APPENDIX 3.6 MARINE ECOLOGICAL IMPACT ASSESSMENT FOR LUNG KWU SHEUNG TAN BARGING POINT

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APPENDIX 3.6 MARINE ECOLOGICAL IMPACT ASSESSMENT FOR LUNG KWU SHEUNG TAN BARGING POINT

Introduction

1.1 This appendix presents the marine ecological impact assessment for the proposed Lung Kwu Sheung Tan Barging Point (LKB) (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** refers). Potential impacts arising from the construction and operation of the proposed barging point on marine ecological resources were identified and evaluated. The proposed barging point at Lung Kwu Sheung Tan is located on developed land with no natural habitats. There will only be small-scaled dredging and marine works without any land-based construction activities. Therefore, no terrestrial ecological issue is considered.

Environmental Legislation, Standards, Guidelines and Criteria

1.2 Guidelines, standards, documents and ordinances / regulations listed in the following sections were referred to during the course of the ecological impact assessment.

1.3 Under the *Wild Animals Protection Ordinance* (Cap. 170), designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals, including marine cetaceans, are protected under this Ordinance.

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

1.5 The amended *Town Planning Ordinance* (Cap. 131) provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment. The authority responsible for administering the Town Planning Ordinance is the Town Planning Board.

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

1.7 Annex 16 of the EIAO-TM 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. Annex 8 recommends the criteria that can be used for evaluating habitat and ecological impact.

1.8 Annex 17 of EIAO-TM sets out the guidelines for fisheries impact assessment. Annex 9 recommends the criteria for evaluating fisheries impact.

1.9 EIAO Guidance Note No. 6/2002 clarifies the requirements of ecological assessments under the EIAO.

1.10 EIAO Guidance Note No. 7/2002 provides general guidelines for conducting ecological baseline surveys in order to fulfill requirements stipulated in the EIAO-TM.

1.11 EIAO Guidance Note No. 11/2004 provides the general guidelines for conduction marine ecological baseline survey in order to fulfill the requirements stipulated in the EIAO-TM in respect of marine ecological assessment for a proposed development.

1.12 The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red

List is to catalogue and highlight those taxa that are facing a higher risk of global extinction. The IUCN Red List also includes information on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an on-going taxon-specific conservation programme.

1.13 The Key Protected Wildlife Species List details Category I and Category II protected animal species under the PRC's Wild Animal Protection Law.

Assessment Methodology

1.14 Existing ecological baseline information was collated and reviewed through a desktop literature review. Monitoring of Chinese White Dolphin (*Sousa chinensis*) in Hong Kong waters has been undertaken by AFCD in the Hong Kong Cetacean Research Project (HKCRP), providing comprehensive data adequate for use in this study. Therefore, no further dolphin survey was conducted. Representative marine ecological surveys were conducted to fill in information gap for carrying out necessary impact assessment, as presented below. The study area for marine ecological impact assessment is the same as the water quality impact assessment. This assessment focuses only on Deep Bay Water Control Zone (WCZ) and North Western WCZ as impacts to Western Buffer and Victoria Harbour WCZs are not anticipated. **Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** shows the location of LKB.

1.15 The marine ecological impact assessment was conducted in accordance with the criteria and guidelines in Annex 8 and 16 of the EIAO-TM, EIAO Guidance Note No. 7/2002 – Ecological Baseline Survey for Ecological Assessment and EIAO Guidance Note No. 11/2004 – Methodologies for Marine Ecological Baseline Surveys.

Ecological Survey

1.16 To provide up-to-date information and fill in ecological information gaps in the study area, ecological surveys were proposed with details of the survey methodology and schedule described below. The proposed survey schedule is shown in **Table 1**.

Table 1 Ecological Survey Schedule

Survey Item	Dry Season					Wet Season	
	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09
Dive Survey				✓			
Benthos Survey			✓			✓	
Intertidal Survey		✓					✓
Horseshoe Crab Survey						✓	✓
Scoping Survey	✓						

Dive Survey

1.17 Dive survey by zig-zag dive routes (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** refers) covering the proposed dredging area and its nearby area was conducted to record presence of any corals. Subtidal substrata (hard substratum seabed, seawall, anchor of fish raft, etc.) along the proposed spot-check dive routes were also surveyed for the presence of any hard corals (order Scleractinia), octocorals (sub-class Octocorallia), or black corals (order Antipatharia).

1.18 Based on the results of the spot-check dive, more detailed surveys along four 100 m transects were carried out with reference to Rapid Ecological Assessment (REA) (see **Annex A** for details). For each transect, the locations of dive routes, distance surveyed, number of colonies, sizes and types of corals, coverage, abundance, condition, translocation feasibility, and the conservation status of coral species in Hong Kong waters were recorded. Representative photographs of subtidal habitat / species were taken.

Benthos Survey

1.19 To survey marine soft bottom benthic fauna, grab sampling of seabed sediment was carried out. Five sampling sites were proposed near the dredging area (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** refers). At each of the sampling sites, three replicates of grab samples were collected using a van Veen grab. Each grab sample covered over 0.1 m^2 of seabed substrate. Samples were then sieved through 0.5 mm sieves and stained with Rose Bengal. Collected organisms were counted, weighed and identified to the lowest practicable taxon as possible.

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

$$H' = -\sum (Ni / N) \ln (Ni / N); \text{ and}$$
$$J = H' / \ln S$$

where S is the total number of species in the sample, N is the total number of individuals, and Ni is the number of individuals of the i^{th} species.

Intertidal Survey

1.21 Survey on intertidal communities was conducted at five representative survey locations to establish the ecological profile of the artificial seawall, rocky shore and sandy shore located at and near to the proposed dredging area (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** refers).

1.22 At each survey location, a qualitative or walk-through survey was conducted to find out the intertidal flora and fauna present and their occurrence in the survey location. The sampling effort for the walk-through survey included active searching by 3 surveyors for a total of 2.5 hour at the survey locations.

1.23 Following the qualitative or walk-through survey, more detailed quantitative surveys were conducted using line transects. At each location, a transect was laid, starting from the high water mark down to low water mark during low tide period (tide below 1 m). Along each transect, standard ecological sampling quadrat of 0.5 m x 0.5 m dimension was laid at 1 m intervals (or other suitable quadrat dimension and interval distance depend on the field situation). Intertidal epifauna and flora within each quadrat were identified and enumerated. In general, mobile fauna were counted in terms of abundance per unit area. Sessile organisms such as barnacles, oysters, algae and cyanobacteria were estimated in terms of percentage cover per fixed area. Representative photographs of intertidal habitat and flora / fauna species identified were taken.

1.24 At each of the survey locations on sandy shore, three core samples using a 1,000 cm^3 hand core sampler were taken from each of the three water levels, i.e. low tide, mid tide and high tide. The collected infauna was then sieved, counted and identified to the lowest taxonomic level as far as practicable.

Horseshoe Crab Survey

1.25 A walk-through survey was conducted along the sandy and rocky shores to record the presence of any adult or juvenile horseshoe crabs during low tide period, in the season when horseshoe crabs are active and possible to be located. Special attention was paid to the search for feeding trails around tidal pools on sandy surface. Juveniles were sought for, which are often partially or completely buried by sediment. Mouths of streams were targeted for searches, as those sites yielded the greatest encounter frequency in other relevant studies.

1.26 Any horseshoe crabs encountered were photographed and identified to the lowest possible level. Any specific behaviour observed, such as feeding, mating and habitat utilization, were recorded.

Ecological Baseline Condition

1.27 The ecological baseline condition of the study area covers the following:

- Coral community;
- Benthos community;
- Intertidal community;
- Marine mammal (Chinese White Dolphin);
- Horseshoe crab;
- Marine Park, Nature Reserve and Site of Special Scientific Interest (SSSI); and
- Artificial Reef.

1.28 **Figure No. NOL/ERL/300/C/XRL/ENS/M51/059** shows the marine ecological resources within the study area of the LKB.

Coral Community

1.29 The marine water around Hong Kong (especially in the west) is relatively turbid and has low salinity, due to the influence of the Pearl River to the west. Corals mainly grow along the northeastern and eastern shores, where the waters are both sheltered and free from the influence of the Pearl River. Therefore, the general absence of hermatypic corals from the study area is not unexpected.

1.30 Dive surveys were conducted in a bay at the eastern coast of Lung Kwu Chau in North Western WCZ by the *EIA Study for Construction of Lung Kwu Chau Jetty* (CED, 2002). Numerous common blue-coloured gorgonian (*Euphexaura* sp.) and two dead colonies of the ahermatypic coral *Tubastrea* sp. were found attached to a shipwreck structure past the north of the bay. Six small colonies of *Euphexaura* sp. were also found growing on rusting steel bars in the southern section of the bay of the existing jetty. No scleractinian coral was recorded within the bay, owing to silty mud substrate, turbid waters and discharge from Pearl River, which are unsuitable for hard coral growth.

1.31 The *LNG Receiving Terminal and Associated Facilities EIA Report* (CPPL, 2006) and *Permanent Aviation Fuel Facility EIA Report* (AAHK, 2007) reviewed the findings from "EIA of the Aviation Fuel Receiving Facility" (PAA, 1995). Dive surveys were conducted in 1994 at Sha Chau and only a few hermatypic hard corals (Family Faviidae) were recorded.

1.32 Spot-check dives in the current survey were conducted in February 2009. A total of 10 spot-check dives were carried out (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** refers).

1.33 All the sites in the study area supported limited marine life. No hard coral was found in the study area. One species of gorgonian *Echinomuricea* sp. was found on boulder surfaces and along the study area at SD1 and SD2, on the vertical seawall at SD3 and on the scattered rocks at SD4. In addition, green mussel *Perna viridis* was recorded at SD1, SD2 and SD4, while rock oyster *Saccostrea cucullata* was found at SD3, SD4 and SD5, with green algae *Ulva* sp. also recorded at SD5. Only tube anemone *Cerianthus filiformis* was recorded at the muddy substrate at SD7 to SD10. No rare or species of conservation interest was recorded. The percentage cover of the gorgonian found was low (<1%) (**Table 2** refers).

Table 2 Species Coverage and Size of Coral Colonies Recorded during the Spot-Check Dive Surveys

Site	Coral Species	Coverage (%)	Size in Height (cm)
SD1	*Echinomuricea* sp.	<1	3 – 10
SD2	*Echinomuricea* sp.	<1	3 – 10
SD3	*Echinomuricea* sp.	<1	15 – 20
SD4	*Echinomuricea* sp.	<1	3 – 5

1.34 Four 100 m REA transects were surveyed following the spot-check dives. Limited marine life was observed within the REA transects. **Table 3** summarizes the ecological and substratum attributes along the four REA transects.

Table 3 Ecological and Substratum Attributes of the REA Transects

Ecological Attributes	REA 1	REA 2	REA 3	REA 4
Hard Coral	0	0	0	0
Octocoral (Soft Corals and Gorgonians)	0.5	0.5	0.5	0.5
Black Corals	0	0	0	0
Dead Standing Corals	0	0	0	0
Substratum Attributes	**REA 1**	**REA 2**	**REA 3**	**REA 3**
Bedrock / Continuous Pavement	4	4	4	0
Boulders Blocks (diam. > 50 cm)	3	3	0	5
Boulders Blocks (diam. < 50 cm)	1	1	1	1
Rubble	0	0	1	1
Other	0	0	0	0
Soft Substrata	0	0	0	0
Sand	1	1	1	1
Mud / Silt	0	0	0	0

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

1.35 Only sparse coverage of gorgonian coral *Echinomuricea* sp. (1 – 5%) was recorded during the REA surveys. A total of 45 colonies of *Echinomuricea* sp. with sizes ranged from 3 cm to 20 cm in height were recorded on the surfaces of bedrock, boulders and artificial vertical seawall along the REA transects at the depth from 2 m to 4 m. No hard coral was recorded.

1.36 *Echinomuricea* sp. is common and widespread in Hong Kong waters including turbid and harsh environment in western waters.

1.37 More detailed results of the dive surveys are provided in the **Annex B**. Representative photographs of the habitats and species recorded are shown in **Annex C**.

Benthos Community

1.38 Benthic surveys were carried out in dry and wet seasons (February and July 2004) at Black Point and Urmston Road in Deep Bay WCZ under the study for *LNG Receiving Terminal and Associated Facilities EIA Report* (CPPL, 2006). In dry season (37.4 individuals per grab from 50 genera with 90.3 g wet weight total biomass), Annelida (89.7%) were the dominant organisms recorded, followed by Arthropoda (4.2%), Echinodermata (3.1%), Mollusca (2.5%), Echiura (0.3%) and Sipuncula (0.1%), with the polychaete worm *Prionospio queenslandica* being the most abundant species. In wet season (197.9 individuals per grab from 84 genera with 712.5 g wet weight total biomass), the majority (81.5%) of organisms recorded were Mollusca, followed by Annelida (16.6%), Arthropoda

(1.3%) and Echinodermata (0.6%), with the estuarine clam *Potamocorbula laevis* being the most abundant species. No rare or uncommon species was recorded in both seasons.

1.39 According to the *EIA Study for Construction of Lung Kwu Chau Jetty* (CED, 2002), grab samples of bottom mud were obtained in November 2001 from a bay at the eastern coast of Lung Kwu Chau in the North Western WCZ. The site comprised dark olive green homogenous viscous silty mud and no macroscopic benthic organism was recorded.

1.40 The *Permanent Aviation Fuel Facility EIA Report* (AAHK, 2007) reviewed the findings from "Environmental Monitoring and Audit for Contaminated Mud Pits IV at East Sha Cha" in North Western WCZ. Macro-epifauna invertebrate surveys were conducted in dry and wet seasons (January and October 2005) by demersal trawls. Crustaceans, especially crabs (about 28% in dry season and 33% in wet season) and molluscs, especially snails and sea slugs (about 27% in dry season and 18% in wet season) were the top two dominant species in terms of total number of species recorded. The epifauna diversity recorded was considered to be low ($H' < 2$), which may reflect both the natural stresses such as periodic fluctuations in the physicochemical environment associated with the Pearl River run-off and anthropogenic impacts such as trawling pressures.

1.41 The *EIA Study for Upgrading of Pillar Point Sewage Treatment Works* (DSD, 2008) reviewed the findings from *Consultancy Study on Marine Benthic Communities in Hong Kong* (AFCD, 2002). Polychaete annelids (46.9% of total species), crustaceans (18.2%) and bivalves (11.1%) were the most abundant groups recorded in the Deep Bay, North Western and Western WCZs, with $H' < 2$ and $J < 0.8$ in general. Deep Bay WCZ had lower species diversity and evenness when compared with the eastern and southern waters, reflecting the response of benthic communities to influence of the Pearl River, discharge of freshwater from the Shenzhen River and high trawling pressure.

1.42 With reference to *Shenzhen Western Corridor EIA Report* (HyD, 2002b), benthic surveys were conducted in dry season and wet season (October 2001 and January 2002) near Sheung Pak Nai and Ngau Hom Shek in the Deep Bay WCZ. Polychaete constituted the main component of the organisms recorded in the surveys (21 of 29 total species recorded). In terms of abundance, annelida and phoronida constituted approximately 90% of the total organisms recorded. The benthic fauna diversity was low, with H' ranging from 0.76 to 1.56. No rare species was found in the samples.

1.43 In the current survey, dry season and wet season marine grab sampling were conducted in January and April 2009. The sediment at the study area at Lung Kwu Sheung Tan consisted of about 65% silt-clay fraction (particle diameter <64 μm) and 35% coarse materials (gravels, coarse sand, broken shells of molluscs and crustaceans). The sediment was grey in colour and no special odour was detected.

1.44 A total of approximately 2,000 and 900 organisms were collected in dry and wet season surveys. Out of the 114 taxa recorded, 108 taxa were identified to genus or species levels. The most diverse phylum was polychaetes (56 species) followed by crustaceans (23 species), molluscs (20 species), echinoderms (5 species), cnidarians (3 species), echiurans (2 species), and sipunculan (1 species).

1.45 In dry season, 49%, 39% and 11% of organisms collected (in terms of number of individuals) were polychaetes, crustaceans and other phyla, respectively. The total biomass (wet weight) was 64.75 g, in which 30%, 27%, 16%, 13%, 11%, and 3% of total biomass were accounted by crustaceans, echiurans, polychaetes, molluscs, echinoderms and other phyla, respectively. In wet season, 68%, 15%, 9% and 8% of organisms collected were polychaetes, molluscs, crustaceans, and other phyla respectively. The total biomass was 85.60 g, in which 66%, 14%, 9%, 5% and 5% of total biomass were accounted by echinoderms, crustaceans, molluscs, polychaetes, and other phyla respectively. **Table 4** lists the total abundance and biomass of each faunal group.

Table 4 Total Abundance and Biomass of Each Faunal Group

Faunal Group	No. of Individuals	Percentage (%)	Biomass (g)	Percentage (%)
Dry Season				
Polychaeta	941	49	10.1534	16
Crustacea	757	39	19.7107	30
Mollusca	99	5	8.3718	13
Nemertea	47	2	0.9745	2
Cnidaria	45	2	0.4529	1
Echinodermata	26	1	7.3581	11
Echiura	16	1	17.6814	27
Sipuncula (1)	8	0	0.0490	0
Total	**1,939**	**-**	**64.7518**	**-**
Wet Season				
Polychaeta	615	68	4.5522	5
Mollusca	133	15	7.6516	9
Crustacea	84	9	12.3144	14
Echinodermata	41	5	56.8245	66
Nemertea (1)	26	3	0.4219	0
Cnidaria (1)	4	0	3.0011	4
Platyhelminthes (1)	1	0	0.0029	0
Echiura (1)	1	0	0.5115	1
Fish (1)	1	0	0.3245	0
Total	**906**	**-**	**85.6046**	**-**

Note:
(1) 0% means total individual / biomass of the faunal group is less than 1% of all organisms recorded.

1.46 In dry season, the total number of species, abundance and biomass ranged between 38 – 59 spp. 0.3 m^{-2}, 493 – 1,960 individual m^{-2} and 23.7 – 56.4 g m^{-2}, respectively among the five sampling points. In wet season, the number of species and abundance decreased to 20 – 43 spp. 0.3 m^{-2} and 263 – 1,097 individual m^{-2} with total biomass ranged between 16.9 – 112.4 g m^{-2}. The *H'* and *J* ranged between 2.12 – 3.05 and 0.55 – 0.81 respectively during the surveys with no seasonal pattern (**Table 5**).

Table 5 Total Number of Species, Abundance, Biomass, Species Diversity and Evenness at Each Sampling Point

	B1	B2	B3	B4	B5
Dry Season					
Total No. of species (spp. 0.3 m^{-2})	46	53	59	38	54
Total abundance (individual m^{-2})	1,770	1,960	1,043	493	1,197
Total biomass (g m^{-2})	23.7	56.4	26.1	54.9	54.8
Species diversity (*H'*)	2.12	2.94	3.03	2.80	2.58
Species evenness (*J*)	0.55	0.74	0.74	0.77	0.65
Wet Season					
Total No. of species (spp. 0.3 m^{-2})	20	40	31	43	36
Total abundance (individual m^{-2})	263	1,097	433	553	673
Total biomass (g m^{-2})	38.7	16.9	40.8	76.7	112.4

	B1	B2	B3	B4	B5
Species diversity (*H'*)	2.24	2.87	2.19	3.05	2.58
Species evenness (*J*)	0.75	0.78	0.64	0.81	0.72

1.47 In dry season, polychaetes and crustaceans were the dominant groups at all sampling points that they constituted more than 80% of total abundance. In wet season, polychaetes became the dominant group with more than 60% of total abundance. The study area was dominated by amphipods and polychaetes *Prionospio malmgreni* and *Mediomastus* sp. The presence of abundant amphipods and these two polychaete species indicates an organic-enriched environment in Lung Kwu Sheung Tan. **Table 6** and **Table 7** show the proportion of each faunal group (in total abundance) and the five most abundant species at each sampling point. All the species recorded are common and no rare species or species with conservation importance was found.

Table 6 Percentage Proportion of Faunal Groups (in Total Abundance) at Each Sampling Point

% Proportion of Faunal Groups	B1	B2	B3	B4	B5
Dry Season					
Polychaeta	41	64	49	53	32
Crustacea	54	23	36	30	50
Mollusca	1	7	7	4	6
Others	4	6	8	14	12
Wet Season					
Polychaeta	82	61	77	65	70
Mollusca	3	27	3	13	9
Crustacea	10	7	12	7	12
Others	5	5	8	15	9

Table 7 The Five Most Abundant Species at Each Sampling Point

Sampling Point	Group [(1)]	Species	Mean Density (individual m^{-2})	Mean Biomass (g m^{-2})	Relative Abundance (%)
Dry Season					
B1	C	Amphipod spp.	923	0.41	52.2
	P	*Prionospio malmgreni*	250	0.54	14.1
	P	*Phylo ornatus*	67	0.05	3.8
	P	*Eunice indica*	53	1.09	3.0
	P	*Glycinde gurjanovae*	40	0.03	2.3
B2	P	*Prionospio malmgreni*	907	2.98	23.1
	C	Amphipod spp.	667	0.35	17.0
	M	*Ruditapes philippinarum*	253	4.56	6.5
	P	*Phylo ornatus*	173	0.19	4.4
	P	*Glycera alba*	173	0.27	4.4
B3	C	Amphipod spp.	660	0.43	31.6
	P	*Mediomastus* sp.	200	0.95	9.6
	P	*Prionospio malmgreni*	180	0.53	8.6
	N	Nemertean spp.	53	0.63	2.6

Sampling Point	Group (1)	Species	Mean Density (individual m^{-2})	Mean Biomass (g m^{-2})	Relative Abundance (%)
	P	*Glycinde gurjanovae*	53	1.01	2.6
B4	C	Amphipod spp.	233	0.14	23.6
	P	*Mediomastus* sp.	207	1.87	20.9
	Eh	*Urechis* sp.	73	74.60	7.4
	P	*Ceratonereis marmorata*	67	0.06	6.8
	N	Nemertean spp.	27	0.10	2.7
B5	C	Amphipod spp.	1,093	0.40	45.7
	Cn	*Cerianthus filiformis*	167	1.14	7.0
	P	*Mediomastus* sp.	120	0.63	5.0
	P	*Prionospio malmgreni*	93	0.19	3.9
	P	*Notomastus* sp.	67	0.28	2.8
Wet Season					
B1	P	*Mediomastus* sp.	83	0.18	31.6
	P	*Prionospio malmgreni*	63	0.11	24.1
	P	*Sigambra hanaokai*	20	0.00	7.6
	C	Amphipod spp.	17	0.01	6.3
	P	*Glycera chirori*	13	0.50	5.1
B2	P	*Prionospio malmgreni*	220	0.19	20.1
	M	*Ruditapes philipinarum*	167	3.93	15.2
	P	*Schistocomus* sp.	107	0.08	9.7
	P	*Phylo ornatus*	100	0.05	9.1
	C	Amphipod spp.	63	0.02	5.8
B3	P	*Mediomastus* sp.	217	0.46	50.0
	C	Amphipod spp.	37	0.01	8.5
	P	*Glycera chirori*	27	0.77	6.2
	P	*Sigambra hanaokai*	20	0.00	4.6
	Ec	*Protankyra bidentata*	20	28.03	4.6
B4	P	*Mediomastus* sp.	160	0.41	28.9
	P	*Tharyx* sp.	33	0.07	6.0
	N	Nemertean spp.	30	0.45	5.4
	Ec	*Protankyra bidentata*	30	39.08	5.4
	P	*Ophiodromus angutifrons*	23	0.02	4.2
B5	P	*Mediomastus* sp.	263	1.09	39.1
	C	Amphipod spp.	57	0.06	8.4
	Ec	*Protankyra bidentata*	43	88.38	6.4
	P	*Tharyx* sp.	37	0.08	5.4
	P	*Ehlersileanira hwanghaiensis*	33	0.03	5.0

Note:
(1) P=Polychaeta; C=Crustacea; M=Mollusca; Ec=Echinodermata; N=Nemertea; Eh=Echiura; Cn=Cnidaria

1.48 The benthic community was spatially divided into four groups in Hong Kong waters (Shin *et al.*, 2004). The benthic community at Lung Kwu Sheung Tan had a relatively high diversity and low evenness (**Table 8** refers). The high biodiversity in Lung Kwu Sheung Tan is owing to the high number of

species recorded. As the non-dominant species was present in relatively low density, the species evenness in the study area was low.

Table 8 Mean *H'* and *J* of Benthos Communities at Different Waters

Water Zone	Lung Kwu Sheung Tan	Tolo Harbour	Eastern and Southern Waters	Victoria Harbour	Deep Bay
H'	2.64	1.36	2.82	1.64	2.32
J	0.72	0.83	0.81	0.44	0.73

Intertidal Community

1.49 The intertidal surveys for *LNG Receiving Terminal and Associated Facilities EIA Report* (CPPL, 2006) including natural shoreline, artificial shoreline and artificial seawall were conducted in dry season and wet season (March and July 2004) on the shores of Black Point in the Deep Bay WCZ. The high intertidal zone was dominated by littorinid snails including *Nodilittorina radiata*, *Nodilittorina vidua* and *Littoraria articulata* in dry season. Snails (*Monodonta labio* and *Planaxis sulcatus*), predatory gastropod (*Thais clavigera*) and limpets (*Nipponacmea concinna* and *Siphonaria japonica*) were found in mid and low intertidal zones. Rock oyster (*Saccostrea cucullata*), barnacles (*Capitulum mitella*, *Tetraclita japonica*, *Tetraclita squamosa* and *Balanus amphitrite*) and algae (*Ulva* sp. and encrusting algae) were also recorded on the shores. A total of 21 species were recorded on the natural and artificial shores with low abundance except littorinid snails. The species composition of the intertidal organisms in wet season was similar to that of dry season, with the total abundance of the organisms found in wet season was lower in general. All the species found were common and widespread.

1.50 According to the *EIA Study for Construction of Lung Kwu Chau Jetty* (CED, 2002), intertidal surveys on rocky and sandy shores were conducted along the eastern coast of Lung Kwu Chau in North Western WCZ. Littorinids and sea slaters (*Ligia exotica*) were the most common species observed in the higher zone of the rocky shore. Snails *Monodonta* spp. and *Nerita* spp. were found lower down the shore. On the mid shore, crustose algae *Hildenbrandia*, limpet *Tetraclita squamosa* and stalked barnacle (*Capitellum mitella*) were recorded. Rock oyster (*Saccostrea cucullata*) was observed in lower shore. In winter, the lower shore was dominated by macroalgae *Enteromorpha* and *Ulva*, as well as *Sargassum*. The species found were common and widespread on Hong Kong rocky shores. No macro-invertebrate was recorded on sandy shore, owing to the coarse grain size and thus limiting water retention and leading to desiccation. Only one large ghost crab (*Ocepode certophthalmus*) was recorded near a small number of burrows on sandy shore.

1.51 The *EIA Study for Upgrading of Pillar Point Sewage Treatment Works* (DSD, 2008) reviewed the findings from "Biological Monitoring in Sha Chau and Lung Kwu Chau Marine Park" (Put O Ang, Jr. *et al.*, 2005). Intertidal surveys were carried out on rocky shores at Sha Chau and Lung Kwu Chau in North Western WCZ. *Littoraria articulata*, *Saccostrea cucullata*, *Balanus amphitrite*, *Tetraclita squamosa*, *Echinolittorina trochoides*, *Septifer virgatus* and juvenile snails (<1 mm) were the dominant species. The species recorded were common and widespread in Hong Kong and no rare species was recorded.

1.52 With reference to the *Shenzhen Western Corridor EIA Report* (HyD, 2002b), surveys on intertidal community were conducted at Ngau Hom Shek, Ngau Hom Sha and Sheung Pak Nai in Deep Bay WCZ. Mudskipper and crab species (*Macrophthalmus* and Grapsid crabs) were the dominant intertidal epifauna on mudflat, with rock oyster (*Saccostrea cucullata*) occasionally recorded. Annelids, bivalves and crustaceans were the dominant infauna recorded, with polychaete (*Neanthes glandicincta*) being the most common and abundant infauna. No rare species was recorded. Yet, seagrass *Halophila beccarii* was recorded on the south shore of Deep Bay on the seaward side of mangrove communities and near stream months.

1.53 From the *Deep Bay Link EIA Study* (HyD, 2002a), intertidal surveys on mudflat and mangrove were conducted at Ngau Hom Shek in the Deep Bay WCZ. Epifauna was dominated by molluscs, while

crab and mudskipper were the most dominant species found in burrows of mudflat for macro-infauna. For benthic infauna, 719 macro-benthic organisms from 25 taxa were reported. Polychaete worms dominating with Terebellidae and Nereidae being the most abundant. Several small patches of seagrass *Halophila beccarii* were found on the intertidal shore at Ngau Hom Shek.

1.54 Intertidal surveys in the current study were conducted in dry and wet seasons in December 2008 and May 2009. Three types of intertidal habitats, including vertical seawall (T1 and T2), rocky shore (T3) and sandy shore (T4 and T5) were recorded within the study area (**Annex C** refers). A total of 57 intertidal species were observed during the walk-through survey (**Table 9** refers).

1.55 In addition to the above intertidal species recorded during the walk-through survey, 15 colonies of hard coral *Oulastrea crispata* and 11 colonies of gorgonian coral *Echinomuricea* sp. were found exposed on boulders at middle zone of the rocky shore (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/058** and **Annex C** refer). The size of corals recorded were small (i.e. approximately 1 cm in diameter for *Oulastrea crispata* and 1 – 5 cm in height for *Echinomuricea* sp.) and they are located approximately 260 m from the works area.

1.56 *Oulastrea crispata* has a wide range of adaptations to different environmental conditions (including those unfavourable to most corals) and locations (Chen e*t al.,* 2003). It is common and widespread in Hong Kong marine waters, especially those more turbid and harsh environment in the western waters (Chan *et al.,* 2005). *Oulastrea crispata* is protected by the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).

Table 9 Intertidal Species Recorded during the Walk-through Survey

Scientific Name	Abundance in Hong Kong
Limpets/False Limpets	
Patelloida pygmaea	Common
Cellana grata	Common
Cellana toreuma	Common
Nipponacmea concinna	Common
Siphonaria japonica	Common
Chitons	
Acanthopleura japonica	Common
Periwinkles	
Littoraria articulata	Common
Echinolittorina radiata	Common
Echinolittorina trochoides	Common
Echinolittorina vidua	Common
Topshells	
Monodonta labio	Common
Turban Shells	
Lunella coronata	Common
Whelks	
Thais clavigera	Common
Thais luteostoma	Common
Morula musiva	Common
Nerites	
Nerita albicilla	Common
Nerita costata	Common
Planaxid Snails	
Planaxis sulcatus	Common
Ceriths	
Nassarius festivus	Common
Barnacles	
Tetraclita japonica	Common
Tetraclita squamosa	Common
Chthamalus malayensis	Common

Scientific Name	Abundance in Hong Kong
Balanus amphitrite	Common
Megabalanus volcano	Common
Bivalves	
Barbatia virescens	Common
Perna viridis	Common
Septifer virgatus	Common
Saccostrea cucullata	Common
Tapes variegates	Common
Scapharca cornea	Common
Algae	
Ulva sp.	Common
Endarachne binghamiae	Common
Enteromorpha spp.	Common
Pseudulvella applanata	Common
Gelidium pusillum	Common
Hildenbrandia rubra	Common
Chroococcus sp.	Common
Sea Anemones	
Haliplanella lineata	Common
Hermit Crabs	
Clibanarius virescens	Common
Clibanarius infraspinatus	Common
Pagurus dubius	Common
Diogenes spinifrons	Common
True Crabs	
Hemigrapsus sanguineus	Common
Charybdis acutifrons	Common
Thalamita crenata	Common
Ocypode sp. (burrows)	Common
Shrimps	
Palaemon serrifer	Common
Alpheus sp.	Common
Sea Slaters	
Ligia exotica	Common
Tubeworms	Common
Amphipods	Common
Worm Snails	
Serpulorbis imbricatus	Common
Sea Squirts	
Styela plicata	Common
Ear Shells	
Sinum spp.	Common
Fishes	
Takifugu niphobles	Common
Ambassis gymnocephalus	Common
Eel sp.	Common
Corals	
Oulastrea crispata	Common
Echinomuricea sp.	Common

1.57 Five representative transects were laid on the artificial seawall, rocky shore and sandy shore based on the results from the walk-through survey. Periwinkles *Littoraria articulata* and *Echinolittorina radiata* were the dominant species in the upper zone of the vertical seawalls, while rock oyster (*Saccostrea cucullata*) was found dominating the lower zone (**Annex D** refers). Encrusting algae

Hildenbrandia lineata and *Pseudulvella applanata*, and erect algae *Ulva* sp. and *Gelidium pusillum* of low coverage were also recorded at the vertical seawalls.

1.58 Bivalves *Perna viridis*, *Septifer virgatus* and *Saccostrea cucullata*, and barnacle *Balanus amphitrite* were recorded in middle to high zone of the rocky shore. *Echinolittorina trochoides*, *Littoraria articulata* and Nerites *Nerita albicilla* were the dominant species in upper shore. Ceriths *Nassarius festivus* and *Batillaria zonalis* were dominating the middle shore, with whelks *Thais luteostoma* and *Morula musiva*, and limpet *Nipponacmea concinna* also recorded. A tubeworm species of high abundance was also found dominating the lower to middle shore. In the rocky shore, only three types of algae including *Ulva* sp. and encrusting algae *Gelidium pusillum* and *Hildenbrandia occidentalis* were recorded in the upper shore, while hermit crab *Pagurus dubius* was found in different zones in occasion (**Annex D** refers).

1.59 Only five individuals of amphipod species and tubeworm were found buried in the sand and attached on rubbles in the sandy shore, respectively. Amphipods were also recorded in the core samples of upper and middle sandy shore (**Annex D** refers).

1.60 In total, there were 59 species recorded in the intertidal communities at Lung Kwu Sheung Tan. All of the recorded species were of low abundance except the tubeworm. The species were common and widespread, and a locally very common protected coral species (*Oulastrea crispata*) was recorded (**Annex D** refers).

Marine Mammal

1.61 Sixteen species of cetaceans have been recorded in Hong Kong waters, but only Chinese White Dolphin (local name of Indo-Pacific humpback dolphin *Sousa chinensis*) and Finless Porpoise (*Neophocaena phocaenoides*) reside in Hong Kong (AFCD, 2007). In the study area, only Chinese White Dolphin was recorded. Chinese White Dolphins prefer estuarine habitat and usually live in the areas influenced by freshwater input from the Pearl River.

1.62 Chinese White Dolphin is locally protected by the Wild Animals Protection Ordinance (Cap. 170). Internationally it is categorized as “Near Threatened” by the IUCN Red List of Threatened Species and in “Appendix I” in the CITES. In China, Chinese White Dolphin is listed as a “Category I National Key Protected Species”. Updated information on Chinese White Dolphin sightings made in 2007 – 2008 as reported in *Monitoring of Marine Mammals in Hong Kong Waters – Data Collection Final Report* (Hung, 2008) was discussed below.

Sightings and Distribution

1.63 Detailed dolphin surveys were conducted from April 2007 to April 2008 in different line-transect survey areas, including Deep Bay, Northwest Lantau, Northeast Lantau, West Lantau, Southwest Lantau, Southeast Lantau, Lamma and Po Toi, to determine the abundance and habitat use for Chinese White Dolphin (Hung, 2008). The Deep Bay and Northwest Lantau survey areas are within the Deep Bay and North Western WCZs, which are the most relevant to our study area. A total of 344 groups of Chinese White Dolphins, numbering 1,109 individuals, were sighted in these surveys. Most of the dolphin groups were sighted in West Lantau (152 groups) and Northwest Lantau (111 groups). In addition, 37 sightings were made in Southwest Lantau, and 36 sightings were made in Northeast Lantau. Only a few sightings were made in Deep Bay (4), Lamma (2) and Southeast Lantau (2). In West Lantau, dolphins were frequently sighted throughout the entire survey area, especially along the stretch of waters between Tai O Peninsula and Kai Kung Shan. Dolphin sightings were concentrated in several areas in North Lantau region, including the waters east of Lung Kwu Chau, between Lung Kwu Chau and Black Point, near Pak Chau and around the Brothers. In contrast, dolphins generally avoided the area off Castle Peak Bay, Lung Kwu Tan, around Chek Lap Kok Airport platform, and the eastern end of Northeast Lantau.

1.64 Encounter rates of Chinese White Dolphins (number of on-effort sightings per 100 km of survey effort) were examined in the four main survey areas where Chinese White Dolphins commonly occurred (Northeast Lantau, Northwest Lantau, West Lantau and Southwest Lantau) to determine the areas of importance to dolphins (Hung, 2008). Among the four survey areas, dolphin encounter rate was the highest in West Lantau (26.1 sightings per 100 km), which was 2.5 times higher than in Northwest

Lantau (10.5), and 6 – 7 times higher than in Northeast Lantau (4.7) and Southwest Lantau (3.7). In addition, West Lantau recorded the highest encounter rate in all four seasons and the relative importance of the four survey areas has been consistent in the past six years of monitoring, with much higher encounter rate recorded in West Lantau than in Northwest Lantau, Northeast Lantau and Southwest Lantau. Therefore, West Lantau has been the most important dolphin habitat since regular surveys began there in 2002.

1.65 Seasonal variation in dolphin encounter rates was evident in the survey period from 2007 to 2008. Winter months recorded a lower encounter rate (8.1 sightings per 100 km of survey effort) than that of the other three seasons (10.0 – 11.2). In Northwest Lantau (the closest proximity to the study area at Lung Kwu Sheung Tan), encounter rates were higher in spring and autumn (>10 sightings per 100 km survey effort) than in summer and winter (<10). In general, higher encounter rates were usually recorded in summer and autumn months and lower in spring months in 2002 – 2007.

Habitat Utilization

1.66 Quantitative grid analysis (1 km^2 grids) of habitat use by Chinese White Dolphins was conducted by Hung (2008). SPSE (number of on-effort sightings per 100 units of survey effort) and DPSE (number of dolphins from on-effort sighting per 100 units of survey effort) were determined. SPSE and DPSE provided information on the frequency of sightings and the relative density of dolphins within a grid, respectively. The waters between Lung Kwu Chau and Black Point as well as the west coast of Lantau were the most heavily utilized habitats by Chinese White Dolphins in 2007 – 2008. A number of grids recorded very high SPSE and DPSE values near Lung Kwu Chau and Black Point in Northwest Lantau, while almost all of the grids were utilized by Chinese White Dolphins in West Lantau in 2007 – 2008. High dolphin densities could be found at grids near Tai O Peninsula, Kai Kung Shan and Fan Lau in West Lantau. All survey effort and on-effort sightings from 2002 – 2007 were also pooled for calculation of SPSE and DPSE values to examine dolphin habitat use in recent years. Most grids in Northwest Lantau, Northeast Lantau and West Lantau were utilized by dolphins with different intensities during the six-year monitoring. West Lantau appeared to be the most important dolphin habitat in Hong Kong, with very high SPSE and DPSE values recorded in the majority of grids (e.g. near Tai O Peninsula, Kai Kung Shan, Peaked Hill and Fan Lau). In Northwest Lantau, the area all around Lung Kwu Chau (especially the east and northeast of the island) recorded high dolphin densities. All these habitats (West Lantau and the area around Lung Kwu Chau in Northwest Lantau) should be considered as the most important habitats to Chinese White Dolphins in recent years.

Dolphin Surveys from other Studies

1.67 Aerial dolphin surveys were conducted monthly from November 2001 to March 2002 in the Deep Bay and northern part of Northwest Lantau under the study for "Shenzhen Western Corridor EIA Report" (HyD, 2002b). A total of 20 sightings were made during the monitoring period, including 13 sightings at the mouth of Deep Bay, five sightings between Lung Kwu Chau and Black Point, and two sightings at the east of Lung Kwu Chau.

1.68 Vessel-based surveys were undertaken monthly from July 2005 to May 2006 in Northwest Lantau (only the western portion) and Deep Bay (only the southern portion) by the "LNG Receiving Terminal and Associated Facilities EIA Report" (CPPL, 2006). Sixty-two and 25 sightings of Chinese White Dolphins were made in Northwest Lantau and Deep Bay, respectively. Dolphins were observed throughout the survey areas except directly south of the Sha Chau and Lung Kwu Chau Marine Park and the very northern end of the Deep Bay survey area. Northwest Lantau had higher levels of dolphin density and abundance than Deep Bay.

Marine Mammals at Lung Kwu Sheung Tan

1.69 Lung Kwu Sheung Tan is not considered as an important habitat for Chinese White Dolphin when compared with other waters in the North Western WCZ. Only low occurrence and low density of Chinese White Dolphin was observed in the waters surrounding the proposed works area of the LKB in recent years and no Chinese White Dolphin was recorded in 2007 – 2008 (**Annex E** refers).

Horseshoe Crab

1.70 Three species of horseshoe crab have been reported in Hong Kong waters (*Tachypleus tridentatus*, *Carcinoscorpius rotundicauda* and *Tachypleus gigas*). Adult horseshoe crabs occur in shallow to deep local waters. They were occasionally fished up by trawlers fishing in waters off Sai Kung, Lamma Island and Lantau Island. Juvenile horseshoe crabs were found on some sandy beaches or mudflats in Deep Bay and Lantau Island (AFCD, 2009).

1.71 From the *Shenzhen Western Corridor EIA Report* (HyD, 2002b), part of an adult horseshoe crab carapace was found on the mudflat at Sheung Pak Nai in Deep Bay WCZ in September 2001. A juvenile horseshoe crab *Tachypleus tridentatus* was also found semi-buried near seagrass beds at Ngau Hom Sha in the Deep Bay WCZ in October 2001.

1.72 The *Permanent Aviation Fuel Facility EIA Report* (AAHK, 2007) and *EIA Study for Upgrading of Pillar Point Sewage Treatment Works* (DSD, 2008) reviewed numerous literature on horseshoe crabs in Hong Kong waters (CED, 1997; Huang, 1997; Chiu and Morton, 1999; Fong, 1999; MTRC, 2003; HyD, 2004 and CEDD, 2005). Five individuals of *Tachypleus tridentatus* and an unknown juvenile were recorded in Lung Kwu Sheung Tan from 1987 – 1998 (Chiu and Morton, 1999). No further horseshoe crab species has been reported in Lung Kwu Sheung Tan since 1998. Horseshoe crabs were also recorded from Sha Chau and Lung Kwu Chau Marine Park in North Western WCZ (*Tachypleus tridentatus*, *Carcinoscorpius rotundicauda* and *Tachypleus gigas*), Nim Wan in the Deep Bay WCZ (unknown juvenile) and other more distant locations such as The Brothers, Sha Lo Wan, San Tau, Tung Chung Wan, Sham Wat and Tai Ho Wan in the North Western WCZ.

1.73 Shin *et al.* (2007) provided updated information of the local distribution of horseshoe crabs in Hong Kong. A total of 17 sites were surveyed for horseshoes crabs from 2004 – 2006. *Tachypleus tridentatus* had been recorded in Tsim Bei Tsui (4 individuals), Pak Nai (1) and Ha Pak Nai (7 at two survey sites) in the Deep Bay WCZ by random sampling in 2004 – 2005. Two and one individuals of *Tachypleus tridentatus* were also found at more distant locations in San Tau and Yi O in the North Western WCZ, respectively. More individuals of *Tachypleus tridentatus* were recorded by walk-through surveys (4 in Tsim Bei Tsui, 10 in Pak Nai, 11 in the two sites of Ha Pak Nai, 10 in San Tau, 2 in Sham Wat, 2 in Yi O and 1 in Tung Chung). In addition, *Carcinoscorpius rotundicauda* were also recorded in both the Deep Bay WCZ (7 individuals in Tsim Bei Tsui, 1 in Sheung Pak Nai, 7 in Pak Nai, 5 in the two sites of Ha Pak Nai) and the North Western WCZ (2 in Tai Ho Wan, 1 in Yi O, 1 in Tung Chung) by walk-through surveys.

1.74 Horseshoe crab surveys in the current study were conducted in the wet season in April and May 2009. No horseshoe crab was found on the Lung Kwu Sheung Tan area.

Horseshoe Crab at Lung Kwu Sheung Tan

1.75 Lung Kwu Sheung Tan is not considered as an important habitat for horseshoe crabs when compared with other waters in the Deep Bay WCZ and the North Western WCZ. No further horseshoe crab species has been reported in Lung Kwu Sheung Tan since 1998.

Marine Park, Nature Reserve and Site of Special Scientific Interest (SSSI)

Sha Chau and Lung Kwu Chau Marine Park

1.76 Sha Chau and Lung Kwu Chau Marine Park is located in the western waters of Hong Kong (in the North Western WCZ), which is located approximately 2.5 km from the proposed LKB. It encloses three islands including Sha Chau, Lung Kwu Chau and Pak Chau. Sha Chau and Lung Kwu Chau Marine Park was designated on 22nd November 1996, covering a total sea area of about 1,200 ha. Being located in the Pearl River Estuary, the water is greatly influenced by the freshwater discharge. In these marine conditions, Sha Chau and Lung Kwu Chau Marine Park is rich in estuarine resources. More than 50 fish species have been recorded in the area, with Belanger's croaker and Japanese sillago being the most abundant species. The rich fish resources with Sha Chau and Lung Kwu Chau Marine Park provide a feeding ground for Chinese White Dolphin. A major function of the marine park is therefore to protect the Chinese White Dolphin.

Mai Po Nature Reserve and Mai Po Inner Deep Bay Ramsar Site

1.77 The wetland in the Mai Po and Inner Deep Bay region (in the Deep Bay WCZ) was declared a Wetland of International Importance, or Ramsar Site, under the Ramsar Convention on 4th September 1995. The Mai Po Inner Deep Bay Ramsar Site covers an area of 1,500 ha of fishponds, *gei wai* and intertidal mudflats. This site is recognized as an important feeding ground for migrant and winter visiting birds, particularly wetland-dependent species which include a number of globally-threatened species. In addition, the Mai Po Inner Deep Bay Ramsar Site is also the home for a number of restricted-range invertebrates.

Site of Special Scientific Interest (SSSI)

1.78 Lung Kwu Chau, Tree Island and Sha Chau SSSI (in the North Western WCZ) was designated in 1979 for its importance to night-time roosting Cormorants.

1.79 Pak Nai SSSI (in the Deep Bay WCZ) was designated in 1980 due to its importance as a high tide roost for gulls and terns. It is an important foraging site for many wetland bird species including the endangered Saunders's Gull *Larus saundersi*.

1.80 The area of mangroves and *gei wai* known as Mai Po Marshes (in the Deep Bay WCZ) was designated as SSSI in 1976 for its botanical and ornithological value. Adjacent to the Mai Po mangroves at their seaward edge is the Inner Deep Bay SSSI (in the Deep Bay WCZ) established in 1986 to protect the Inner Deep Bay mudflats. Tsim Bei Tsui SSSI was designated in 1986 to protect mangroves communities, while Tsim Bei Tsui Egretry SSSI was established in 1989 to protect an egretry (in the Deep Bay WCZ). Wetland Conservation Area (WCA) and Wetland Buffer Area (WBA) were established in 1999 around Mai Po and the Inner Deep Bay mudflats, with the goal of prohibiting development incompatible with conservation of the area's natural value.

Artificial Reefs

1.81 Two artificial reefs have been deployed in 2000 in the North Western WCZ at Sha Chau and near the Hong Kong International Airport (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/059** refers). Artificial reefs are deployed to enhance marine resources, rehabilitate degraded habitats, protect spawning and nursery grounds and protected areas, and enhance habitat quality in open seabed areas. The artificial reefs at Sha Chau are located approximately 6.5 km from the LKB.

Ecological Value

1.82 Based on the available literature and current ecological survey results discussed above, the ecological value of marine ecological resources present within the study area have been assessed and evaluated in accordance with the EIAO-TM Annex 8 (**Table 10 – Table 13** refer).

Table 10 Ecological Evaluation of Subtidal Hard Substrate Habitat and Soft Bottom Habitat within the Study Area

Criteria	Subtidal Hard Substrate Habitat	Soft Bottom Habitat
Naturalness	The area is made up of artificial vertical seawalls, artificial slopping boulders and bedrock.	Natural habitat with limited disturbance (e.g. activities from fishing vessels)
Size	Small.	Small.
Diversity	Low.	Moderate.
Rarity	No rare species found. Only gorgonian coral *Echinomuricea* sp. was recorded.	No rare species found.
Re-creatability	High.	Easily recreated as disturbed soft-bottom sediments readily re-colonised.
Fragmentation	N/A.	N/A.
Ecological linkage	Ecological linkage to other valuable ecological resources was not observed.	The habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.

Criteria	Subtidal Hard Substrate Habitat	Soft Bottom Habitat
Potential value	Low.	Low.
Nursery / breeding ground	Nursery / breeding activity was not observed.	Nursery / breeding activity was not observed.
Age	N/A.	N/A.
Abundance / Richness of wildlife	Low.	Low.
Ecological Value	Low.	Low.

Table 11 Ecological Evaluation of Intertidal Habitats within the Study Area

Criteria	Intertidal Habitats
Naturalness	The area is made up of artificial vertical seawalls, artificial sloping boulders, rocky shore and sandy beach.
Size	Small.
Diversity	Low.
Rarity	No rare species found in the current survey although horseshoe crabs were previously recorded. Small colonies of hard coral *Oulastrea crispata* and gorgonian coral *Echinomuricea* sp. were recorded.
Re-creatability	Habitat can be recreated for sandy beach, vertical seawalls and artificial sloping boulders.
Fragmentation	N/A.
Ecological linkage	Ecological linkage to other valuable ecological resources was not observed.
Potential value	Low.
Nursery / breeding ground	Nursery / breeding activity was not observed.
Age	N/A.
Abundance / Richness of wildlife	Low.
Ecological Value	Low.

Table 12 Ecological Evaluation of Marine Park and Artificial Reefs within the Study Area

Criteria	Sha Chau and Lung Kwu Chau Marine Park	Artificial Reefs
Naturalness	Natural habitat.	Low. The artificial reefs are man-made and artificial.
Size	Small.	Small.
Diversity	High.	Moderate.
Rarity	Important habitat for the rare and protected Chinese White Dolphin *Sousa chinensis*.	No rare species was recorded.
Re-creatability	Low.	High.
Fragmentation	N/A.	N/A.
Ecological linkage	Chinese White Dolphin habitats extend in all directions along the coastal waters of the Marine Park.	Link to the marine habitat for Chinese White Dolphin and possibly enhance its food availability.
Potential value	High.	Moderate.

Criteria	Sha Chau and Lung Kwu Chau Marine Park	Artificial Reefs
Nursery / breeding ground	Nursery / breeding ground for Chinese White Dolphin, coastal and oceanic fish and shellfish species	Possible nursery / breeding ground.
Age	N/A.	Less than 10 years.
Abundance / Richness of wildlife	High.	Moderate.
Ecological Value	High.	Moderate.

Table 13 Ecological Evaluation of Chinese White Dolphin and Horseshoe Crab within the Study Area

Criteria	Chinese White Dolphin	Horseshoe Crab
Protection Status	Chinese White Dolphin is locally protected by the Wild Animals Protection Ordinance (Cap. 170) and Protection of Endangered Species of Animals and Plants Ordinance (Cap 586). Internationally it is categorized as 'Near Threatened' by the IUCN Red List of Threatened Species, and in 'Appendix I' in the CITES. In China, it is listed as a "Grade 1 National Key Protected Species".	No statutory protection status in Hong Kong and China.
Distribution	Local population mainly distributed in estuarine habitat in the Pearl River Delta and the North Western WCZ within the study area.	Local population mainly distributed in estuarine habitat in the Deep Bay WCZ and the North Western WCZ within the study area. Two species, *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*, have been recoded within the study area.
Rarity	Over 1,000 individuals recorded in the Pearl River and Hong Kong waters. It is not locally uncommon.	Relatively local rare species of a taxonomically distinct and ancient class. Rarity is probably due to unsustainable harvest.

1.83 Based on the existing literature and data from the recent surveys, most of the ecological habitats identified within the study area were considered to be of relatively low ecological value due to their disturbed nature and low diversity of fauna. Sha Chau and Lung Kwu Chau Marine Park, and the artificial reefs within the Marine Park area were considered to be of relatively high ecological value (i.e. moderate and high value) due to the rich fish diversity and the provision of nursery / breeding grounds for Chinese White Dolphin and other fish species.

1.84 No species of conservation interest was recorded in the study area in the current survey.

Identification of Environmental Impacts

1.85 Minor dredging works would be conducted to form a berthing area for the barging facility in Lung Kwu Sheung Tan, and modification of existing seawall would also be involved. Details of the proposed work are described in **Section 2**. The dredging depth would be 2 m deep from the existing seabed level and a maximum dredging rate of about 2000 m^3 per day is anticipated. The dredging area

would be reduced from over 5 ha (about 950 m long from shore) in the original design scheme to approximately 0.65 ha (65 m long) to avoid encroachment on the offshore ecological resources.

1.86 The direct and indirect marine ecological impacts associated with the dredging work during construction of the barging point, are outlined below.

Construction Phase

1.87 The proposed barging point would affect habitats in waters off Lung Kwu Sheung Tan. Impacts on ecological resources would include:

- direct impacts from loss of intertidal and subtidal habitats and associated fauna resulting from barging point modification and dredging;
- indirect impacts to intertidal and subtidal habitats and associated fauna due to changes in water quality and increased sedimentation; and
- indirect impacts on dolphins from noise generated by dredging activities and increased marine traffic, and change of prey abundance and distribution.

Operation Phase

1.88 Potential impacts resulting from the operation of the barging point are likely to be indirect impacts on dolphins from noise generated and potential harm by increased marine traffic in surrounding area.

1.89 The significance of predicted ecological impacts to the habitats and species of conservation interest are discussed below.

Evaluation of Environmental Impacts

Subtidal Habitats (Corals and Benthos Communities)

1.90 The modification of the barging point would result in temporary loss of vertical seawall (approximately 0.05 ha) with low coverage of gorgonian *Echinomuricea* sp. About 15 colonies of *Echinomuricea* sp. (common in Hong Kong waters, especially in harsh and turbid environment) on the artificial vertical seawall would be directly affected. In addition, the gorgonians found in the nearby waters are unhealthy (high mortality of the colonies: 50 – 70%). Re-colonization of the gorgonian is expected after the construction of the new artificial seawall. It was found that the distribution of gorgonian is closely related to the availability of a suitable substratum for settlement and growth (Goh and Chou, 1994). As the gorgonians were recorded from the existing artificial seawalls, they are expected to re-colonize on the new seawall substrate after spawning.

1.91 During dredging, fine sediment would be suspended into the water column, which may then be transported away from the works area by tidal currents to form sediment plumes, affecting the habitats and associated fauna nearby at the Urmston Road. The quantities of fine sediment lost to suspension during dredging will primarily depend on dredging rate and methods. The determination of the acceptability of elevations in suspended solids concentrations is based on the Water Quality Objectives (WQO). The WQO for suspended solids is defined as being an allowable elevation of 30% above the background in the North Western WCZ. The allowable increases in suspended sediment concentrations is 5.4 mg/l in the dry season derived from EPD's nearest monitoring station.

1.92 The gorgonians present along the shore near the dredging area may be indirectly affected by water quality deterioration, particularly siltation from dredging. According to the results of water modelling in this EIA Study (**Section 11** refers), the sediment plumes generated from the minor dredging works are expected to be localized and acceptable with implementation of proper mitigation measures, such as deployment of silt curtain for dredging region (as discussed in **Section 11**).

1.93 Gorgonians are highly tolerant to turbid environment. They are not prone to sediment accumulation due to their erecting growth forms and flexible branches. In addition, gorgonians do not contain symbiotic zooxanthellae so that they are not affected by reduced light penetration by the sediment.

Therefore, the indirect impact of dredging-induced sedimentation on gorgonians is expected to be minimal.

1.94 The dredging for berthing area would result in temporary loss of soft bottom habitat (approximately 0.65 ha). Current surveys revealed that the soft bottom benthic species recorded from the study area are common and widespread in Hong Kong waters. The potential ecological impacts on subtidal habitats due to dredging are therefore expected to be low.

Table 14 Evaluation of Ecological Impacts to Subtidal Hard Substrate and Soft Bottom Habitats

Criteria	Impacts to Subtidal Hard Substrate Habitat	Impacts to Soft Bottom Habitat
Habitat Quality	Low.	Low.
Species	No hard coral species was found in the study area. Only gorgonian coral *Echinomuricea* sp. of low coverage (1-5%) was recorded.	Common and widespread in Hong Kong such as polychaetes and crustaceans.
Size / Abundance	Small area of artificial vertical seawall would be impacted (about 0.05 ha). About 15 colonies of *Echinomuricea* sp. would be affected.	Small area of soft bottom habitat would be impacted (about 0.65 ha).
Duration	Short term. Impacts are anticipated during the construction phase only.	Short term. Impacts are anticipated during the construction phase only.
Reversibility	Reversible. Re-colonization of gorgonian coral *Echinomuricea* sp. is expected after the construction of the new vertical seawall.	Reversible. Re-colonization of the benthic community is expected.
Magnitude	The scale of habitat loss is small near the shore.	The scale of habitat loss is small in the context of the surrounding similar habitats.
Overall Impact Evaluation	Low.	Low.

Intertidal Habitats

1.95 There would be temporary loss of approximately 100 m shoreline of intertidal habitats (artificial vertical seawall), and some indirect water quality impacts on the intertidal communities from the dredging activities. Although a small number of *Oulastrea crispata* and *Echinomuricea* sp. were recorded at the rocky shore, they are common in Hong Kong waters and are located approximately 260 m from the works area. Given the low ecological significance of the intertidal areas and with implementation of water quality control measures, limited impact to intertidal habitats is expected.

Table 15 Evaluation of Ecological Impacts to Intertidal Habitats

Criteria	Impacts to Intertidal Habitats
Habitat Quality	Low.
Species	Common and widespread in Hong Kong. Hard coral (*Oulastrea crispata*) and gorgonian coral (*Echinomuricea* sp.) were also recorded (approximately 260 m from the works area).
Size / Abundance	Small area of artificial vertical seawall would be impacted (approximately 100 m shoreline).
Duration	Short term. Impacts are anticipated during the construction phase only.
Reversibility	Reversible. Re-colonization of intertidal species is expected after the construction of the new vertical seawall.
Magnitude	Low.

Criteria	Impacts to Intertidal Habitats
Overall Impact Evaluation	Low.

Marine Park and Artificial Reefs

1.96 Impacts to Sha Chau and Lung Kwu Chau Marine Park and the artificial reefs are not anticipated as they are located approximately 2.5 km and 6.5 km respectively from the proposed barging point.

Table 16 Evaluation of Ecological Impacts to Marine Park and Artificial Reefs

Criteria	Impacts to Sha Chau and Lung Kwu Chau Marine Park	Impacts to Artificial Reefs
Habitat Quality	High.	Moderate.
Species	Important habitat for Chinese White Dolphin.	Supporting over 50 fish species.
Size / Abundance	Significant area of habitat to be affected is not anticipated.	Significant area of habitat to be affected is not anticipated.
Duration	Short term. Indirect impacts are anticipated during the construction phase only.	Short term. Indirect impacts are anticipated during the construction phase only.
Reversibility	Significant impact on the Marine Park is not anticipated.	Significant impact on the Artificial Reefs is not anticipated.
Magnitude	Insignificant.	Insignificant.
Overall Impact Evaluation	Insignificant.	Insignificant.

Impact to Species of Conservation Interest

Marine Mammal

1.97 Chinese White Dolphins would be impacted by the noise generated by dredging activities and increased marine traffic. Noise disturbance would interfere with communication and echolocation pulses of the dolphins, which are used for navigation and feeding, leading to behavioural changes. There would also be potential harm to the dolphins by vessels movements in surrounding area. However, an increased in the number of large, slow-moving vessels in the area would not cause a significant impact to the dolphins. The dredging works would also alter the fish distribution near the dredging area, in which Chinese White Dolphins are primarily fed on fish. However, the impact is anticipated to be limited given only very small scale of dredging works would be involved. Operation of the barging point would unavoidably increase the marine traffic in the waters off Lung Kwu Sheung Tan. Since Lung Kwu Sheung Tan is not considered as a dolphin habitat of high importance when compared with the waters between Black Point and Lung Kwu Chau, the potential impact to Chinese White Dolphin and their habitats is anticipated to be low.

Horseshoe Crab

1.98 There is no recent record of horseshoe crab in Lung Kwu Sheung Tan since 1998. In addition, there would be no direct impact on their potential habitat due to the proposed works. Indirect impact to any horseshoe crab that might be present in the area due to sedimentation or water quality deterioration is not anticipated with implementation of proper mitigation measures.

Table 17 Evaluation of Ecological Impacts to Marine Mammal and Horseshoe Crab

Criteria	Impacts to Marine Mammal	Impacts to Horseshoe Crab
Habitat Quality	The habitat is subject to certain	The habitat is subject to certain

Criteria	Impacts to Marine Mammal	Impacts to Horseshoe Crab
	degree of disturbance from marine traffic and influence of water pollution from Pearl River and Hong Kong urban discharges.	degree of disturbance from influence of water pollution from Pearl River and Hong Kong urban discharges.
Species	Chinese White Dolphin is locally protected by the Wild Animals Protection Ordinance (Cap. 170) and Protection of Endangered Species of Animals and Plants Ordinance (Cap 586). Internationally it is categorized as 'Near Threatened' by the IUCN Red List of Threatened Species, and in 'Appendix I' in the CITES. In China, it is listed as a "Grade 1 National Key Protected Species".	Although horseshoe crab is not protected locally, it is considered as of conservation interest due to its dramatic decline in population worldwide.
Size / Abundance	Low abundance and low density near the proposed works area.	No recent record of horseshoe crab in Lung Kwu Sheung Tan since 1998. Potential habitat of horseshoe crab is located outside the proposed works area, no direct impact is expected.
Duration	Short term. Minor disturbance to Chinese White Dolphin due to minor increased marine traffic is anticipated mainly during the construction phase.	Short term and only minor indirect impact due to sedimentation if unmitigated.
Reversibility	Reversible.	Reversible.
Magnitude	Low in the context of the surrounding more important habitats for the dolphins, especially between Black Point and Lung Kwu Chau.	Low.
Overall Impact Evaluation	Low.	Low.

Evaluation of Cumulative Environmental Impacts

1.99 The planned construction period of the LKB would be from December 2010 to February 2011. A number of coastal construction projects are identified. Details of these projects are summarized in **Table 18**.

Table 18 Relevant Concurrent Projects

Project Title	Project Proponent	Planned Construction Period	Distance from Project Site
Environmental Assessment Services for Permanent Aviation Fuel Facility	Airport Authority Hong Kong	2009 to 2013	>5 km
Upgrading of Pillar Point Sewage Treatment Works – Investigation, Design and Construction	Drainage Services Department	Mid 2009 to 2012	>5 km
Siu Ho Wan Water Treatment Works Extension	Water Supplies Department	February 2005 to December 2011	>5 km

Project Title	Project Proponent	Planned Construction Period	Distance from Project Site
New Contaminated Mud Marine Disposal Facility at Airport East / East Sha Chau Area	Civil Engineering and Development Department	January 2007 to June 2015	>10 km

1.100 The proposed dredging works at Lung Kwu Sheung Tan would be short term and small in scale. Potential water quality impacts are expected to be localized and confined in close proximity of the proposed barging point. No significant cumulative marine ecological impact would be contributed from this Project

Mitigation of Environmental Impacts

1.101 According to EIAO-TM Annex 16 guidelines, mitigation measures are discussed in this section to avoid, minimize and compensate for identified ecological impacts.

Avoidance

1.102 The proposed works area would make use of an existing barging point such that extensive marine construction works and hence impact to intertidal habitat can be largely avoided. Only small-scale dredging for a berthing area and minor modification of the existing artificial vertical seawall would be carried out. In addition, dredging works at water between Black Point and Lung Kwu Chau with high significance Chinese White Dolphin habitats has been avoided. The use of high-speed vessels should also be avoided during the construction and operation of the proposed barging point.

Minimisation

1.103 The following general mitigation measures have been considered to minimize the potential marine ecological impacts:

- The dredging extent and duration has been reviewed throughout the design phase taking into account the possible occurrence of the important ecological resources in the area. The proposed dredging area has been largely reduced from over 5 ha to 0.65 ha affecting only a small area of an existing artificial seawall.
- No dumping of rubbish, oil or chemicals would be allowed.

1.104 The following mitigation measures have been considered to minimize the potential impacts on subtidal habitats:

- Deployment of double silt curtains around the closed grab dredgers and the works area as far as practicable to minimize the suspended sediment impact due to dredging activities in dredging region, where the maximum tidal current speeds are less than 0.5 m/s. According to the modelling results in **Section 11**, the suspended sediment concentrations would be below 5.4 mg/l at less than 700 m from the dredging operation by deployment of single silt curtains. With the deployment of double silt curtains, the impact from suspended sediments is expected to be much smaller (smaller distance of sediment plumes from the dredging area).

Compensation

1.105 The marine ecological impact due to the loss of a small area of vertical seawall (with low coverage of gorgonian *Echinomuricea* sp.), intertidal communities and soft bottom habitats by the marine works would be temporary and reversible. Re-colonization of gorgonian on the modified vertical seawall is expected. With the implementation of mitigation measures proposed above, no compensation of habitat or species is considered necessary.

Additional Precautionary Measures for Chinese White Dolphin

1.106 The following additional precautionary measures have been considered to further control any potential impacts on Chinese White Dolphin:

- Measures would be taken to minimize the noise impact on dolphins as far as practicable. The number of work vessels and small crafts would be minimized during construction phase. Dredging would be carried out continuously without unnecessary break to prevent unpredictable or sudden noise outbursts at random intervals.
- During the operational phase, engines of vessels moored at the barging point would be turned off to minimize unnecessary underwater noise, as far as practicable.

Evaluation of Residual Environmental Impacts

1.107 There would be a temporary loss of 15 colonies of gorgonian coral *Echinomuricea* sp. and intertidal fauna on the artificial seawall as well as 0.65 ha benthic communities of low ecological value. However, re-colonization of the coral, intertidal and benthic communities is expected after the completion of dredging works and seawall construction. With the effective implementation of mitigation measures, no other residual marine ecological impact is anticipated.

Environmental Monitoring and Audit

1.108 The implementation of the ecological mitigation measures should be checked as part of the Environmental Monitoring and Audit procedures during the construction period.

Conclusion

1.109 Dredging works would be conducted to form a berthing area for the barging facility in Lung Kwu Sheung Tan (LKB), and modification of an existing seawall would also be involved. The works will last for three months and involve a small area of dredging (about 0.65 ha). No species of conservation interest has been found within the works area during the marine ecological field surveys.

1.110 The LKB area is not a Chinese White Dolphin habitat of high importance, the potential impact to the dolphins and their habitats is anticipated to be low. There is no recent record of horseshoe crab in Lung Kwu Sheung Tan, and no significant impact on their potential habitat due to the proposed works is anticipated.

1.111 Given the low ecological significance of the areas and with the implementation of water quality control measures such as deployment of silt curtain, limited ecological impact to sub-tidal and intertidal habitats is expected. As a precautionary measure, the dredging and operation phase activities will be minimised to avoid disturbance to Chinese White Dolphin.

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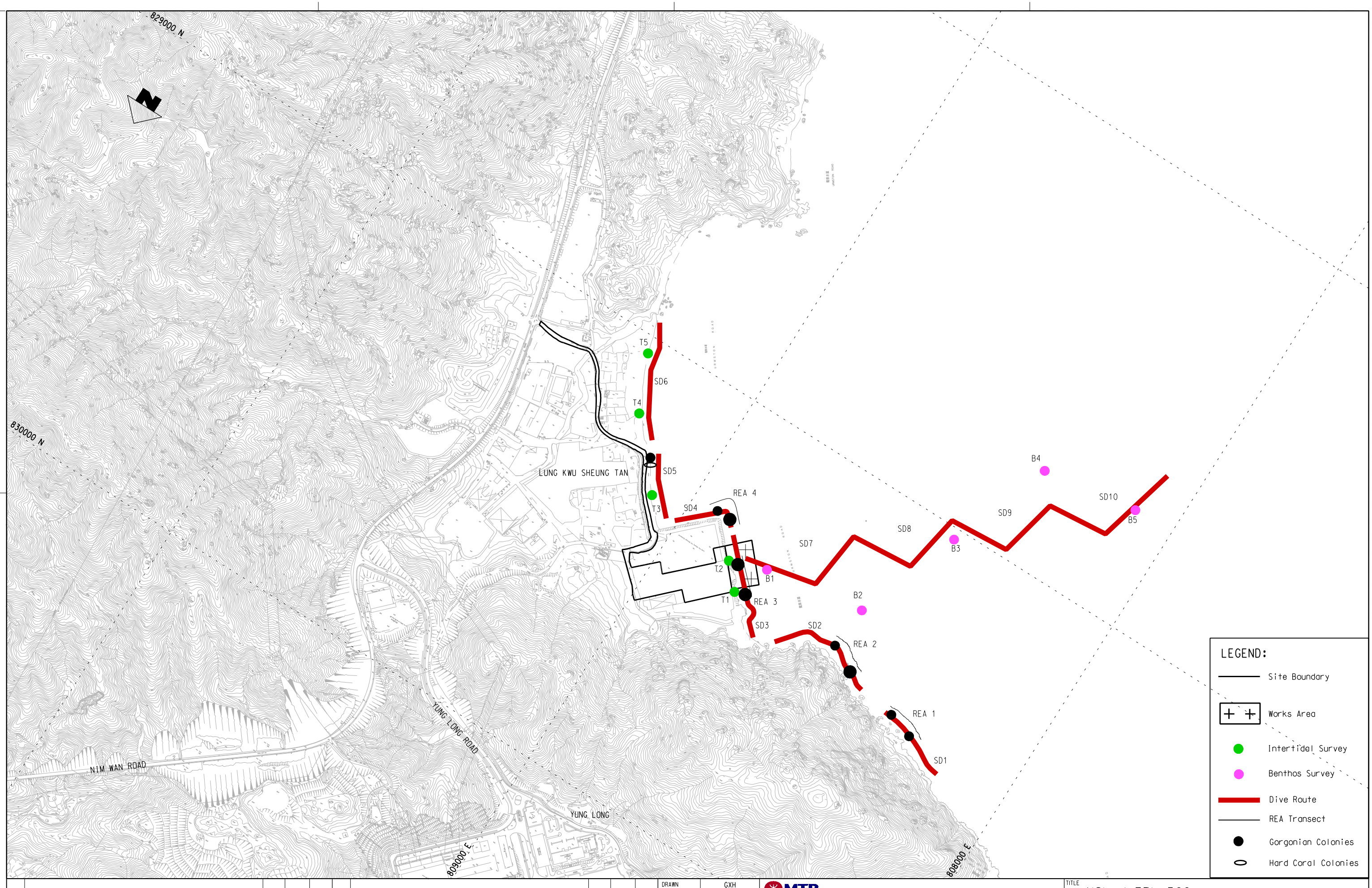
Figures



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TITLE
NOL / ERL-300
ENVIRONMENTAL IMPACT ASSESSMENT
LOCATION OF MARINE ECOLOGICAL SURVEYS

SCALE	FIGURE NO.	REV.
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LEGEND:

- CORALS
  - C - NEAR SHA CHAU
- MAI PO NATURE RESERVE AREA
  - M - MAI PO NATURE RESERVE AREA
- MAI PO RAMSAR SITE
- MARINE PARK
  - MP1 - INDICATOR POINT FOR SHA CHAU AND LUNG KWU CHAU MARINE PARK
  - MP2 - INDICATOR POINT FOR SHA CHAU AND LUNG KWU CHAU MARINE PARK
  - MP3 - INDICATOR POINT FOR SHA CHAU AND LUNG KWU CHAU MARINE PARK
  - MP4 - INDICATOR POINT FOR SHA CHAU AND LUNG KWU CHAU MARINE PARK
- SITE OF SPECIAL SCIENTIFIC INTEREST (SSSI)
  - S1 - TSIM BEI TSUI
  - S2 - PAK NAI
  - S3 - INNER DEEP BAY
  - S4 - MAI PO
  - S5 - LUNG KWU CHAU, TREE ISLAND AND SHA CHAU
- ARTIFICIAL REEFS
  - AR1 - SHA CHAU AND LUNG KWU CHAU
  - AR2 - CHEK LAP KOK MARINE EXCLUSION ZONE
- CHINESE WHITE DOLPHIN
- HORSESHOE CRAB
- SEAGRASS
  - SHEUNG PAK NAI
  - SHA KONG TSUEN
  - NGAU HOM SHEK
  - MAI PO
  - HA PAI NAI
- MANGROVE COMMUNITIES
  - 1 MAI PO
  - 2 LUT CHAU
  - 3 TSIM BEI TSUI
  - 4 SHEUNG PAK NAI
- NATURAL INTERTIDAL HABITAT
- PROPOSED SELECTED ALIGNMENT
- WORKS AREA

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TITLE

NOL / ERL-300
ENVIRONMENTAL IMPACT ASSESSMENT
MARINE ECOLOGICAL RESOURCES WITHIN THE STUDY AREA OF LUNG KWU SHEUNG TAN BARGING POINT

SCALE	FIGURE NO.	REV.
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Annex A	Rapid Ecological Assessment

Annex A Rapid Ecological Assessment

Rapid ecological assessment (see [1]DeVantier *et al.* 1998) is a two-tiered approach for underwater survey to assess the sub-littoral substrata and benthic organisms. This methodology has been modified to suit Hong Kong conditions and has become a standardized and widely adopted way to establish ecological baseline conditions. Two levels of information are to be recorded in a swathe ~2m wide, 1m on either side of each transect:

- Tier 1 will assess the relative cover of major benthic groups and substrata
- Tier 2 will provide an inventory of sedentary / sessile benthic taxa, which are also ranked in terms of their abundance in the community at the survey site.

Self-evidently, data have to be recorded by an expert who is experienced in field identification of sedentary / sessile benthic taxa, particularly corals.

Tier 1: Categorization of benthic cover

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

Table 1 Tier 1 Benthic Attribute Categories

Ecological Attributes	Substratum Attributes
Hard Corals	**Hard substrata**
Octocorals (soft corals and gorgonians)	Bedrock / continuous pavement
Black corals	Boulder blocks (diam. >50cm)
Dead Standing Corals	Boulder blocks (diam. <50cm)
	Rubble
	Other
	Soft substrata
	Sand
	Mud / Silt

Table 2 Tier 1 Ordinal Ranks of Percentage Cover of Benthic Attributes

Rank*	Percentage Cover
0	None recorded
0.5	1 – 5%
1	6 – 10%
2	11 – 30%
3	31 – 50%
4	51 – 75%
5	76 – 100%

[1] DeVantier, L.M., G. De'ath, T.J. Done and Turak, E. (1998). Ecological Assessment of a Complex Natural System: A Case Study from the Great Barrier Reef. *Ecological Applications* 8:480-496.

*Note: For substratum attributes, it is preferable to record actual estimates of cover. The percentage of hard substrata vs soft substrata can be provided (e.g. 80% and 20% respectively). The percentage cover of the types of hard or soft substrata could also then 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 an approach adopted by similar recent survey reports.

Tier 2: Taxonomic inventories to define types of benthic communities

An inventory of benthic taxa along each transect should be compiled during the survey. The taxa should be defined in situ to at least the following levels:

Table 3 Taxonomic Inventory Identification

Type of Benthos	Level of Taxa
Hard corals	Species level, wherever possible
Octocorals	Genus level
Black Corals	Genus level

For each transect, each taxon in the inventory should be ranked in terms of abundance in the community.

Table 4 Ordinal Ranks of Taxon Abundance

Taxon Abundance Rank	Abundance
0	Absent
1	Rare
2	Uncommon
3	Common
4	Abundant
5	Dominant

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

Annex B	Raw Data Recorded during the Dive Surveys at Seafront of Lung Kwu Sheung Tan

Annex B Raw Data Recorded During the Dive Surveys at Seafront of Lung Kwu Sheung Tan

Table 1 Weather Condition During the Spot-Check Dives on 16th – 19th February 2009

Date	Condition	Average Underwater Visibility
16 February 2009	- Northeast force 3 to 4, - Sunny periods	0.5 m
17 February 2009	- East force 4 to 5, - Sunny periods	0.5 m to 1 m
18 February 2009	- East force 4, - Sunny periods	0.5 m
19 February 2009	- Northeast force 3 to 4, - Sunny periods	0.5 m

Table 2 GPS Location, Route Distance, Maximum Depth, Bottom Substrate and Bottom Visibility of Spot-Check Dive Sites 1 to 10

Site	Location (GPS) (Starting Point)	Route Distance (m)	Max. Depth (m)	Bottom Substrate	Visibility (m)
SD1	E 113°54'14.7" N 22°24'17.8"	200	3	Bedrock / Boulder	0.5
SD2	E 113°54'21.7" N 22°24'15.6"	285	3	Bedrock / Boulder	0.5
SD3	E 113°54'33.3" N 22°24'16.1"	275	3	Bedrock / Artificial Seawall	1.0
SD4	E 113°54'39.7" N 22°24'10.3"	200	4	Artificial Slopping Boulder	0.5
SD5	E 113°54'44.1" N 22°24'12.2"	180	2	Artificial Boulder / Sandy Beach	0.5
SD6	E 113°54'50.2" N 22°24'05.6"	160	2	Sandy Beach	0.5
SD7	E 113°54'37.3" N 22°24'12.4"	315	4	Muddy	<0.5
SD8	E 113°54'31.9" N 22°24'08.3"	340	6	Muddy	<0.5
SD9	E 113°54'26.7" N 22°24'03.0"	340	7	Muddy	<0.5
SD10	E 113°54'20.4" N 22°23'57.5"	340	8	Muddy	<0.5

Table 3 Weather Condition for the REA Survey on 4th – 5th February 2009

Date	Condition	Average Underwater Visibility
4 March 2009	- East force 4, occasionally force 5 - Cloudy with a few light rain patches and mist.	0.5 m
5 March 2009	- East to southeast force 3 - Misty, heavy rain later.	0.5 m

Table 4 GPS of Transect Starting Point and Ending Point, Maximum Depth, Bottom Substrate and Bottom Visibility of the Four REA Transects

Transect	Location (GPS) (Starting Point)	Location (GPS) (End Point)	Max. Depth (m)	Bottom Substrate	Visibility (m)
REA 1	E 113°54'16.5"	E 113°54'20.3"	3	Bedrock / Boulder	0.5
	N 22°24'17.2"	N 22°24'16.3"			
REA 2	E 113°54'23.6"	E 113°54'26.6"	3	Bedrock / Boulder	0.5
	N 22°24'15.4"	N 22°24'13.8"			
REA 3	E 113°54'34.8"	E 113°54'37.4"	3	Bedrock / Artificial Seawall	0.5
	N 22°24'14.7"	N 22°24'12.4"			
REA 4	E 113°54'39.7"	E 113°54'42.2"	4	Artificial Slopping Boulder	0.5
	N 22°24'10.3"	N 22°24'10.7"			

Table 5 Size and Health Condition of Coral Colonies found at Transect REA 1

Coral Number	Coral Species	Size (cm)	Health Condition
1	*Echinomuricea* sp.	5	Unhealthy
2	*Echinomuricea* sp.	3	Unhealthy
3	*Echinomuricea* sp.	3	Unhealthy
4	*Echinomuricea* sp.	5	Unhealthy
5	*Echinomuricea* sp.	5	Unhealthy
6	*Echinomuricea* sp.	10	Unhealthy
7	*Echinomuricea* sp.	7	Unhealthy
8	*Echinomuricea* sp.	10	Unhealthy
9	*Echinomuricea* sp.	5	Unhealthy
10	*Echinomuricea* sp.	5	Unhealthy
11	*Echinomuricea* sp.	6	Unhealthy
12	*Echinomuricea* sp.	8	Unhealthy

Table 6 Size and Health Condition of Coral Colonies found at Transect REA 2

Coral Number	Coral Species	Size (cm)	Health Condition
1	*Echinomuricea* sp.	4	Unhealthy
2	*Echinomuricea* sp.	5	Unhealthy
3	*Echinomuricea* sp.	4	Unhealthy
4	*Echinomuricea* sp.	10	Unhealthy
5	*Echinomuricea* sp.	8	Unhealthy
6	*Echinomuricea* sp.	8	Unhealthy
7	*Echinomuricea* sp.	5	Unhealthy
8	*Echinomuricea* sp.	5	Unhealthy
9	*Echinomuricea* sp.	10	Unhealthy
10	*Echinomuricea* sp.	8	Unhealthy

Table 7 Size and Health Condition of Coral Colonies found at Transect REA 3

Coral Number	Coral Species	Size (cm)	Health Condition
1	*Echinomuricea* sp.	18	Fair
2	*Echinomuricea* sp.	15	Fair
3	*Echinomuricea* sp.	20	Fair
4	*Echinomuricea* sp.	15	Fair
5	*Echinomuricea* sp.	20	Fair
6	*Echinomuricea* sp.	20	Fair
7	*Echinomuricea* sp.	15	Fair
8	*Echinomuricea* sp.	20	Fair
9	*Echinomuricea* sp.	18	Fair
10	*Echinomuricea* sp.	18	Fair
11	*Echinomuricea* sp.	15	Fair
12	*Echinomuricea* sp.	15	Fair
13	*Echinomuricea sp.*	20	Fair
14	*Echinomuricea sp.*	15	Fair
15	*Echinomuricea sp.*	20	Fair

Table 8 Size and Health Condition of Coral Colonies found at Transect REA 4

Coral Number	Coral Species	Size (cm)	Health Condition
1	*Echinomuricea* sp.	3	Unhealthy
2	*Echinomuricea* sp.	5	Unhealthy
3	*Echinomuricea* sp.	5	Unhealthy
4	*Echinomuricea* sp.	5	Unhealthy
5	*Echinomuricea* sp.	5	Unhealthy
6	*Echinomuricea* sp.	3	Unhealthy
7	*Echinomuricea* sp.	5	Unhealthy
8	*Echinomuricea* sp.	5	Unhealthy

Annex C	Representative Photographs of Habitats and Species Recorded within the Study Area

Annex C Representative Photographs of Habitats and Species Recorded within the Study Area

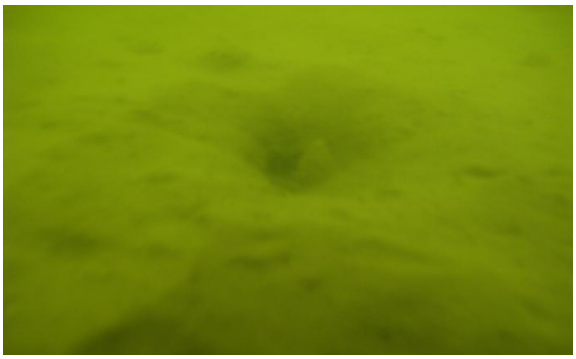
Natural Bedrocks

Artificial Vertical Seawall

Artificial Slopping Boulders

Rocky Shore

Sandy Shore



Muddy Bottom

Annex C Representative Photographs of Habitats and Species Recorded within the Study Area

Echinomuricea sp. on Boulders at Rocky Shore

Oulastrea crispata on Boulders at Rocky Shore

Echinomuricea sp. on Vertical Seawall

Annex D	Raw Data Recorded during the Intertidal Surveys at Seafront of Lung Kwu Sheung Tan

Annex D - Raw Data Recorded during the Intertidal Surveys at Seafront of Lung Kwu Sheung Tan

Composition and Abundance (number of individuals / percentage cover per 0.25 m^2) of Organisms Recorded in Intertidal Community
Intertidal Invertebrates

	Dry Season																																		
Survey Date	**16/12/2008**							**17/12/2008**																													
Survey Location	**T1**			**T2**				**T3**																									**T4**	**T5**	
Intertidal Type	**Vertical**			**Vertical Seawall**				**Rocky Shore**																									**Sandy Shore**	**Sandy Shore**	
Transect Length (m)	**1.5 m***			**4 m**				**29 m**																									**16 m**	**16 m**	
Quadrat	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**24**	**25**	**26**	**27**		**2**	**16**
Periwinkles																																				
Echinolittorina radiata			11																																
Echinolittorina																																8	6			
Littoraria articulata		18	41	1		4	21																							1		110	23			
Whelks																																				
Thais clavigera	2																																			
Thais luteostoma									1										1	1				1	8											
Morula musiva																	2							1												
Limpets/False Limpets																																				
Patelloida pygmaea		1			1																															
Siphonaria japonica				1																																
Cellana grata		2																																		
Bivalves																																				
Perna viridis																				1%							60%									
Septifer virgatus																			5%	50%	20%	30%	40%	30%	70%	50%	20%	5%								
Saccostrea cucullata	80%	20%		80%	40%	10%	5%										5%			1%				1%	5%	5%	10%	30%		20%	5%	5%				
Barnacles																																				
Balanus amphitrite																	5%									1%	5%	5%								
Tetraclita japonica						4																														
Nerites																																				
Nerita albicilla	1					5																			2		4	8		15	10	1				
Ceriths																																				
Nassarius festivus								1				1					2	11	1	5	1	2	2	3	1											
Batillaria zonalis												1					1			1	2	1	4	5												
Encrusting Algae																																				
Hildenbrandia				10%	40%	20%	10%																													
Gelidium pusillum																										1%			1%		20%	20%				
Pseudulvella applanata					5%																															
Erect Algae																																				
Ulva sp.				5%																						20%		30%								
Hermit Crabs																																				
Pagurus dubius										1		2							1		1		2	2	1		1									
True Crabs																																				
Hemigrapsus																				1																
Tubeworm								57	92	20	31	95	33	71	103	105	95	152	42	105	46	25	14	12	2	5	2									
Amphipod spp.																																			1	4

Note:

Low tide mark – Quadrat 1

Line transects: mobile fauna in terms of abundance 0.25 m^{-2}; sessile organisms estimated in terms of percentage cover

Quadrat area = 0.25 m^2

* Quadrats laid at 0.5 m intervals due to field situation

Sampling Effort During Walk-through Surveys

Date of Survey	16/12/08	17/12/08
No. of Surveyor	2	3
Survey Time	0845-1230	0840-1330
Duration (hr) :	1.5	1

Annex D - Raw Data Recorded during the Intertidal Surveys at Seafront of Lung Kwu Sheung Tan

Composition and Abundance (number of individuals / percentage cover per 0.25 m^2) of Organisms Recorded in Intertidal Community
Intertidal Invertebrates

	Wet Season																			
Survey Date	**21/05/2009**																	**22/05/2009**		
Survey Location	**T1**				**T2**			**T3**										**T4**	**T5**	
Intertidal Type	**Vertical Seawall**				**Vertical Seawall**			**Rocky Shore**										**Sandy Shore**	**Sandy Shore**	
Transect Length (m)	**2 m***				**1.5 m***			**11.5 m**										**22 m**	**22 m**	
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Core (upper**	**Core (upper**	**Core (middle**
Periwinkles																					
Echinolittorina radiata			40	36		21	40								17	6	9	14			
Littoraria articulata		2	49	7		18	19				2		2	14	98	118	121	28			
Turban Shells																					
Lunella coronata								1													
Topshells																					
Monodonta labio						1		1		11	2	4	6								
Whelks																					
Thais clavigera	2	1			4																
Limpets/False Limpets																					
Patelloida pygmaea		2	1		2	1					4		3								
Cellana toreuma						2															
Nipponacmea concinna	6	43	1		7	25		4	4	12	15	2	6		6						
Bivalves																					
Barbatia virescens					<1%																
Septifer virgatus			<1%					5%	5%		<1%	<1%			1%	<1%	<1%				
Saccostrea cucullata	70%	95%	20%		100%	60%			30%	10%	30%	10%	5%		5%	1%					
Barnacles																					
Balanus amphitrite		<1%				<1%		15%	1%		3%		<1%	<1%	<1%	<1%					
Nerites																					
Nerita albicilla						1		1	4	5	14	5	14	1	1						
Encrusting Algae																					
Hildenbrandia										5%	20%	5%	30%	<1%	5%	30%	<1%				
Gelidium pusillum	70%	50%			80%	10%		15%	30%												
Erect Algae																					
Ulva sp.	<1%	<1%						10%	10%		<1%										
Sea Anemones																					
Haliplanella lineata	2	5			5	3		2													
True Crabs																					
Hemigrapsus	6				1			3	1		1										
Sea Slaters																					
Ligia exotica	10	3			4	3															
Tubeworm								2													
Amphipod spp.	1				1					24									3	6	1

Note:

Low tide mark – Quadrat 1

Line transects: mobile fauna in terms of abundance 0.25 m^{-2}; sessile organisms estimated in terms of percentage cover

Quadrat area = 0.25 m^2

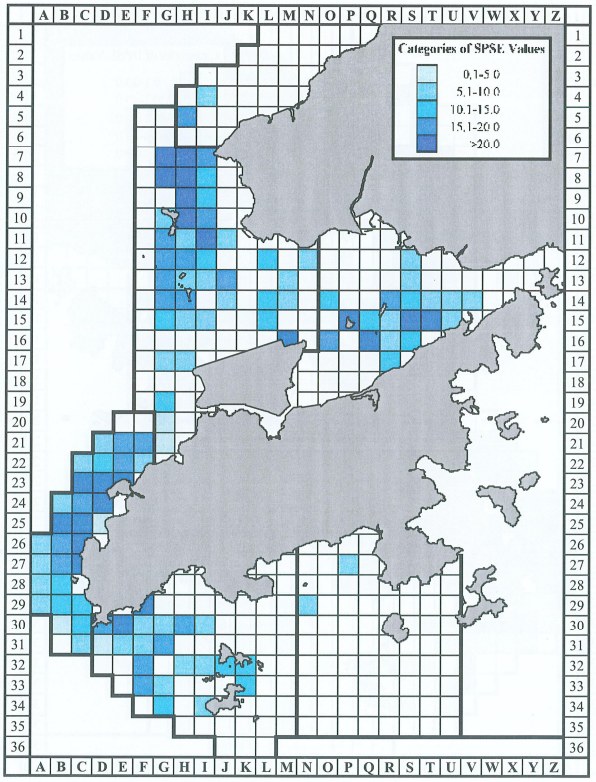
* Quadrats laid at 0.5 m intervals due to field situation

Sampling Effort During Walk-through Surveys

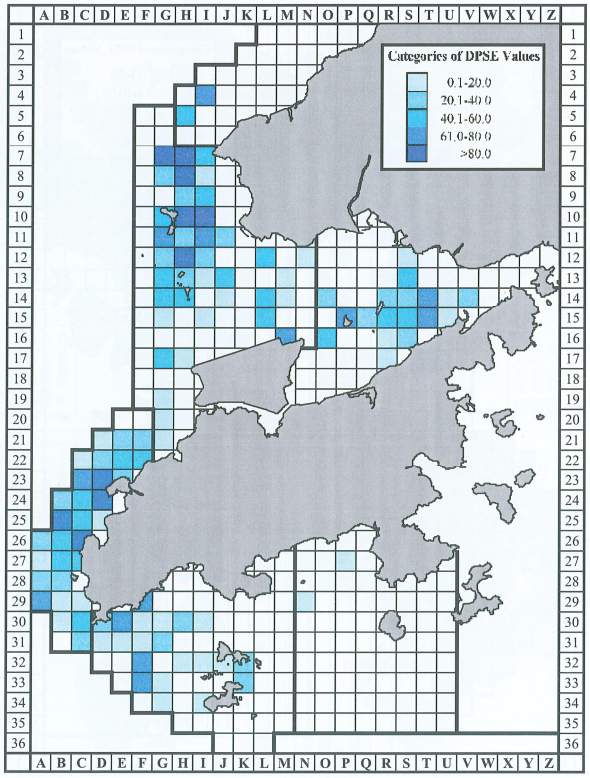
Date of Survey	21/5/2009	22/5/2009
No. of Surveyor	3	2
Survey Time	1330-1700	1330-1630
Duration (hr) :	1.5	1

Annex E	Quantitative Grid Analysis (1 km^2 Grids) of Habitat Use by Chinese White Dolphin

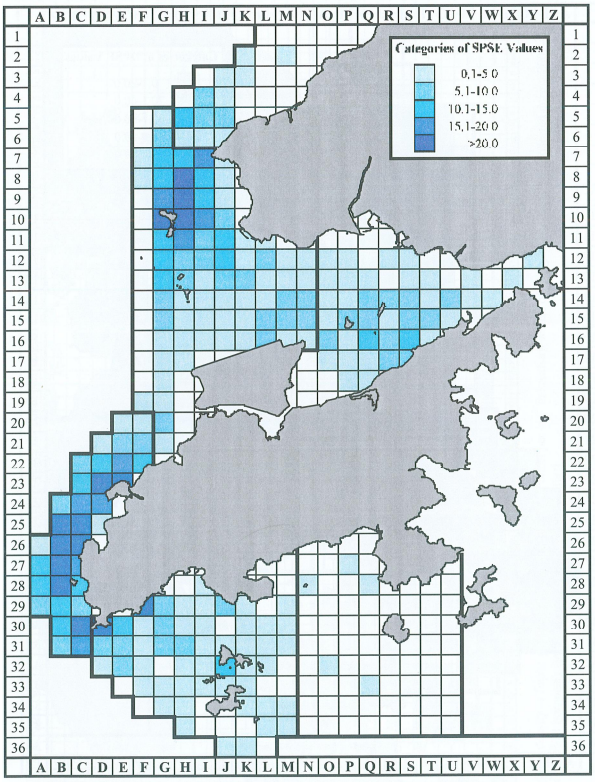
Annex E Quantitative Grid Analysis (1 km^2 Grids) of Habitat Use by Chinese White Dolphin



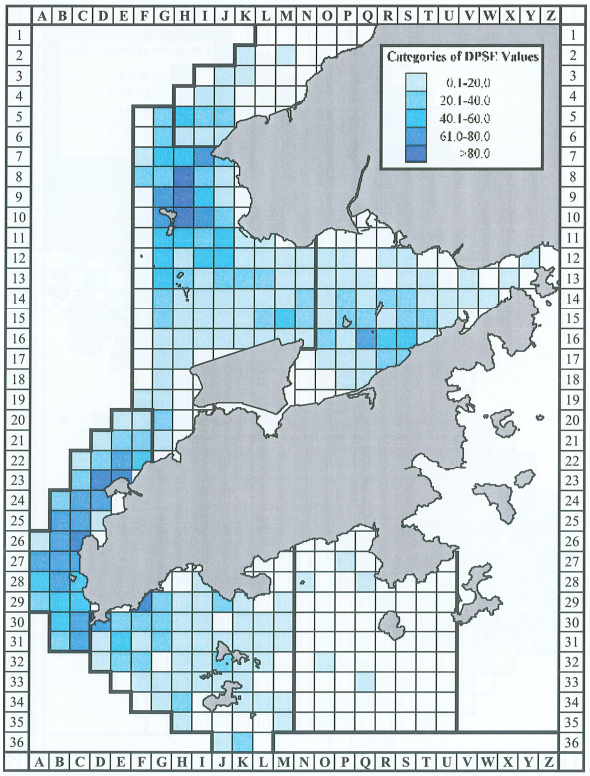
Sighting Density of Chinese White Dolphins (SPSE) with Corrected Survey Effort per km^2 in Waters around Lantau Island in 2007 – 2008 (Hung, 2008)



Density of Chinese White Dolphins (DPSE) with Corrected Survey Effort per km^2 in Waters around Lantau Island in 2007 – 2008 (Hung, 2008)



Sighting Density of Chinese White Dolphins (SPSE) with Corrected Survey Effort per km^2 in Waters around Lantau Island in 2002 – 2007 (Hung, 2008)



Density of Chinese White Dolphins (DPSE) with Corrected Survey Effort per km^2 in Waters around Lantau Island in 2002 – 2007 (Hung, 2008)