the relatively natural hard substrate at Green Island and Kau Yi Chau were recorded with coral communities. Both sites are in proximity to the dredging area at Western Fairway. As indicated in the marine dive survey results, 7 colonies of hard coral, one species of ahermatypic coral, 4 species of gorgonians and one species of soft coral were recorded at Green Island. Hard coral cover was only 10% on the hard substratum.

Similar to Green Island, Kau Yi Chau is also close to the dredging area at Western Fairway and with moderate-low cover of coral communities. Seventeen species of hard coral of 15% cover were recorded in the marine dive survey. These coral sites are regarded as the closest location to the dredging area subject to potential impact.

To the east of the dredging area, the sub-tidal habitats in Victoria Harbour WCZ are highly disturbed by marine traffic and pollutants. Although hard coral species were recorded in sporadic locations, the species are mostly common and tolerant to disturbance. Therefore, the potential impact to the hard coral communities in this WCZ is insignificant given the low ecological value of the hard coral communities.
Further in the southern part of the Western Buffer WCZ, coral communities were recorded along Sandy Bay. This is a site with low coverage of hard coral communities. Within the same WCZ, coral communities in Northern Lamma are in moderate-low coverage of hard coral with no rare species were recorded. To the west of the dredging area, various coral species were recorded along the coastline of the outlying islands in Southern WCZ, e.g. Peng Chau, Sunshine Island and Hei Ling Chau. Although moderate diversity of coral species was recorded in these areas, no rare species was recorded and the coral coverage is generally low in the area.

The prediction of alternation of water quality induced by the dredging works was determined through the assessment of water quality modelling results. The modelling scenarios included representative coral sites as specific sensitive receivers (Figure 3.1). The daily sedimentation rate, which is influential to coral growth, was also included as a parameter in the analysis in order to determine the potential impact on the health of the coral sites. It is acknowledged that benthic organisms, including corals, may suffer damage to their respiratory function as a result of sediment deposition blocking the respiratory and feeding organs of those organisms. According to Hawker and Connell (1992), a sedimentation rate higher than 0.1 kg m\(^{-2}\) per day would introduce moderate to severe impact upon corals. This criterion was adopted as the assessment criterion for protecting the marine ecological sensitive receivers in this Study. While there are no established legislative criteria for water quality for corals, an elevation criterion of SS levels less than 30% of ambient baseline conditions (Hawker and Connell, 1992) has been adopted as the critical value above which impacts to the habitat may occur. This criterion is based on a previously approved EIA for assessing SS impacts on corals (Maunsell, 2001).

The impact of SS elevation on the coral communities was simulated under Scenarios 1 to 6 as described in Section 3.5.2.3 for a typical spring neap tidal cycle during dry and wet seasons in Hong Kong. The coral sites for water modelling include those sites listed in the Condition 3.4.7.3 set in EIA Study Brief No. ESB-198/2008, including Peng Chau (CR 14-18), Green Island (CR 7), Kau Yi Chau (CR 8-10), Siu Kau Yi Chau (CR 11-13), Sandy Bay (CR 6), Pak Kok (CR 1), Shek Kok Tsui (CR 2) and Ap Lei Chau (CR 5). The contours presented in Appendices A3.1 and A3.2 show the SS elevation during dry and wet seasons whilst Appendix A3.3 presents the average daily deposition rate. The SS elevations in all the coral sensitive receivers for all scenarios are compliant with the SS criteria (data presented in Tables 3.12, 3.14, 3.16, 3.18, 3.20 and 3.22). The contours shown in Appendix A3.3 indicated the deposition rate is within acceptable level (<0.02 kg m\(^{-2}\) per day) for all the coral sites. Therefore, it is anticipated that the proposed dredging works of the Project will have minor impact upon the coral communities at the above waters.

Since the sedimentation rate in the coral sites are relatively low, the potential for large scale siltation on corals that cause suffocation is anticipated to be very low. The impact on growth, recruitment and resilience of the coral community is also considered to be minor. Although Sunshine Island and Hei Ling Chau were not included in the specific modelling point, the sedimentation rates at both sites are regarded as negligible with reference to the contours results presented in Appendices A3.1-A3.3. The evaluation of the impact on hard-bottom sub-tidal habitats is summarized in Table 5.12.

Table 5.12: Impact Evaluation of Hard-bottom Sub-tidal Habitats

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Peng Chau, Sunshine Island and Hei Ling Chau (Southern WCZ)</th>
<th>Pak Kok, Shek Kok Tsui, Ap Lei Chau</th>
<th>Green Island, Kau Yi Chau, Siu Kau Yi Chau and Sandy Bay</th>
<th>Taing Yi and Kwai Tsing Container Basin (Western Buffer WCZ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Quality</td>
<td>Natural habitat but also subjected to moderate level of artificial modification.</td>
<td>Natural habitat but also subjected to moderate level of artificial modification.</td>
<td>Mostly natural in Green Island, Siu Kau Yi Chau and Kau Yi Chau. Mostly artificial in Sandy Bay.</td>
<td>Artificial modified</td>
</tr>
</tbody>
</table>

259053/TNI/ENL/23/E July 2010
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5.6.1.3 Impacts on Soft-bottom Marine Benthic Communities

**Direct impact on habitat loss**

Temporary habitat loss of marine benthic sediment will occur at the dredging area in KTCB, Northern Fairway and Western Fairway. It will lead to direct removal of marine organism inhabiting the benthic sediment. The seabed substrates are composed of silt, clay, fill and alluvium that receive continuous disturbances from the heavy marine traffic. Species recorded in this region were common and dominated by pollution tolerant marine benthos including polychaetes *Sigambra hanaokai* and oligochaetes *Thalassodrilides gurwitschyi*, recorded both within and in the vicinity to the Project area. Benthic fauna is expected to recolonize the seabed after the dredging works with similar seabed substrates before dredging. After recolonization and settlement of marine organism on the benthic sediment, the habitat will be recovered and the loss of habitat is regarded as temporary only. In considering the high commonness and low quality of marine benthic organisms recorded, the low ecological value of the highly disturbed seabed and the recovery of seabed for recolonization of benthic fauna after construction, the direct impact on the temporary loss of approximately 446ha of seabed habitat along the Container Basin, Northern Fairway and Western Fairway are considered to be minor.

**Indirect disturbance associated with suspended solids**

The dredging activities will cause sediment transport, and high sediment deposition on the benthic environment could cause smothering and burial of marine organisms. Less mobile species such as bivalves are more susceptible to these potential impacts. The evaluation of the potential impact has taken into account the ecological value of the potentially affected marine organism and the dispersion of sediment plume. The influence of SS concentration is predicted by using the water quality modelling which simulated the dispersion of sediment generated as a result of various dredging scenarios.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Peng Chau, Sunshine Island and Hei Ling Chau (Southern WCZ)</th>
<th>Pak Kok, Shek Kok Tsui, Ap Lei Chau</th>
<th>Green Island, Kau Yi Chau, Siu Kau Yi Chau and Sandy Bay</th>
<th>Tsing Yi and Kwai Tsing Container Basin (Western Buffer WCZ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Hard coral communities are in moderate diversity but low coverage. Species assemblage dominated by Faviidae family.</td>
<td>Hard coral communities are in moderate diversity but low coverage. Species assemblage dominated by Faviidae family.</td>
<td>The species recorded in the dredging area are common and pollution tolerant. 17 species of hermatypic scleractinian corals were recorded in Kau Yi Chau whilst 7 species were recorded in Green Island.</td>
<td>No hard coral were found.</td>
</tr>
<tr>
<td>Size/Abundance</td>
<td>Large area but low abundance of coral communities.</td>
<td>Large area but low abundance of coral communities.</td>
<td>Moderate area and moderate-low abundance of coral communities.</td>
<td>Moderate area but no coral communities.</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction phase</td>
<td>Construction phase</td>
<td>Construction phase</td>
<td>Construction phase</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low magnitude</td>
<td>Low magnitude</td>
<td>Low magnitude</td>
<td>Low magnitude</td>
</tr>
<tr>
<td>Summary</td>
<td>The potential impact to the moderate-low ecological valued sub-tidal habitat is predicted to be negligible.</td>
<td>The potential impact to the moderate-low ecological valued sub-tidal habitat is predicted to be negligible.</td>
<td>The impacts to the moderate-low ecological valued sub-tidal habitat are predicted to be minor.</td>
<td>Minor impact due to low abundance of marine ecological resources.</td>
</tr>
</tbody>
</table>
The water quality modelling results indicated that high concentration of SS will be confined to the area in close proximity to the dredging area, and to a lesser extent to the adjacent area. The contours presented in Appendices A3.1 and 3.2 show the extent of maximum surface, bottom and depth-averaged SS elevations over the complete simulation period during dry and wet seasons, respectively. As shown in these figures, the extent of SS impact appears to be confined near the dredging areas at Rambler Channel, Northern Fairway and Western Fairway. Temporal variations at snapshots in the tidal cycle of surface, mid-depth, bottom and depth-averaged SS elevations at various WSRs in close proximity to the dredging areas during dry and wet seasons are also shown in Appendices A3.1 and A3.2. The benthic communities in the areas with high predicted SS level currently experience high levels of disturbance. Since the ecological values of the benthic organisms inhabiting these potentially affected areas are relatively low, the potential impact is predicted to be minor.

With regard to the benthic communities at the Southern WCZ, the predicted sediment deposition will potentially affect the northern part of the Southern WCZ (i.e. near the Western Fairway) but not to the southern part. As have been evaluated, no benthos species of conservation concern were recorded in this region. Given the low ecological value of the marine benthic communities, the potential impact induced by the increase in sediment deposition is considered as minor. According to the predicted SS sediment plume in water quality modelling, the relatively important marine resources at the southern part of the Southern WCZ will unlikely be affected. Evaluation of the impact on marine benthic habitat is summarized in Table 5.13.

### Table 5.13: Impact Evaluation of Soft-bottom Marine Benthic Habitats

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Quality</td>
<td>Highly disturbed benthic communities.</td>
<td>Highly disturbed benthic communities.</td>
<td>Highly disturbed benthic communities.</td>
<td>Northern part is highly disturbed. Southern part is relatively less disturbed.</td>
</tr>
<tr>
<td>Species</td>
<td>Species are common in similar habitat.</td>
<td>Species are common in similar habitat.</td>
<td>Species are common in similar habitat.</td>
<td>Species are common in similar habitat. One species of conservation concern was found in Soko Islands but far from dredging area.</td>
</tr>
<tr>
<td>Size/Abundance</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction phase</td>
<td>Construction phase</td>
<td>Construction phase</td>
<td>Construction phase</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible</td>
<td>Reversible</td>
</tr>
<tr>
<td>Magnitude</td>
<td>The impact to the benthic habitat is of low magnitude.</td>
<td>The impact to the benthic habitat is of low magnitude.</td>
<td>The impact to the benthic habitat is negligible.</td>
<td>The impact to the benthic habitat is of low magnitude.</td>
</tr>
<tr>
<td>Summary</td>
<td>The impacts to the low ecological valued marine benthos are predicted to be minor.</td>
<td>The impacts to the benthic communities are predicted to be minor owing to the highly disturbed seabed, ready recolonization of benthos and low ecological importance of the marine benthic</td>
<td>Impact to the benthic communities in North Western WCZ is predicted to be negligible.</td>
<td>The impacts to the benthic communities at the northern part of the WCZ are predicted to be minor since no species of conservation concern was recorded. The relative important marine resources at the southern part of the WCZ are unlikely to be</td>
</tr>
</tbody>
</table>
5.6.1.4 Impacts on Marine Waters Habitat – Dolphin Habitat

The proposed dredging activities may cause impact to the marine waters habitat through dispersal of SS or potential release of contaminated material into the water column. This is a potential concern for the protected dolphins inhabiting the marine waters. The impacts on dolphins from the coastal development projects are generally classified into four main categories, which are land reclamation, percussive piling, dredging of spoil and increases in vessel traffic (Jefferson 2008). Regarding the nature of this Project, only dredging works and increases in marine traffic could potentially affect the marine mammals.

Dredging activities will result in a loss of marine habitat but only on a temporary basis. There will be no residual impact on the loss of marine habitat for marine mammals after the project is completed.

Direct Impact

Based on the results of the long-term marine mammals surveys (AFCD 2009), it is noted that the Project site is not a major habitat for marine mammals. In fact, there have been very few sightings of marine mammals recorded in the Project area and its vicinity in the last 10 years (distribution maps for CWD and Finless Porpoise refer to Figures 5.6a,b and 5.7a,b respectively). Since the Project site is situated in an existing fairway with heavy marine traffic, the minor increase in marine traffic during construction and operation around the project sites will not significantly increase the chance of collision with marine mammals.

Indirect Impact associated with Change of Water Quality

The water quality modelling results indicate that the SS elevation will be confined to the dredging area. The water bodies near to Cheung Chau and South Lamma Island, where Finless Porpoises have been recorded, are not predicted to be affected. Also, as indicated in Figures 5.6a,b, the natural range of the CWD is outside the area predicted with high SS elevation as presented in Appendices A3.1 and A3.2. Therefore, there is no indirect impact on marine mammals arising from any increase in SS concentrations. In view of the distance from the natural home range of marine mammals in Hong Kong and the confined effect of SS in the water column, the potential impact on marine mammals arising from the dredging activities has been assessed as negligible.

Indirect Impact on Marine Mammals associated with potential bioaccumulation of toxic contaminants

Dredging of the seabed would potentially cause the release of toxic contaminants from the benthic sediments. Some contaminants, such as Persistent Organic Pollutants (POPs) and heavy metals can be bio-accumulated through diet along the food chain and by environmental exposure, which would lead to illness of marine organisms or even death. The potential release of contaminant from dredging of the existing marine sediment is inferred from the results of the elutriate tests summarised in Table 3.26 under Section 3.7.1.6 and has been assessed in the Water Quality Impact Assessment.

During dredging operation, toxic contaminants such as POPs and heavy metals would be potentially released from the disturbed seabed. Suspension of exceeded contaminated material may lead to bioaccumulation of toxic substances in the marine mammals through the intake of polluted prey fish.
impact of heavy metals and POPs on marine mammals including the effect on reproductive capacity, immune system and carcinogenic, has been well documented (Jefferson 2005).

According to the Water Quality Impact Assessment in Section 3.7.1.6, the elutriate test results indicated that all the POPs (including PCBs, PAHs and chlorinated pesticides) and heavy metal concentrations released from the sediment samples at most sampling locations were below the detection limits. Given that the predicted SS elevation is confined to the dredging area and the predicted POPs and heavy metal levels are within environmental acceptable standards with the effects rapidly diluted by the large volume of marine water within the dredging site away from the mixing zone, potential of bioaccumulation of the toxic contaminants associated with the release of sediment due to the dredging works of this Project is predicted to be minor. Since the marine mammals are seldom sighted in the Project area, the potential for bioaccumulation of POP’s due to this Project is further minimized, especially as prey items of the CWD are primarily estuarine fishes in northern and western Lantau.

With reference to Figures 5.6a and b, the prime CWD habitats are to the west and north of Lantau, and also at the Sha Chau and Lung Kwu Chau Marine Park in the North Western WCZ. Water quality modelling results included in Chapter 3 indicate the sediment plume generated by dredging for this Project is confined to the dredging area within the Container Basin, Northern and Western Fairway. These locations are far away from the CWD habitats. Similarly, the habitat for Finless Porpoise in Southern Waters, as indicated in Figures 5.7a and b, will not be affected by increases in SS concentrations. Therefore, the potential impact of bioaccumulation of toxic contaminants released from the Project induced sediment is minor and considered to be acceptable.

Table 5.14: Impact Evaluation of Marine Water Habitats

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Victoria Harbour WCZ</th>
<th>Western Buffer WCZ</th>
<th>North Western WCZ</th>
<th>Southern WCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Quality</td>
<td>Low ecological value</td>
<td>Low ecological value</td>
<td>High ecological value owing to the presence of CWD.</td>
<td>Moderate ecological value owing to the presence of Finless Porpoise.</td>
</tr>
<tr>
<td>Species</td>
<td>No recent record of dolphin.</td>
<td>Low abundance of CWD.</td>
<td>High abundance of CWD.</td>
<td>Low abundance of CWD. Low density of Finless Porpoise population but of importance in Hong Kong.</td>
</tr>
<tr>
<td>Size/Abundance</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
<td>Large</td>
</tr>
<tr>
<td>Duration</td>
<td>Construction phase</td>
<td>Construction phase</td>
<td>Construction phase</td>
<td>Construction phase</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Reversible after construction</td>
<td>Reversible after construction</td>
<td>Reversible after construction</td>
<td>Reversible after construction</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Low</td>
<td>Moderate-low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Summary</td>
<td>Minor impact owing to the low ecological value of this WCZ.</td>
<td>Minor impact owing to direct impact of dredging activities but low density of marine mammals.</td>
<td>Negligible impact owing to the far distance from dredging site and limited dispersal of the sediment plume.</td>
<td>Minor impact owing to the limited dispersal of sediment plume.</td>
</tr>
</tbody>
</table>

Table 5.15: Impact Evaluation of Marine Mammals

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Disturbance Impact to Marine Mammals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receivers</td>
<td>Chinese White Dolphin</td>
</tr>
<tr>
<td>Size/Abundance</td>
<td>Very Low abundance near Project</td>
</tr>
</tbody>
</table>
5.6.1.5 Impact to Recognized Sites of Conservation Importance

Three locations in Southern WCZ are identified as recognized sites of conservation importance including Cape D’Aguilar Marine Reserve, Sham Wan SSSI and Soko Islands whilst the other two are identified in North Western WCZ, namely Sha Chau and Lung Kwu Chau Marine Park and San Tau Beach SSSI. With reference to the water modelling results in Appendices A3.1 and A3.2 of Chapter 3, the predicted SS elevation will unlikely affect those five important sites (with SS elevation less than 0.1mg/l). The potential impact of the Project on the sites of conservation importance is thus negligible.

5.6.1.6 Potential Impacts on Marine Ecology due to Disposal of Contaminated Mud

Disposal of Category L, M and H sediments were identified for the project. Possible release of contaminants from the dredged materials may alter the water quality and hence, affect the marine habitats and ecology. As stated in Section 4.5.5 in Chapter 4 Waste Management, maximum dredging rate is 4,000 m$^3$ (in-situ volume) per grab dredger per day during the dredging operations. Maximum three number of grab dredgers would be in operation per day which would result in up to 12,000 m$^3$ (in-situ volume) per day. In accordance with the ETWB TCW No. 34/2002, the contaminated material must be dredged and transported with great care, with mitigation measures strictly followed. The dredged sediment of Category M and H must be effectively isolated from the environment upon final disposal and shall be disposed of at designated Contaminated Mud Pits, typically East Sha Chau which is designated for the disposal of contaminated mud in Hong Kong. With the proper implementation of mitigation measures stated in Section 4.5, no unacceptable impacts would be expected from the transportation and disposal of the dredged sediment.

5.6.1.7 Potential Impacts on Marine Ecology due to Changes in Hydrology and Hydrodynamics Properties

The free surface hydrology of sea is a complex of physical processes involving mainly surface runoff, subsurface flow, evapotranspiration and hydraulics. Prediction of future behaviour of hydrologic systems is based on calculation of various hydrodynamic properties of fluid, such as velocity, pressure, density and temperature. Since only marine dredging works is involved in this project, surface runoff, subsurface flow and evapotranspiration are not considered further.

The only potential change relates to sea water velocity and pressure. Impacts on water velocity and pressure only occur if the construction works significantly affect the width of channel, depth of water and nature of the substrate. Since there will be no reclamation works or large scale seawall modification works involved, the potential for change of channel width and substratum nature is negligible. Owing to the depth of the seabed and free surface nature of the Project area it is unlikely there will be any effect on the water velocity or pressure. The environmental conditions at the dredging area for the Contaminated Mud Pit V (CMPV) Project at Sha Chau were monitored regularly during the dredging period and it was found that the water quality parameters including levels of DO, depth-average Turbidity and total suspended solid complied with the Action and Limit Levels during the dredging period (ERM 2010). The monitoring results
showed no major change on the hydrology due to the dredging activities. Since the dredging depth of this Project is shallower than the CMPV, it is predicted that the potential impact on water quality and hydrology is similarly insignificant. Therefore the indirect impact to the marine ecology due to change of hydrology and hydrodynamic properties are negligible.

5.6.1.8 Potential Impacts on Marine Ecology due to Changes in Sedimentation Rates and Pattern

Excessive sedimentation upon seabed could cause suffocation and smothering of marine benthic organisms in particular to sessile animals with low mobility. Sediment released to the water column by the dredging activities will disperse along with water current before finally settling on the seabed. The potential impact is regarded as low as the induced SS and sedimentation is confined to the Project area without wide dispersal to ecologically sensitive areas such as coral sites. As indicated in the water quality modelling results given in Appendices A3.1 to A3.3, the higher sedimentation rates are confined to the Project area without wide dispersion. Given the limited dispersion of sediment, the potential impact to the marine ecology is considered to be acceptable.

5.6.1.9 Potential Impacts on Marine Ecology due to Deterioration of Water Quality

The potential release of unionised ammonia (UIA) and increase in ammoniacal nitrogen concentration during the dredging activities may cause indirect disturbance to marine ecology due to toxic effects of these substances. The toxic effect will be increased with an increase in pH value and in warmer temperatures. According to the water quality prediction, UIA concentration at all the sensitive corals community indicated no exceedance of WQO during construction phase. Thus the potential impact of increased UIA concentration on coral communities is anticipated to be negligible.

Marginal exceedances of WQO for UIA in the coastal waters are predicted according to the annual average water quality modelling results, with 0.034 mg L\(^{-1}\) at B2 (Approach Beach) and 0.028 mg L\(^{-1}\) at B3 (Ting Kau Beach) (Table 3.35). These coastal waters are mostly modified to sandy beaches with frequent disturbance. The maximum yearly average UIA concentration predicted at coastal waters around the Kwai Tsing Container Basin areas with modified artificial seawalls (EMSD1 Figure 3.1 refers) is predicted to be around 0.041 mg L\(^{-1}\), which exceeds the WQO UIA.

When comparing with the water quality assessment guideline under the Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment (City U’s CCPC 2001), it is noted that the predicted total ammoniacal nitrogen concentrations (Table A3.12b of Appendix 3.12) at Approach Beach and Ting Kau Beach during the dry season ranged from 0.70 to 0.86 mg L\(^{-1}\) and are all below 0.16 mg/L during the wet season for all scenarios. The ammoniacal nitrogen concentration were found to range from 0.06 to 0.70 mg L\(^{-1}\) for EMSD1 during dry season for all scenarios (Table 3.22). It is shown that there is a seasonal variation in terms of total ammoniacal nitrogen prediction representing higher predicted value during the dry season compared to the averaged value throughout the year (Table A3.12b of Appendix 3.12). The higher seasonal values are compared with the recommended criterion for maximum NH\(_3\)-N concentration (1.2 mg/L) for 80% protection of fisheries and marine biota from acute effect (City U’s CCPC 2001) and are all below the criterion. These areas are of low ecological significance and thus, the potential toxicity effect on marine ecology at coastal waters surrounding the proposed dredging area is anticipated to be of low impact.
5.6.1.10 Potential Impacts on Marine Ecology due to Noise Generated by the Construction Activities

Since the construction works involve mainly dredging and no marine piling activities, the potential impact on marine noise affecting the marine organisms is relatively low. For the removal of hard material within the dredging area, blasting will not be employed (cutter suction dredger (CSD) instead), so that the potential impact is limited to SS elevation with no significant impact relating to noise or vibration. Since the dredging area is outside the waters identified with high density of dolphins, the potential impact on the dolphins due to construction noise is negligible.

5.6.1.11 Potential Impact on Marine Ecology due to the Modification of Tsing Yi Submarine Sewage Outfall and Demolition of the Kwai Chung Submarine Outfall

The modification of the Tsing Yi Submarine Sewage Outfall will involve removal of the rock armour, replacement of the existing riser pipes and non-return valves followed by re-application of rock armour. Demolition of the Kwai Chung Submarine Outfall will involve only the dismantling of the pipe section that is above the dredge level. The proposed works will cause a temporary loss of inter-tidal and sub-tidal habitats of the rock armour to be removed. Both outfalls are located within the existing Kwai Tsing Container Basin. As evaluated in Sections 5.4 and 5.5, the inter-tidal and hard bottom sub-tidal habitats at Kwai Tsing Container Basin are of low ecological value, with common and very common species of low diversity, no hard corals and no species of conservation concern recorded in the vicinity. The temporary removal of rock armour is unlikely to cause adverse impacts to marine ecology and the re-application of rock armour will allow reinstatement of the habitat to allow recolonization of inter-tidal and sub-tidal communities. Replacement of the riser pipes and non-return valves are minor submarine works which have no significant impact on seabed and water quality. After repositioning of rock armour, the submarine outfall would resume its original setting such that no unacceptable adverse impact to marine ecology is expected.

In respect of the Kwai Chung Submarine Sewage Outfall, the dismantling of the pipe section above the dredge level will not require dredging of the seabed; therefore, no significant impact on the soft-bottom sub-tidal habitat or the water quality of the surrounding waters is expected. As such, no unacceptable adverse impact on marine ecology is anticipated.

5.6.2 Operational Phase

Impact on Marine Mammals induced by Change in Marine Traffic Volume

Increased vessel traffic can potentially increase the chance of dolphins and porpoises being killed or injured by vessel collisions. Further, vessel traffic can also result in acoustic disturbance to dolphins and porpoises (Jefferson et al. 2008). It may create changes in the diving and surfacing patterns of the dolphins and porpoises to avoid collisions with marine vessels, which in turn could displace them from their preferred habitats. This Project will not create additional marine traffic per se; however, a consequence of this Project is likely to be the increased port business for the KTCP, and as a result, an increase in the ULCS berthing at KTCP. Notwithstanding this however, the KTCP is not located within the distribution range of either the Chinese White Dolphin and Finless Porpoise in Hong Kong (distribution refer to Figures 5.6a,b and 5.7a,b respectively), and as such the potential impacts of direct collision with vessels and acoustic disturbance is minor.
Potential Impact from Maintenance Dredging

Although there is no significant siltation in the Project area of the KTCB, in order to account for possible increases in the sediment load in the Pearl River Estuary, a balance between capital and maintenance dredging works, has been adopted with a target dredge level of -17.5mCD to allow for 0.5m for future potential siltation.

From the findings in Section 2.7 on the need for maintenance dredging, it may be concluded that the current trend of no appreciable siltation in the Container Basin or its approaches in the Northern and Western Fairways will persist after the proposed lowering of the sea bed in these areas. However, unexpected changes in siltation rates cannot be ruled out nor can the need for the terminal operators to undertake maintenance dredging or the removal of high spots.

As noted in the water quality assessment (Section 3.7.2) the future maintenance dredging will be of a much smaller scale than capital dredging works. As the impacts of capital works on marine ecological resources were acceptable, the reduced scale of the works during maintenance dredging is also likely to be acceptable. Furthermore, in view of the fact the Project area is of low ecological value and not the prime habitat for marine mammals, the potential impacts on marine ecology during maintenance dredging works are considered to be negligible.

5.7 Mitigation of Adverse Environmental Impact

Environmental acceptability has already been taken into account in the planning and design of this Project to avoid and minimize any unacceptable environmental impacts through the selection of the dredger with the lowest release of SS. Grab dredgers have been selected as the preferred dredger option as it meets the technical requirements and will have limited the environmental impact compared to a trailer suction hopper dredger (TSHD), bucket ladder dredger and backhoe dredger. The number of concurrent dredgers operating at the same time is also limited to three as part of the environmental constraints. Therefore, the total daily dredging rate is restricted to 12,000m$^3$ (in-situ volume) per day to minimize the release of SS.

To minimize any potential adverse impacts arising from the dredged marine sediment, release of dredged sediment into the surrounding water should be avoided and the distance between the barge and the dredging point should be shortened as far as possible to avoid dropping sediment from the close grab to seawater. Frame type silt curtains will also be deployed to reduce the migration of sediment plumes. As suggested in Section 4.5, the dredged sediment will be transferred to barges for subsequent disposal as allocated by Marine Fill Committee (MFC) depending on the level of contamination and disposed of at the designated disposal site according to its category.

To minimise potential impacts on water quality and marine ecology, the following measures should be taken during transportation and disposal of the dredged marine sediments for Type 1 and Type 2 disposal (ETWB TCW no. 34/2002 refers):

- Bottom opening of barges shall be fitted with tight fitting seals to prevent leakage of material. Excess material shall be cleaned from the decks and exposed fittings of barges and dredgers before the vessel is moved.
- Monitoring of the barge loading shall be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels shall be equipped with automatic self-monitoring devices as specified by the EPD.
Barges or hopper barges shall not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation.

The provision of water quality mitigation measures would also minimize the impact on marine ecology. The general good site practices and mitigation measures to control water quality impact proposed in Chapter 3 Water Quality Impact Assessment are summarised as follows:

- All vessels should be sized so that clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- Speed of all vessels should be controlled within the works area to prevent propeller wash from stirring up the seabed sediments;
- All barges / dredgers used should be fitted with tight fitting seals to their bottom openings to prevent leakage of material;
- Construction activities should not cause foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or dumping grounds; and
- Barges or hopper should not be filled to a level that will cause the overflow of materials or polluted water during loading or transportation.
- Frame type silt curtains shall be deployed to control the migration of sediment plumes.

With the implementation of waste management practices and water quality control measures listed above, the potential adverse impact on water quality would be minimized to an environmentally acceptable level. Since no major impact on marine ecology is predicted, no specific marine ecological mitigation measure is required.

5.8 Cumulative Impact

In addition to the potential marine ecological impacts identified in Section 5.6, other concurrent projects which involve marine works within the Project area and vicinity will potentially impose cumulative impacts on the marine ecological environment. The potential cumulative impacts would occur during the construction phase – i.e. the dredging period. The marine projects which are anticipated to be undertaken concurrently with this Project are detailed in Section 2.8.

The potential impacts of induced SS level in the water column and associated water quality deterioration due to the dredging and dumping activities on the soft-bottom benthos, coral communities and inter-tidal communities arising from the concurrent projects are confined to the North Western WCZ as reviewed in the approved EIA reports. As indicated in the water quality modelling results presented in Section 3.7.1.2 and Appendix 3.8, the dredging works at KTCP, Northern Fairways and Western Fairways under Scenario 3 and Scenario 7 (with concurrent projects) indicated that no SS exceedances were found at any marine ecological sensitive receivers. The maximum predicted sedimentation rate at all the coral communities for Scenario 7 was less than 23 g m\(^{-2}\) per day (22.2 g m\(^{-2}\) per day at WSR CR9 Kau Yi Chau), which is well within the criterion of 100g m\(^{-2}\) per day. Therefore, the potential cumulative impact of the increase in suspended solids at marine ecology sensitive receivers including coral communities at Green Island and Kau Yi Chau is considered to be minor with the implementation of frame type silt curtain and water quality
control measures. The loss of the soft-bottom sub-tidal habitat will be temporary and benthic fauna will be recolonized after the dredging works cease.

For the potential impact on the cetacean species, there is negligible impact on the species from this Project and no cumulative impact is anticipated. The potential cumulative impact on the CWD is considered to be negligible.

5.9 Evaluation of Residual Impacts

The Project will result in the loss of approximately 446ha of seabed. Following completion of the dredging works the new seabed will be recolonized by benthic organisms to develop a new benthic community. Provided that the benthic organism can readily recolonize the dredged seabed of similar substrates in short period of time and the existing benthic communities are of low richness and species diversity, it is anticipated that the residual impact would be insignificant and acceptable.

5.10 Environmental Monitoring and Audit

During construction phase, water quality monitoring will be carried out at sensitive receivers (including some marine ecological sensitive receivers) under an Environmental Monitoring and Auditing (EM&A) Programme. Details of the requirement are listed in the separate EM&A Manual. The water quality monitoring programme with action plan will monitor any potential impact to the marine ecology induced by deteriorations in water quality and allow quick action to be taken to alleviate the situation. No other marine ecology-specific monitoring programme is considered necessary.

5.11 Summary

The marine ecological resources within or around the dredging area have been studied through literature review and field survey. Marine ecology field surveys for inter-tidal, sub-tidal hard-bottom and soft-bottom benthic habitats were conducted between September 2009 and January 2010. The evaluation of the ecological importance of the marine habitats was conducted through the review of the ecological resources in inter-tidal, sub-tidal hard-bottom and soft-bottom marine benthic communities and the marine mammals in open waters. It was found that the ecological resources in Kwai Tsing Container Basin are relatively low in ecological importance owing to the newly installed artificial habitats colonized by low abundance of pollution tolerant marine organisms. Along the Western Fairway, the marine ecological resources at the inter-tidal and sub-tidal zones are of moderate-low importance with the more natural shores and presence of coral communities at Green Island and Kau Yi Chau.

Potential impact of loss of soft-bottom seabed habitat due to the dredging works is considered to be minor, owing to the high re-colonizing ability of the marine benthic communities on similar seabed substrates after construction. According to the water quality modelling results, the predicted sediment plume is confined to the dredging area such that the elevation of suspended solid level around the coral sites is considered to be within acceptable levels. Therefore the indirect disturbance impacts to off-site habitats induced by the elevation of suspended solid concentration in the water column and the increase in sedimentation rate is expected to be minor. The potential impacts regarding the direct collision and indirect disturbance to the marine mammals during the dredging activities and operation are anticipated to be negligible since the Project area is outside the distribution range of both the Chinese White Dolphin (Sousa chinensis) and Finless Porpoise (Neophocaena phocaenoides) in Hong Kong.
In conclusion, the direct impacts on marine ecology associated with the dredging works are minor owing to the relatively low abundance and diversity of marine organisms and no species of conservation concern recorded in the highly disturbed habitats within the Project area. The indirect impact due to change of water quality is predicted to be negligible in view of the limited dispersion of SS, the acceptable level of predicted sedimentation rate at coral sites and the rapid dilution effect of the potential release of contaminants during dredging.

During the operational phase, maintenance dredging will be of a much smaller scale than capital dredging works, and in view of the fact that the Project area is of low ecological value and not the prime habitat for marine mammals, the potential impacts on marine ecology are considered to be negligible.

The potential cumulative impact of the increase in suspended solids at marine ecology sensitive receivers including coral communities at Green Island and Kau Yi Chau is considered to be minor with the implementation of frame type silt curtain and water quality control measures. The loss of the soft-bottom sub-tidal habitat will be temporary and benthic fauna will be recolonized after the dredging works cease. The residual impacts on marine ecology are considered to be negligible.

With the implementation of water quality mitigation measures and environmental monitoring and auditing programme during the construction phase, no mitigation measures specific for marine ecology is required. The potential marine ecological impacts of the proposed dredging, demolition and modification of outfalls are considered to be environmentally acceptable.

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259053/TNI/ENL/23/E July 2010

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