11. MARINE ECOLOGY

11.1 INTRODUCTION

11.1.1 This chapter assesses the impacts of the Project upon marine ecology.

11.1.2 The Project consists of the provision of a drainage tunnel and collecting system for northern Hong Kong Island as well as a discharge outlet at Cyber Port. The discharge outlet includes a stilling basin to release the surface runoff arising from the Hong Kong Island catchment to the Lamma Channel.

11.1.3 The objective of this assessment is to describe ecological conditions in the marine environment of the Study Area, evaluate any impacts of the Project at both construction and operational phases and, where required, to propose mitigation measures to minimize adverse impacts. The assessment follows the criteria and guidelines as stated in Annexes 8 and 16 of the EIAO TM and the EIA Study Brief No. ESB-070/2001.

11.1.4 The assessment is mainly focused on the outlet structures at the proposed Hong Kong West Drainage Tunnel and the receiving water body. The impacts from above-ground intake structures along the tunnel are covered by the chapter for terrestrial ecological assessment in this report.

11.1.5 The nature and scope of the Project are described in **Section 2** of this Report. In accordance with the EIA Study Brief No. ESB-070/2001, this section identifies and assesses the marine ecological impact associated with the Designated Project described in Section 2.

11.1.6 Alternative alignments and design options were studied at an earlier stage of this assignment. Findings of those studies are summarized in **Section 2.4** of this report. The alignment and design option proposed in this report, as compared with other alignments and design options, has minimum predicted impact.

11.1.7 There are no scheduled concurrent designated projects (DP) in the vicinity of the proposed tunnel portals, intakes or tunnel alignment during the construction and operation phase.

11.2 Environmental Legislation, Standards and Guidelines

11.2.1 The following Hong Kong SAR Government legislation, standards and guidelines are relevant to the assessment of impacts to marine ecology associated with the construction and operation of the project:

- Environmental Impact Assessment Ordinance (Cap.499) and the Technical Memorandum on Environmental Impact Assessment Process (EIAO TM);
- Marine Parks Ordinance (Cap. 476) and associated subsidiary legislation;
- Wild Animals Protection Ordinance (Cap. 170); and

- Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187).

11.2.2 This study also takes note of the following relevant international agreements:

- Convention on International Trade in Endangered Species of Wild Fauna and Flora ("CITES"); and
- Convention on Biological Diversity (CBD).

11.3 Baseline Methodology

11.3.1 Based on the tunnel alignment and the TM guideline, the study area boundary was set 500m outside the project boundary, and was located on southwest Hong Kong Island including the shore line and the subtidal zone. The study area for marine ecology was chosen to be the same as for marine water quality impact assessment (**Figure 11.1**). This includes 5 Water Control Zones (WCZs) within HKSAR (listed below), as well as any areas likely to be impacted by the Project:

- Eastern Buffer WCZ;
- Western Buffer WCZ;
- Victoria Harbour WCZ;
- Southern WCZ; and
- Second Southern Supplementary WCZ.

11.3.2 A literature review was conducted to provide information on existing conditions in the study area and to identify habitats and species of potential importance that may be affected by the Project. Literature review included Government and private sector reports, independent and Government published literature and academic studies. Literature review included the following:

- Marine Ecology of Hong Kong: Report on Underwater Dive Surveys (October 1991 - November 1994) (Binnie 1995). Dive surveys at 86 sites in central and eastern Hong Kong waters.
- Ecological Status and Revised Species Records of Hong Kong's Scleractinian Corals (AFCD 2004b). A territorial-wide dive survey in Hong Kong.
- Marine Benthic Communities in Hong Kong. Centre for Coastal Pollution and Conservation, City University of Hong Kong prepared for Agriculture, Fisheries and Conservation Department (CCPC 2002). A territorial-wide benthic study in Hong Kong.

- Monitoring of Chinese White Dolphin (*Sousa chinensis*) in Hong Kong waters – Data collection Final report (1 April 2003 to 31 March 2004) (AFCD 2004c). A annual territorial-wide survey on local cetaceans.

11.3.3 Literature review was supplemented by field surveys. Field surveys were designed to fill data gaps which would prevent an adequate assessment of the project's impacts upon intertidal and subtidal ecology, and the development of appropriate mitigation measures. Intertidal surveys and dive survey were conducted between September 2003 and March 2004. The detailed survey methodology and results are provided in **Appendix A** (Dive Survey) and **Appendix B** (Ecological Baseline Survey) of this report.

11.4 Assessment Methodology

11.4.1 Impacts to habitats, species or groups were assessed based on the guidelines in Annexes 8 and 16 of the TM, the consultants' local knowledge and international standards and practice in conservation biology.

11.4.2 The significance of ecological impacts is evaluated based primarily on the criteria set forth in Table 1, Annex 8 of the TM:

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

11.4.3 Impacts are generally ranked as "minor", "moderate" or "severe", although in a few cases a ranking of "minimal" (less than "minor") may be given. The ranking of a given impact varies based on the criteria listed above. For example, an impact might be ranked as "minor" if it affected only common species and habitats, or if it affected only small numbers of individuals or small areas, whereas it might be ranked as "severe" if it affected rare species or habitats, large numbers of individuals or large areas. The major factors giving rise to a ranking are explained in the text. As noted in Annex 16 of the TM, a degree of professional judgement is involved in the evaluation of impacts.

11.5 BASELINE CONDITIONS

11.5.1 The outfall location falls within the Western Buffer WCZ. Although there are some recognized/designated sites of marine conservation interest within the marine ecological assessment area, none of them is located in the vicinity of the outfall structure.

Recognized Sites of Conservation Importance

11.5.2 The following recognized sites of conservation importance are located at or near the study area and are shown in **Figure 11.2**:

- SSSI in Sham Wan: An area of 4 hectares including the sandy beach and the adjacent shallow shore in Sham Wan was designated as an SSSI on 3 June 1999. This area has been identified as important habitat for Green Turtle *Chelonia mydas* nesting (Morton 1998). This site is about 7.5 km from the outfall of the drainage tunnel.

- Restricted Area for green turtles in Sham Wan: The sandy beach of Sham Wan was also designated on 30 July 1999 as a Restricted Area under the Wild Animals Protection Ordinance (Cap. 170). Entry is prohibited from 1 June to 31 October each year to protect breeding Green Turtles.

- SSSI in Tai Tam Bay: an inlet of about 600 m in length and 250m in width. It possesses a diversity of habitats and associated plant and animal communities. This site is about 10 km from the outfall of the drainage tunnel.

- Cape D'Aguilar Marine Reserve: The Cape D' Aguilar Marine Reserve was designated on 5 July 1996. It lies in the southeastern tip of Hong Kong Island. The total sea area of the reserve is about 20 hectares. The biodiversity is rich, including numerous kinds of fishes, hard corals, soft corals, gorgonian and marine invertebrates. To protect these important habitats, water sports and coastal activities are not allowed. This site is about 14.5 km from the outfall of the drainage tunnel.

- The horseshoe crab nursery site at Shui Hau: Shui Hau is the third identified horseshoe crab nursery site in Hong Kong (Chiu & Morton 1999). This site is about 22 km from the outfall of the drainage tunnel.

- Proposed Marine Parks south of Lantau: the Fan Lau Marine Park and Soko Islands Marine Park were proposed to ExCo by AFCD in 2002. These two Marine Parks are located in waters off the southwest coast of Lantau for the protection of cetaceans (**Figure 11.2**). A feasibility study was completed in 1999 (Tsang & Milicich 1999). The nearer proposed Soko Islands Marine Park site is about 22 km from the outfall of the drainage tunnel.

11.5.3 No other designated, proposed or recognised protected areas or sites of conservation importance lie within the study area.

Intertidal habitats

11.5.4 The intertidal ecology of Hong Kong is well studied (Morton and Morton 1983). More recent publications on the intertidal fauna and flora include Tam and Wong (2000), Williams (2003) and Chan and Caley (2003). Intertidal habitats in Hong Kong are of two major types, hard shores such as rocky shore, and soft shores such as mudflats and mangroves.

11.5.5 Intertidal mudflats, together with the mangroves and seagrasses, are considered to be the most ecologically important intertidal habitats in Hong Kong. Ecological functions provided by these communities include energy cycling, coastal stabilisation, and habitat for wildlife such as coastal birds.

11.5.6 Mudflat is important not only because it provides a habitat to infauna which are in turn the prey items of many waterfowl, but also it is a suitable substrate for the colonization of mangroves and seagrasses, both of which are important habitat types in Hong Kong. Seagrass beds are also an important nursery and feeding ground of horseshoe crabs. The physical complexity of the mudflat habitat is diversified by colonizing vegetation. A large variety of microhabitat types may contribute to a diverse intertidal fauna. The high species richness of crabs on Mai Po mudflats, where 32 species of crabs have been recorded, is attributed to the large variety of microhabitats there (Lee & Leung 1999). Mangrove communities are under threat from urbanisation and reclamation, and because many stands have been destroyed in Hong Kong they are considered to be a conservation priority (Tam and Wong 2000).

11.5.7 Although they are important, soft shore intertidal habitats are not widely distributed in Hong Kong. Rather, they are concentrated in two locations, northwest and northeast Hong Kong. Among the five WCZs of the Study Area for the present project, there is no established soft shore habitat in the Western Buffer, Victoria Harbour or Eastern Buffer WCZs. In the two remaining WCZs, the only major softshores are sandy beaches and sandflats (such as in Shui Hau and Tai Tam), both are less productive than intertidal mudflats. No significant/recognized site of any of these habitats has been recorded within the Western Buffer WCZ, where the Project is to be located.

11.5.8 The majority of hard shores in Hong Kong are rocky shores. These are not rare in HKSAR, nor are they characterized by high productivity, species richness or diversity as are intertidal mudflats.

11.5.9 The intertidal communities on the rocky shores in Sok Kwu Wan were studied (Maunsell 2002) and were found similar to those found on other semi-exposed coastlines in Hong Kong. Fauna records for wave-exposed shores in that study included littorinid snails (*Littorina scabra*, *Littorina brevicula* and *Nodilittorina millegrana*), *Grapsus albolineatus* (Crustacea, Brachyura), *Eriphia smithii* (Crustacea, Brachyura) and *Septifer bilocularis* (Bivalvia, Lamellibranchia). Boulder shore species included *Polycheir rufescens* (Echinodermata, Holothuroidea), *Petrolisthes japonicus* (Crustacea, Anomura) and *Gaetice depressus* (Crustacea, Brachyura), were recorded (*ibid*.). As with most shores of Hong Kong, zonation patterns were evident, but no rare fauna was found. Overall the fauna appeared to be lacking in diversity and abundance.

11.5.10 The existing coastline in Victoria Harbour is almost entirely artificial and made of concrete or large granite rocks. Although fouling organisms were regarded as common on artificial seawalls and wharf piles (Morton & Morton 1983), due to the polluted nature of the water combined with the homogenous nature of the concrete seawalls, the vertical concrete seawalls in the harbour are not a favourable habitat for intertidal organisms. Few intertidal species, such as Isopods, have colonised those vertical concrete seawalls.

11.5.11 Rubble-mount seawall usually provides more hiding cover for intertidal organisms and is thus regarded as of higher ecological value than vertical concrete seawall.

11.5.12 The closest natural coast within the harbour is located at Green Island. Natural coastline on Green Island was surveyed in the Green Island Development Study (TDD 1998). The intertidal community there was found to be typical of a semi-exposed shore. Abundant limpets and snail *Monodonta labio* were found, while encrusting algae were common in the low intertidal zone.

Intertidal habitat at the Project Site

11.5.13 The entire coastline in Cyberport had been converted to artificial seawalls. The outfall location is located at the western end of the coastline. This section of coastline was also recently converted to artificial seawall to facilitate a haul road for a road improvement project. Though a small headland just to the west provides a very limited sheltering effect, the outfall location is basically facing to the East Lamma Channel. Immediately east of the outfall location is a section of large boulder seawall for the sewage treatment plant which has been operated for a few years. The intertidal habitat in the vicinity (500m distance) of the tunnel outfall was comprised of only a small section of natural rocky shore west of the outfall, and the artificial seawalls along the rest of the Kong Sin Wan area. The location of the outfall was previously part of the artificial seawall but is currently inside a construction site where there is disturbance from ongoing construction works. Building materials including sand and rock have been deposited onto the shore within the construction site including the outfall location. During the field survey for the present project (see **Appendix B**), three intertidal sampling transects were established and only 14 species were recorded. Snail *Monodonta labio* and Stalked barnacle *Pollicipes mitella* were found at all 3 transects and were the commonest species. Numbers of species varied from 9-12 and numbers of individuals from 100-304 among three transects. Shannon's species diversity index (H') ranged from 1.5 to 2.1. Recorded species are common and characteristic of intertidal habitats throughout Hong Kong. Abundant *Monodonta labio* were also found in an earlier study at the nearby Green Island (TDD 1998). *Pollicipes mitella* is a typical barnacle of exposed Hong Kong shores (Morton and Morton 1983). Both species are considered very common rocky shore species (Williams 2003). The site supported low species diversity and low abundance of intertidal fauna.

Horseshoe crab

11.5.14 Horseshoe crabs are an ancient and taxonomically isolated group (class Merostomata, sub-class Xiphosura) related to spiders, ticks and mites. Though not presently protected under local law, Horseshoe crabs have recently been identified as a species of potential conservation importance in Hong Kong.

11.5.15 There are no general restrictions on taking of horseshoe crabs in HKSAR, mainland China, or Vietnam. Taiwan and Guangdong Province, however, have each designated at least one protected area within which taking is prohibited. The Delaware Bay, USA population of *Limulus polyphemus* required around a decade to recover following a complete ban on taking. This matches the duration of the horseshoe crab life cycle from

egg to breeding adult (Ecological Research & Development Group website, www.horseshoecrab.com).

11.5.16 Three species have been reported in HKSAR waters: *Tachypleus tridentatus*, *T. gigas* and *Carcinoscorpius rotundicauda* (Chiu & Morton 1999). These represent all species known from the South China Sea, and three of four species known worldwide. All three species appear to be in population decline and are thought to be under severe pressure in the South China Sea, including Hong Kong waters, due to habitat loss, pollution and over exploitation (Huang 1997). All three species are listed by IUCN Redlist of Threatened Species as data-deficient (DD). This means that the IUCN Species Survival Commission concludes that there are not adequate data to determine the status and/or trend of the global population of any of the three species.

11.5.17 The most critical habitat is the sandy shore and sandy backshore where adult horseshoe crabs mate and lay eggs. These habitats are being degraded regionally by construction of bulkheads, seawalls and groines. Bulkheads and seawalls prevent access of breeding adults to preferred nesting areas. Groines accelerate beach erosion.

11.5.18 It was reported that *Tachypleus gigas* and *Tachypleus tridentatus* were collected from trawl surveys at Tap Shek Kok just south of Lung Kwu Tan, and the beaches at Lung Kwu Sheung Tan and Lung Kwu Tan have been therefore identified as potential breeding sites for *T. gigas* (ERL 1993, ERM 1996).

11.5.19 In an extensive study of the distribution of horseshoe crabs in Hong Kong conducted between March 1995 and June 1998, however, *Tachypleus gigas* was not recorded and its local status is uncertain (Chiu and Morton 1999). It is likely that only two species of horseshoe crab (*T. tridentatus* and *C. rotundicauda*) are extant in Hong Kong as no recent records of *T. gigas* have been reported (*ibid*.).

11.5.20 Horseshoe crabs are currently more often found in western waters of Hong Kong, though they once thrived on many beaches in Hong Kong including Tolo Harbour (Huang 1997; Huang *et al*. 1999). Horseshoe crabs, most commonly *T. tridentatus*, have been recorded in HKSAR at Tap Shek Kok, Sha Chau, Tai Po and Peng Chau, though there are no recent records from any of these sites (Huang 1997). *C. rotundicauda* was recorded in 1997 from Ma Wan Chung, Lantau, at a site that was lost to development of the Tung Chung New Town (*ibid*.). The other areas where horseshoe crabs have been recorded in the HKSAR are on the shores of Outer Deep Bay and the waters around Black Point-Tap Shek Kok.

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

11.5.22 In Hong Kong the preferred habitat of horseshoe crab was identified as sandy to muddy shores, which provide habitats for mating and egg laying, and for juveniles.

11.5.23 Confirmed nursery sites for horseshoe crabs in recent years include Pak Nai, San Tau and Shui Hau (Huang *et al*. 1999), together with Tai Ho Wan (Fong 1999) and Sok Kwu Wan (Maunsell 2003). Some other beaches on Lantau, including Tai O, Yi O, Sham Wat Wan, Sha Lo Wan and Tung Chung, are considered probable nursery sites because adult horseshoe crabs are frequently captured offshore (Huang *et al*. 1999).

11.5.24 At a HKSAR-wide study, three locations, i.e. Pak Nai in Deep Bay, San Tau near Tung Chung, and Shui Hau at south Lantau, were identified as important horseshoe crab nursery sites, all of which are located in western waters (Chiu & Morton 1999). Of these three sites, Shiu Hau is the only site located within the marine study area for the present study and it is about 22 km from the proposed outfall location. As part of the historical records before the commencement of the Chiu and Morton study, it was reported that an adult *Tachypleus tridentatus* was seen climbing up the artificial rock shore at Kong Sin Wan (*ibid*.). However, no further sightings were recorded at Kong Sin Wan during that study. The nearest location of a horseshoe crab sighting reported by Chiu and Morton (1999) was within the East Lamma Channel approximately 4 km from the proposed outfall location. While the location of juveniles reported in Sok Kwu Wan was also about 6 km away from the outfall location.

11.5.25 The coastline in Kong Sin Wan is currently all artificial seawall and not suitable for use by juvenile horseshoe crabs. Aside from the single historical record, there have been no sightings of juvenile or adult horseshoe crabs at or near the outfall location from the territorial-wide study, or during the dive survey (**Appendix A**) or the intertidal survey (**Appendix B**) for the present EIA study. We therefore conclude that the outfall location and its vicinity are not important for horseshoe crab conservation.

Soft Bottom Benthos

11.5.26 The first comprehensive study of Hong Kong subtidal benthos was conducted in 1976-1977 (Shin and Thompson 1982). Shin & Thompson (1982) studied benthic grab samples collected from 200 stations throughout Hong Kong waters. Data from these stations, however, was not treated separately, but was pooled with other stations with similar species composition.

11.5.27 Thompson & Shin (1983) performed a further study which concentrated on the Victoria Harbour area and also related the spatial distribution of benthic infauna to sewage pollution. Their report described in detail the benthic conditions in Victoria Harbour. Its focus was on infauna assemblages and substratum and organic nutrients. Another benthic sampling project was conducted in 1995 (Cai *et al*. 1997) with the purpose of determining changes in infauna since the Thompson & Shin study. This report contains detailed background information on benthic ecology. Its focus is on temporal and spatial changes of benthic communities in Victoria Harbour. Sediment samples were also collected at three stations off the Central waterfront during November 1995 (ERM 1997) as part of the surveys for Central Reclamation Phase III Studies.

11.5.28 In 2001, a second HKSAR-wide benthic survey commissioned by AFCD was conducted (CCPC 2002). Information on the subtidal benthic communities, including spatial

distribution, abundance, and species composition, was collected at 120 sampling stations over the territorial waters of Hong Kong which were divided into 5 regions. The cephalochordate *Branchiostoma belcheri* is the only known benthic macrofauna species of conservation concern in Hong Kong. The species is regarded as a living fossil link in the evolution of marine invertebrates to vertebrates and is, therefore, considered an important species. The species is typically recorded in the eastern waters of Hong Kong (CCPC 2002) and recently south of Cheung Chau (Mouchel, 2003). Both areas are distant from the outfall location of the proposed Project. No other species of conservation concern were recorded in the Study Area. Station 43 of the second AFCD benthic survey was just offshore from Kong Sin Wan and probably best represent the benthic conditions in the vicinity of the outfall portal. In summer, only 19 species were recorded, while in winter 24 species were foundand no species of conservation concern was recorded. The density and biomass recorded were also low at this station, i.e. 84 individuals/m^2 and 1.68 g/m^2 in summer and 128 individuals/m^2 and 14.8 g/m^2 in winter. This area is therefore not of special conservation importance in terms of benthic communities.

Corals

11.5.29 Established coral communities of any size are regarded as important habitat types in Hong Kong as defined in Annex 8 of EIAO-TM. Among the corals, however, hard corals are more vulnerable than soft corals. Soft corals and gorgonians do not contain symbiotic algae zooxanthellae and do not require light penetration for photosynthesis. Many of the soft corals can survive at greater depths (Morton and Morton 1983; Morton 1994). They are more widely distributed in Hong Kong and are found in areas of higher turbidity such as south Tsing Yi, where sea pens and gorgonians were recorded during a trawl survey for epibenthic species (ERM 1995).

11.5.30 Hard corals are protected in Hong Kong by the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187), which includes the protection of all stony (hard) corals. While the vertical distribution of hermatypic corals is largely controlled by the requirements of their photosynthesising zooxanthellae which require strong light and hence shallower water, the geographical distribution of hard corals in Hong Kong is affected by the salinity of the water. The Hong Kong waters can be broadly divided into estuarine, transitional and oceanic zones based on the distance from the Pearl River estuary (Morton and Morton 1983). The Study Area of the Project covers a large area including the transitional zone and part of the estuarine zone. Hard corals are vulnerable and prefer clear oceanic water. Hard corals in Hong Kong therefore exhibit distinct gradients in distribution, species diversity and abundance, with the coral cover and diversity increasing from west to east, with declining influence of the Pearl River (Scott 1984).

11.5.31 Opposite to the abundance and diversity of corals in eastern Hong Kong waters, the estuarine environment of the western waters was thought unsuitable for the existence of scleractinians (reef-building corals)(Scott 1984). Water quality in the western waters, particularly elevated freshwater and suspended sediment levels which are characteristic of estuarine environments, prevent substantial coral growth (Hodgson and Yau 1997). Western waters are thus characterized by the domination of soft and ahermatypic corals.

Soft corals, sea pens and gorgonian corals (sea fans) are present throughout the northwestern waters (Mouchel 2002). The hard coral species recorded in the northwestern waters are generally common throughout local waters (Scott 1984) although they are more abundant in the eastern waters. The northwestern waters may represent their westernmost distribution in Hong Kong.

11.5.32 It is notable that the ahermatypic cup coral (*Balanophyllia* or *Phyllangia* sp.) and the pale-blue gorgonian (*Euplexaura* sp.) have only rarely been recorded in the oceanic eastern and southern waters of Hong Kong and it is likely that these species are adapted to the hyposaline waters of western Hong Kong (Mouchel 2001).

11.5.33 AFCD commissioned intensive underwater surveys in 2001-2002 to survey corals at 240 sites covering about 70 km of coastline in territorial waters. Corals were also found in western waters of Hong Kong, but in southern (Tong Fuk, Soko Islands) and eastern (Cheung Chau, Hei Ling Chau) Lantau waters only sparse colonies or low-coverage communities were found, composed of extremely tolerant and hardy species. For some locations, no hard coral colonies were found in the hard substrate subtidal zone, including Tung Wan, Tai Long Wan west of Tung Wan, and also the coastline east of Tung Wan up to Shek Lam Chau. The coverage of corals in this region is very low (less than 5%, and usually < 1%, the lowest of all regions in Hong Kong). The "near-total or complete absence" of reef-building hard corals is considered attributable to the high turbidity and low salinity.

11.5.34 Inside Victoria Harbour WCZ, some soft corals and gorgonians were found at Green Island and Little Green Island during the Green Island Development Study (TDD 1998). Some black corals (*Anthipathes* sp.; protected by CITES and Cap. 187), were also found in Green Island.

11.5.35 Binnie (1995) carried out an extensive dive survey in Hong Kong waters. Five sites at the southeastern end of the Western Buffer WCZ were surveyed but no sites were surveyed in the Victoria Harbour or Eastern Buffer WCZs (see **Figure 11.5**). Rich soft corals and sea fans were found at Pak Kok. Hard corals in Pak Kok were also recorded as abundant. However, Ap Lei Chau, Magazine Island, south Telegraph Bay and north Telegraph Bay were all assigned low conservation value in terms of the abundance and diversity of hard and soft corals.

11.5.36 The survey point of North Telegraph Bay (Station 86 in the Underwater Dive Survey, see **Figure 11.5**) was very near the western portal at the headland immediately next to the portal. The conservation value of Station 86 was considered low due to the low diversity and abundance of marine organisms. The seabed was muddy beyond 6 m in depth. Only two species of sea urchins, barnacles, gastropods and bryozoa were recorded in the shallower waters. Other than these organisms, only a few sea whips, Cardinalfish and rabbitfish were found at the site. Dive surveys were also conducted in various locations for Harbour Area Treatment Scheme (HATS) (CDT 2004). It was found that the hard and soft corals at Sandy Bay (to the northwest of Cyberport) were of relatively low percentage cover and species diversity and the communities were not unique compared to others in Hong Kong, and therefore not of high ecological value. At both Luk Chau Wan and Sok Kwu Wan of Lamma Island, however, the hard corals were of high

diversity and coverage. These findings are basically consistent with the findings from the Binnie's study.

11.5.37 A dive survey was conducted for the present EIA study to (i) examine the subtidal communities at the western portal location in Kong Sin Wan and its vicinity; and (ii) to identify the locations and quantify the abundance of any marine species of conservation concern (**Appendix A**). The topography of the subtidal zone at the outfall location is very steep, reaching -10mCD within 35 m from the tideline, and the underwater visibility was found to be very poor (about 0.5 – 0.7m). Both suggest unfavorable conditions for hard coral colonization. The portal area was disturbed by previous and ongoing construction works and the shallow subtidal area was covered by artificial boulders (**Appendix A**).

11.5.38 No hard or soft coral colony was found during the survey. The seabed consisted almost entirely of muddy or sandy substrate with very little biota. Only some barnacles (on the surfaces of boulders), several demersal fishes and two sea urchins *Diadema setosum* were recorded. *Diadema setosum* is widespread and common in shallow marine waters of Hong Kong.

11.5.39 The findings of the present survey were basically similar to those from the 1994 survey by Binnie, and therefore the conservation value of the portal area should also be considered as low at Station 86 due to the low diversity and abundance of marine organisms recorded.

Cetaceans

11.5.40 Of the fifteen cetacean species recorded in Hong Kong waters only two, the Chinese White Dolphin (*Sousa chinensis*) and Finless porpoise (*Neophocaena phocaenoides*) are resident (Parsons *et al*., 1995). Both are listed by the IUCN World Conservation Union Species Survival Commission's Cetacean Specialist Group as "data deficient", meaning that there is inadequate information to assess their global population status or degree of threat.

11.5.41 Chinese White Dolphin is present throughout shallow (< 20 m) coastal waters of the Indo-pacific, from Australia and China in the east to South Africa in the west. Off the coast of south China, at least seven separate populations were identified from Guangxi northward to the Yangtze River, all found in estuaries.

11.5.42 In Hong Kong SAR, Chinese White Dolphin is also concentrated in the more estuarine waters. They are found in all the waters of western Hong Kong and throughout the Pearl River estuary (Parsons *et al*. 1995; Jefferson 2000, 2002, 2004; Hung 2002a & b, 2003, 2004; Jefferson & Hung 2004). They are present and common year-round in the waters north and west of Lantau, and also occur seasonally or in small numbers south and east of Lantau Island, as well as in southern Deep Bay and west of Lamma Island (Jefferson 2000, Jefferson & Hung 2004). They are not present in the waters east of Lamma Island, except on rare occasions, such as the one which occurred in 2001/02 in Hebe Haven and Port Shelter (Jefferson personal communication). That individual dolphin has now left the area, and apparently returned to its normal range.

11.5.43 No dolphins have ever been recorded near the outfall location. Two out of the five WCZs of the Study Area overlap with the distribution range of Chinese White Dolphin in Hong Kong. The southeast limit of the distribution range of Chinese White Dolphin falls into the Southern WCZ and the western end of Western Buffer WCZ. In the Southern WCZ, the sightings scatter between west Lamma and the south shore of Lantau, more concentrated in the southwest Lantau waters. In the Western Buffer WCZ, where the tunnel outfall would be located, there was only one dolphin sighting recorded during the 2003-2004 monitoring programme of AFCD. This was south of Tsing Yi, approximately 6.5 km from the proposed outfall location (**Figure 11.3**). Cumulative sighting records within Western Buffer WCZ from 1995 to 2004, which covered a comprehensive study for Chinese White Dolphin between 1995 to 1998 (Jefferson 1998), were only 26 in number. Most of these sightings were recorded in the coastal waters of Lantau Island. Only three sightings were made near Hong Kong Island (between Kau Yee Chau and Hong Kong Island). Among these, even the nearest sighting was over 3.5 km from the proposed outfall location (**Figure 11.3**).

11.5.44 Finless Porpoises occur in Hong Kong's eastern and southern waters, including Mirs Bay, Sai Kung, Po Toi, Ninepins, south of Lamma Island, south of Hong Kong Island, in the waters south and east of Lantau Island, and in particular southwest of Lamma Island at Ha Mei Tsui. But they have never been sighted north or west of Lantau (**Figure 11.4**)(Parsons *et al*. 1995; Jefferson & Braulik 1999; Jefferson *et al*. 2002a). There is no sighting record of Finless Porpoise in the vicinity of the tunnel outfall location, and even the entire Western Buffer WCZ in which the outfall is located. The sighting records nearest to the outfall location were made between Lamma and Sunshine Island, over 4.5 km away.

11.5.45 The size of the local Finless Porpoise population is not known. Based on line transect surveys, there are estimated to be between 55 and 152 porpoises in Hong Kong waters in different seasons. Up to 217 finless porpoises occur in Hong Kong waters plus Mainland waters immediately southwest of Hong Kong where surveys have been completed (Jefferson *et al*. 2002a). The minimum estimate of the population size is thus about 220 porpoises, although the true size of the population is likely to be much larger. Breeding is strongly seasonal, and although some may be born at other times of year, most calves are born from October to January (Jefferson *et al*. 2002b).

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

11.5.47 Two marine parks are proposed for the protection of cetaceans in southwest Lantau and Soko Islands. They are .both far away from the outfall location (i.e. 22 km for the nearer Soko Islands).

Green Turtles

11.5.48 Five species of sea turtles have been recorded in Hong Kong waters, these include: the leatherback turtle (*Dermochelys coriacea*), the olive ridley turtle (*Lepidochelys olivacea*), the green turtle (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*) (AFCD, 2004a). Among them, the green turtle attributes to most local records and it is the only species that nests in the territory at present.

11.5.49 The migratory green turtle, *Chelonia mydas*, is a highly endangered species that is afforded international protection under Appendix I of CITES and the Bonn Convention. It is also listed as a "Class II Protected Animal" in the "List of State Key Protected Wildlife in China". Locally all sea turtles are protected by Cap 170 Wild Animals Protection Ordinance and Cap 187 Animals and Plants (Protection of Endangered Species) Ordinance.

11.5.50 Historically, sea turtles used to nest in many of the remote beaches on Lamma Island, Lantau Island, and Hong Kong Island. However, increasing urban development and human disturbance have reduced the number of sea turtle nesting sites in Hong Kong. Nowadays its only regular nesting beach is at Sham Wan in South Lamma. Since the sandy beach at Sham Wan remains the only regular green turtle nesting site in the territory, it has been designated a SSSI since June 1999, and gazetted as a Restricted Area under the Wild Animals Protection Ordinance since July 1999. Sham Wan in South Lamma is therefore an important ecological sensitive receiver because of its significant conservation status. Sham Wan is about 7.5 km from the proposed outfall location for the Project.

11.6 EVALUATION OF ECOLOGICAL IMPORTANCE OF HABITATS AND SPECIES

11.6.1 The "Important Habitats Types in the Territory" listed in Note, Table (1), Annex 8 to the TM-EIAO existing in or near to the study area are:

- Undisturbed natural coastal areas longer than 500 metres;
- Established coral communities of any size;

11.6.2 Habitats found within the study area were evaluated in terms of ecological importance using the criteria set forth in Annex 8, Table 2 of the TM-EIAO. Details are listed in Tables 11.1 to 11.2 below.

11.6.3 The baseline study described above showed that Chinese White Dolphin and Finless Porpoise are found west of and south of the project area, respectively. Kong Sin Wan and its vicinity are not a horseshoe crab nursery site, and there has been no recent record of juveniles or adults near the area. In the vicinity of the outfall the seabed was not colonized by coral and the marine benthic communities were not of special conservation importance, and the intertidal zone had been disturbed by ongoing construction works.

Table 11.1
Evaluation of ecological importance of intertidal habitat within 500m of the project area

Criteria	Remarks
Naturalness	Low. The majority was artificial seawalls, while the outfall location was disturbed by land reclamation and construction works nearby.
Size	0.3 ha in total within 500m.
Diversity	Low. Only 14 species of fauna recorded.
Rarity	Common habitat in Hong Kong. No protected or rare fauna recorded
Re-creatability	Artificial coastline is readily re-creatable. but constrained by land availability
Fragmentation	Unfragmented. Continuous within 500m.
Ecological linkage	Generally, it is linked with open sea and upper shore shrubland. But not functionally linked to any highly valued habitat in close proximity.
Potential value	Low to moderate. Given sufficient time, it might be colonised by some intertidal and marine organisms
Nursery/breeding ground	Limited due to high human disturbance and the pollution level in the seawater. Only potentially for some inter-tidal animals such as snails, crustaceans and other invertebrates.
Age	Young for reclaimed section, old for natural shore section
Abundance/Richness of wildlife	Low
Overall Ecological value	Low

Table 11.2
Evaluation of ecological importance of subtidal habitat in the vicinity of the project area

Criteria	Remarks
Naturalness	Low to moderate. Close to urbanised areas and artificial coastline
Size	Over 39 ha within 500m
Diversity	Low.
Rarity	Common habitat in Hong Kong. No protected or rare fauna recorded.
Re-creatability	Not re-creatable.
Fragmentation	Unfragmented.
Ecological linkage	Generally, it is linked with open sea. But not functionally linked to any highly-value habitat in close proximity.
Potential value	Moderate.
Nursery/breeding ground	Not known to be breeding/nursery ground
Age	N/A
Abundance/Richness of wildlife	Low
Overall Ecological value	Low to moderate

11.6.4 In accordance with the criteria set forth in Table 3, Annex 8 of the EIAO-TM, the ecological importance of species within the study areas was assessed in terms of:

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

11.6.5 Species recorded during the dive survey (sea urchin) are typical of disturbed areas, while those recorded during the intertidal field survey are very common in rocky shore habitats. They are not of conservation importance.

11.6.6 The list of recorded species of conservation importance is evaluated according to the TM-EIAO in Table 11.3 below.

11.6.7 Chinese White Dolphin is a Class I protected species in the Mainland. In HKSAR it is protected from capture or direct harm under the Wild Animals Protection Ordinance. The degree of extinction threat to the global population cannot be assessed by IUCN World Conservation Union due to a deficiency of data. Finless Porpoise is also protected by the Wild Animals Protection Ordinance in Hong Kong and is also listed as "data deficient" by IUCN World Conservation Union.

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

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

Table 11.3
Evaluation of fauna species of ecological importance recorded within the Study Area

Species / Group	Protection Status	Distribution	Rarity
Chinese White Dolphin	WAPO; Class 1 Protected Animal of China; expanding protected area system in Mainland; intensifying habitat/prey enhancement in HKSAR	Widely distributed in the coastal and inshore waters of the Indian and western Pacific oceans; Local population concentrated in the estuarine waters outside the study area (close to Sha Chau and Lung Kwu Chau)	About 1,500 individuals in the Pearl River estuary and Hong Kong waters (Jefferson & Hung 2004); locally common near Sha Chau and Lung Kwu Chau. Key threats are vessel collisions, and enganglement in fishing nets (IUCN Redlist).
Finless Porpoise	WAPO	Local population concentrated in the waters to the south of Lantau, Lamma, Hong Kong Island.	up to 217 finless porpoises occur in the area of Hong Kong plus Mainland waters immediately to the southwest. Key threats are entanglement in gill nets, vessel collisions, and possibly bio-accumulation of pesticides (IUCN Redlist).
Horseshoe crab	No statutory protection status in Hong Kong, Mainland China, or Vietnam. Both Taiwan and Mainland China have established protected areas for horseshoe crab breeding.	Three of four species world-wide occur in the South China Sea; Two, *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*, have been recorded within the assessment area.	Relatively rare species of a taxonomically distinct and ancient class; rarity probably due to unsustainable harvest
Corals	Cap. 187, and CITES	Exhibit strong gradients in distribution, species diversity and abundance in Hong Kong, with the cover and diversity decreasing from east to west, towards the influence of the Pearl River.	Not uncommon in Hong Kong waters

11.7 IMPACT ASSESSMENT

Identification of Environmental Impacts

11.7.1 The construction works at tunnel portals and intake shafts will include site preparation and clearance, excavation, intake structures and tunnel portal structure construction, utilization of ancillary equipment at tunnel portals to support tunnel construction, material handling and blasting at portals (or intakes if necessary).

11.7.2 Potential sources of impact during construction phase include:

- Habitat loss caused by the portal itself and associated construction works; and
- Water quality degradation caused by dredging and earth works.

11.7.3 Potential sources of impact during operational phase include:

- Water quality degradation caused by the discharge.

Construction phase

11.7.4 This section of the report assesses the potential impacts of project construction on intertidal and subtidal ecology. The construction activities at the western tunnel portal will include site preparation and clearance, excavation, tunnel portal structure construction, utilization of ancillary equipment at the tunnel portal to support tunnel construction, material handling and blasting at the portal.

Habitat loss

11.7.5 To avoid increasing land-based traffic volume a temporary barge berthing point will be constructed at the western portal at Kong Sin Wan. The berth will be used for the transportation of excavated spoil from the proposed drainage tunnel and delivery of supporting materials or equipment for tunnel construction. The dimensions of this temporary pier would be 11m x 40 m. An area of 440m^2 of shallow subtidal zone and a length of 11 m of intertidal seawall (of 22m^2 in area assuming the tidal range to be 2m in height) would be occupied by this berthing point. Construction works for the proposed drainage tunnel would be finished within 4 years. The area occupied by the berthing point would not be available for wildlife use during this period.

11.7.6 After the tunnel construction works are finished, the temporary berthing point would be removed. A stilling basin would be constructed at the same location but on-shore. An armored rock panel (25m x 25m, = 625m^2) would be placed directly on the existing seabed beneath the outlet of the stilling basin.Dredging works would not be required for construction of the stilling basin or placement of the rock panel. The purpose of the rock panel is to protect the seabed from scouring. Each armor rock is about 1 tonne in weight (about 1 m in size) and would rest on the muddy/sandy bottom.

11.7.7 The dive survey showed that most of the area subject to temporary and permanent seabed loss is muddy substrate with boulders. This type of habitat is not of special conservation importance. No hard and soft corals or any other marine species of conservation concern were recorded. It was shown from previous records that the waters near the seabed loss area (the outfall location) were not used by Chinese White Dolphin or Finless Porpoise. In the last ten years there were no sightings of horseshoe crabs in the vicinity of the seabed loss area. Given the low conservation importance of the seabed habitat near the outfall portal and the small area (maximum 625 m^2) affected, the impact of seabed loss is ranked as minor.

11.7.8 An area of 22 m^2 of intertidal zone at the outfall location would be occupied by the berthing point during most of the construction phase. This site would be occupied by part of the outfall itself during the operation phase. An area of 50 m^2 (25m in width and assuming the tidal range to be 2m in height) of intertidal zone, which includes the original temporary barging point and some other existing artificial seawall, would be permanently replaced by the concrete structure of the outfall portal. However, as shown in Figure 1 of Appendix A, the location is currently being disturbed by highway construction works. The impact from the Project would thus only affect some newly constructed artificial coastline. Indeed, even on the nearby natural intertidal zone, both the abundance and diversity of fauna were low. Considering the low ecological value of a recently constructed artificial coastline, the small area involved, and the availability of similar habitat in the vicinity, the impact of intertidal habitat loss is ranked as minimal.

Water quality

11.7.9 At the western portal a pier would be built at Kong Sin Wan as an alternative marine access for barges. This would involve approximately 4,500 m^3 of imported fill material and may lead to re-suspension of sediment and disturbance of the sandy seabed. Suspended solids created during berthing point construction and demolition would increase turbidityand thus reduce the amount of light reaching the sea bed. As they settle on the seabed the sediments could bury sessile benthic organisms. Resuspension of sediments would also reduce oxygen levels and potentially release pollutants into the water column. These factors could adversely affect the health and survival of marine organisms. However, these impacts are not predicted to be severe because they would be short-term and localised in nature. Due to the small scale of the works and the low ecological value of the site the impact is ranked as minor. Mitigation measures for these impacts would be required.

11.7.10 Siltation caused by construction works could adversely affect water quality. Construction of the tunnel and the ground surface structures for the western portal would result in site runoff from a limited area of earth works.

11.7.11 Construction site runoff can contain sediments, organic substances, oil, grease and solvents that can affect marine ecology. These substances can increase turbidity, decrease oxygen levels and introduce contaminants, causing a short-term loss of habitat or degradation of habitat quality. This has potential to injure or kill benthic organisms, and drive mobile organisms away from the affected area.

11.7.12 Impacts would be short-term and would be largely self–correcting after project completion without active restoration efforts. As the sea area in the vicinity of the outfall is not used by dolphins or porpoises, and there are no recent records of horseshoe crabs or corals, impacts from water quality deteriorations on these species of conservation importance would not be significant. Sensitive species near the site that could be directly affected by runoff would only include juvenile life stages of various marine organisms. The impacts of such runoff to subtidal ecology is therefore ranked as minor

11.7.13 No construction works would take place on areas with natural coastline. Considering the scale of the ground surface construction works and assuming that good site management practices are followed, site runoff is not predicted to have an adverse impact on the natural coastline.

Noise and disturbance

11.7.14 Noise and disturbance from underwater and coastal construction could cause disturbance-sensitive marine fauna to migrate from the area, or cause secondary effects such as reduced feeding efficiency. However, no dolphin or porpoise was recorded near the outfall location and any other mobile species that are sensitive to disturbance would most likely vacate the area at the onset of the underwater works. Impacts are therefore ranked as minimal.

11.7.15 There is no disturbance-sensitive receiver in the intertidal zone. Due to the limited area of intertidal zone that would be occupied, however, the impact would be expected to be minimal.

Marine Traffic

11.7.16 Some of the excavated material from the tunnel construction works would be transported by barges from the outfall location. Marine traffic volume will thus increase. Although there is little information on the collision of Finless Porpoises with vessels, high speed vessels are known to be potentially dangerous for Chinese White Dolphin. The speed of vessels (mainly barges) would not be high, and this impact could be ranked as minor. Taking a pre-cautionary approach however, measures for the marine traffic impact are still proposed.

Operation phase

11.7.17 This section of the report considers the potential impacts of project operation on intertidal and subtidal ecology.

Water quality change

11.7.18 The water quality assessment showed that the operation phase effluent from the drainage tunnel would have only limited and localized impacts on marine water quality. The water quality modelling simulated the 1 in 2 years and the 1 in 50 year design storm event

outfall hydrographs for the discharge from the Western Portal. Three parameters, i.e. suspended solid, *E. coli*, and salinity, were simulated and presented in figures. Four coral sites in Lamma and Hong Kong Island (i.e. Pak Kok, Luk Chau Wan, Sok Kwu Wan and Green Island, see **Table 11.4**) were selected as ecological sensitive receivers (SRs) for water quality assessment due to their relatively closer distances to the outfall location and the higher sensitivity of corals. All the recognised sites of marine conservation importance are much farther away from the outfall than these SRs (**Table 11.4**).

Table 11.4
Distance from water quality ecological sensitive receivers and the recognised sites of marine conservation importance to the outfall location

Site	**Distance from the outfall (km)**
Water Quality Ecological Sensitive Receivers	
Pak Kok	2.5 km
Green Island	3 km
Luk Chau Wan	3.5 km
Sok Kwu Wan	5.5 km
Recognised sites of conservation importance	
SSSI in Sham Wan & Restricted Area for green turtles in Sham Wan	7.5km
SSSI in Tai Tam Bay	10km
Cape D'Aguilar Marine Reserve	14.5km
The horseshoe crab nursery site at Shui Hau	22km
Two proposed Marine Parks south of Lantau	22km for the nearer one (Soko Islands)

11.7.19 Predicted suspended solids concentrations were plotted to show areas affected by suspended solids for the 1 in 2 year and 1 in 50 year storm events (see **Figure 4**, **5**, **12** and **13** in **Appendix I -** water quality modelling results). For both the flood and ebb tide scenarios these show that the plume is generally confined to the landward coastal waters on the west coast of Hong Kong Island from Green Island to Ap Lei Chai. For SS the plots show that the corals near Lamma Island (Pak Kok, Luk Chau Wan and Sok Kwu Wan) and near Hong Kong Island (Green Island) are not affected by the plume for either tide scenario (ebb or flood) or discharge magnitude (1 in 2 years or 1 in 50 years).

11.7.20 **Tables 7.8a** and **7.8b** of Water Quality Assessment Chapter showed that for all the Coral SRs, no net increase of the maximum and cumulative SS concentrations are predicted for all flood and tide scenarios from the model and therefore, all predicted results are well within the Marine WQOs. As these ecological SRs are not affected by the SS, all other recognised sites of marine conservation importance which are much farther away as shown in **Table 11.4** are also not affected.

11.7.21 The predicted deposited sediment per m^2 were also plotted (see **Figure 6**, **7**, **14** and **15** in **Appendix I** - water quality modeling results). **Table 7.10** in Water Quality Assessment Chapter summarized the results of the maximum deposition at the coral SRs and showed that the maximum deposition are very small (all < 3 g/m^2) at all tide and discharge scenarios, well below the coral sedimentation rate limit of 0.1kg/m^2/day. Therefore, no adverse impacts to the corals are expected to occur because of the proposed tunnel scheme. A deposition rate of 0.1 kg/m^2/day has been set as a threshold level for coral protection. This criterion has been applied in EIA studies in eastern Hong Kong waters (e.g. The Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong) where corals are typically a key issue in marine ecological conservation. For this reason the standard for the deposition rate is very restrictive. To apply this high standard in the transitional zone of Hong Kong such as the outfall location of the present Project would be conservative. As these ecological SRs are not affected by the sediment deposition, all other recognised sites of marine conservation importance which are much farther away as shown in **Table 11.4** are also not affected.

11.7.22 Maximum relative concentrations of *E. coli* higher than 100 cfu/100ml are limited to the immediate vicinity of the discharge point. *E. coli* concentrations up to 95 cfu/100ml are limited to a narrow strip along the west coast of Hong Kong Island. However, for all modelled flood and tide scenarios no exceedance in terms of maximum cumulative concentrations will occur at any of the Water Quality Sensitive Receivers including sites of corals (see **Tables 7.9a** and **7.9b**). The impact is considered insignificant. As these ecological SRs are not affected by *E. coli*, all other recognised sites of marine conservation importance which are much farther away as shown in **Table 11.4** are also not affected.

11.7.23 The minimum salinity plots (see **Figure 10**, **11**, **18** and **19** in **Appendix I** - water quality modelling results) again show the areas affected by the storm water discharge. These areas are limited to a narrow strip along the west coast of Hong Kong Island. The most affected waters are the surface layer in areas located immediately adjacent to the Western Portal. Salinity will be higher in the middle and bottom layers of the water column owing to the density gradient. In the flood scenarios, the impact is stronger to the SE, while in the ebb scenarios the NW direction is affected the most. It should be noted that the background salinity shows a spatial gradient, due to the presence of the Pearl River plume. In all cases, the impacted areas are smaller in the 1/2 years scenarios, due to the smaller discharge water volume.

11.7.24 The change in salinity at the ecological SRs (coral sites) are assessed with the results shown in **Tables 11a** and **11b** for the 2-year and 50-year storm events, respectively. The tables show the maximum difference between the modelled baseline condition and the modelled implementation scenario (which is the accumulation of the baseline and the proposed tunnel's discharge plume). The WQO requires that "human activity should not cause the natural ambient salinity to change by more than 10%". For both magnitude storm events and tide scenarios the change in salinity is less than 1% and therefore meets the WQOs. Furthermore, the change in salinity resulting from the freshwater plume discharged from the Western Portal is significantly less than the natural daily fluctuations in salinity at the SRs. As these ecological SRs are not affected by the

salinity, all other recognised sites of marine conservation importance which are much farther away as shown in **Table 11.4** are also not affected.

11.7.25 The marine waters subject to change in water quality by the operational discharge are limited to a narrow strip of the landward coastal waters along the SW coast of Hong Kong Island, reaching to the western tip of the island in the NW and to the waters around Ap Lei Chau in the SW, as discussed in the above paragraphs. The affected area is small and far away from the recognised sites of conservation importance as well as ecological SRs for water quality assessment. Even Pak Kok at the northeastern tip of Lamma, the nearest (2.5 km) SR with hard coral communities, is outside the affected area. None of the recognized sites of marine conservation importance (including Sham Wan, Tai Tam, Cape d'Aguilar, Shui Hau, and two proposed Marine Parks, see **Table 11.4**) which are much farther away would be affected. The distribution of Chinese White Dolphin lies distant from the outfall and the affected area. Although the core area for Finless Porpoise's distribution (southwest of Lamma Island at Ha Mei Tsui) is much closer to the project area than that of the Chinese White Dolphin (Umston Road), there is also no overlap between the affected area and the Finless Porpoise sightings. No impact on the two cetacean species is expected. The impacts from the operation of the drainage tunnel is thus ranked as minimal. The construction and operation phase impacts were summarised in **Table 11.5**.

Table 11.5
Summary of construction phase and operational phase impacts of the Project

Impacts	Due to	Duration	Receiver	Severity	Need for mitigation
Construction phase					
Permanent Intertidal Habitat Loss (only artificial seawall, about 22m^2 when the baring point is build, and expand to about 50m^2 when the outfall is constructed)	Temporary berthing point and Outfall	Permanent	Intertidal communities	Minimal	No
Permanent Seabed loss (muddy seabed, 440 m^2 during the barging point is used, and expand to 625m^2 after the outfall is constructed)	Temporary berthing point and Armor rock panel outside outfall and stilling basin	Permanent	Marine organisms	Minimal	No
Marine water quality	Resuspension during construction and demolition of berthing point; construction of outfall and stilling basin Dumping, spilling, and leakage of chemicals from vessels or equipment	Temporary	Marine organisms	Minor	Yes
Construction Noise and Disturbance	Construction activities	Temporary	Intertidal and marine organisms	Minimal	No
Marine traffic	Vessel traffic associated with construction	Temporary	Potentially Finless Porpoise	Minor to moderate	Yes
Operational Phase					
Marine water quality	Increase in suspended solid, nutrient, E.coli. and freshwater during operation	Permanent	Marine organisms	Minimal	No

Cumulative impacts

11.7.26 This section of the report assesses the potential cumulative impacts from other concurrent projects in the study area.

11.7.27 There are no scheduled concurrent designated projects (DP) in the vicinity of the proposed tunnel portals, intakes or tunnel alignment during the construction or operation phase.

11.7.28 As stated in the results of the water quality assessment, no cumulative impact on the marine water quality from other project is predicted. There is also no other concurrent marine works project in the vicinity of the tunnel outfall. Therefore, no cumulative construction and operational marine ecological impacts are likely to arise from this DP.

11.8 MITIGATION MEASURES

Construction phase

11.8.1 As shown in **Table 11.5**, above only construction phase mitigation measures for marine water quality impacts and marine traffic impacts are needed for marine ecology.

11.8.2 Potential sources of marine water quality impacts during construction phase include:

- Site runoff;
- Suspended solid during the construction and demolition of the berthing point; and
- Construction of the stilling basin.

11.8.3 Site runoff will be controlled by general site practices during the construction works.

11.8.4 Silt curtains will be deployed during the construction and demolition of the temporary berthing point. Deployment of silt curtains around the berthing point area would effectively avoid adverse water quality impacts due to barge filling. No ecological impact is anticipated.

11.8.5 The invert of the stilling basin would be at -5.4 mPD. A cofferdam in the form of a pipe-pile wall is to be constructed outside the stilling basin prior to the construction of the basin. The cofferdam will be dewatered to provide a working area for construction of the stilling basin. The boulders from the seawall will then be removed by landbased grabs. Any increase in suspended solid concentrations will thus be minimal. Upon completion of the construction works the cofferdam would be removed and the seawall reinstated.

11.8.6 High speed vessels are known to be potentially dangerous for cetaceans. Although the speed of the working vessels to be used in the present Project (mainly barges) would not be high, a speed limit for marine traffic is proposed as a precautionary measure. A speed limit of 10 knots should be strictly enforced in the works areas, in particular in the waters

between the outfall location and the navigation channel in East Lamma Channel. This particular speed limit has been applied in the Sha Chau and Lung Kwu Chau Marine Park since its establishment and appears to be effective in protecting the dolphins from vessel collisions. The mitigation measures were summarised in **Table 11.6** below.

Table 11.6
Mitigation measures recommended for Construction phase impacts of the Project

Impacts	Sources	Mitigation measures and effects
Marine water quality	Site Runoff	Good Site practices
	Construction and demolition of temporary berthing point	Deployment of silt curtains
	Construction of stilling basin	Cofferdams Dewater the site prior to using land based grab.
Marine traffic		Vessel speed limit of10 knots

11.9 RESIDUAL IMPACT

11.9.1 The construction of the outfall and stilling basin will result in some loss of subtidal muddy bottom habitat. However, the area is small (625 m^2) and the ecological value is low. This habitat loss is not expected to have a significant negative impact on local marine ecology. Residual impacts on habitat loss are acceptable.

11.9.2 No residual impacts on the Chinese White Dolphin or Finless Porpoise populations are predicted. This is because there is no overlap of the geographic distributions of dolphins and porpoises onto the waters affected during the operational phase of the proposed project. There is also no residual impact on all recognised sites of conservation importance as they are all far away from the affected waters.

11.10 ENVIRONMENTAL AUDIT AND MONITORING

11.10.1 Besides the EM&A for water quality, no specific EM&A programme for marine ecology would be required for the Project.

11.11 CONCLUSION

11.11.1 The above discussion should make it apparent that the construction and operation of the Project would have no significant impacts on Chinese White Dolphin or Finless Porpoise, as their ranges lie west and south of the project area, respectively. There is also no significant impact on all recognised sites of conservation importance as they are all far away from the affected waters. Similarly, there would be no significant impacts on horseshoe crabs because there are no recent records of juveniles or adults near the outfall portal. Although there would be some permanent subtidal seabed loss (625m^2) and replacement of artificial intertidal habitat by newly constructed portal (50m^2), in the vicinity of the outfall the seabed was not colonized by coral and the marine benthic communities were not of conservation concern. In addition the intertidal zone had been

disturbed by ongoing construction works. A well-planned program of site practices should be able to maintain the impacts to acceptable level. Specific ecological monitoring during both the construction and operational phases will not be needed.

11.12 REFERENCE

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