8 MARINE ECOLOGY

8.1 INTRODUCTION

This Section presents an assessment of the potential impacts to marine ecological resources as a result of the proposed Sham Tseng Development (STD) Project. This section supplements *Section 9* on *Commercial Fisheries* by concentrating on potential impacts to soft benthos assemblages, intertidal and subtidal hard surface assemblages and marine mammals.

The objectives of the assessment are as follows:

- to establish the ecological importance of the marine ecological habitats affected by the construction operations;
- to identify marine ecological sensitive receivers;
- to assess the scale of possible marine ecological impacts from the proposed STD;
- to highlight any insurmountable impacts to marine ecological resources arising from the proposed Project;
- to identify any mitigation measures and residual impacts; and,
- to assess the need for a marine ecological monitoring and audit programme.

8.2 GOVERNMENT LEGISLATION & STANDARDS

The criteria for evaluating marine ecological impacts are presented in the *Technical Memorandum on Environmental Impact Assessment Process of the Environmental Impact Assessment Ordinance (Cap 499) (EIAO TM)*. *Annex 16* sets out the general approach and methodology for assessment of marine ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential marine ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating marine ecological impacts.

Other legislation which applies to marine species includes:

- *The Wild Animals Protection Ordinance (Cap 170) 1980* which protects all cetaceans.

8.3 BASELINE CONDITIONS

For the purposes of this section of the report the waters within and around Sham Tseng have been divided into two specific areas for ease of reference. These are the reclamation area, encompassing only the area designated as the proposed Sham Tseng Development and the Sham Tseng Study Area (*Figure 2.1a*), combining the reclamation area and the surrounding waters within close proximity to the reclamation area which may potentially be affected by the dredging/reclamation operations.

The marine ecological impact assessment has been performed using relevant information from the literature and field surveys (conducted under this Study and other projects by ERM within the Study Area). It should be noted that the majority of field surveys referenced in this report, especially those for the coastal habitats, were conducted during 1998-99 and thus have direct relevance to this EIA Study. Information on the use of the Study Area by marine mammals has been taken from the latest reports and documents produced by the Ocean Park Conservation Foundation for the North Lantau area.

The marine ecological habitats in the Study Area are mainly categorised into subtidal and intertidal. A habitat map showing the natural intertidal rocky shore, artificial seawall, natural intertidal sandy shore and subtidal habitats (hard bottom and soft bottom) is presented in *Figure 8.3a*. The figure also presents photographs of the habitats as taken during site visits conducted during 1998-99.

8.3.1 *Subtidal Habitats*

Apart from the subtidal hard bottom habitat at Kwai Shek (as shown in *Figure 8.3a),* the sea bed within the Study Area is soft and comprises a mixture of sand and mud. Two interrelated groups of organisms can be found associated with the benthos. The first group are the infauna. These organisms live within the substrate and either feed within the sediment or on the surface. The second group of organisms are the epifauna and are organisms that typically live on the seafloor. The following review of assemblages of the benthos of the Sham Tseng Study Area is separated into two subsections; the first deals with the infauna and the second the epifauna.

Infaunal Benthic Assemblages

Infaunal benthic communities have been studied mainly through the use of grab samples. Five replicates of 0.1 m^2 Smith-McIntyre grab samples were collected at 200 stations around Hong Kong in July, August, September and November 1976 and January 1977 [1]. The particle-size distribution of the benthos between Tsing Yi and Ma Wan (marked as G1 in *Figure 8.3b*), had a mean silt content of 74% and organic content of 1.6% (*Table 8.3a*). In terms of

[1] Shin P K S and Thompson G B (1982) Spatial distribution of infaunal benthos of Hong Kong, Marine Ecology Progress Series 10: 37-47

faunal abundance, a mean value of 107 individuals m^{-2} were recorded, which ranked the area intermediate in comparison with other areas in Hong Kong. Polychaetes were the most abundant organisms, comprising 83% of the total animals sampled (*Tables 8.3a* and *8.3b*). The study's main finding was that the assemblages were typified by high abundances with low numbers of species and low individual biomass. This pattern is typical of the Hong Kong benthos.

Table 8.3a ***Physical & Biological Parameters for Sediments in the Western Harbour/ North Lantau Areas.***

Parameters	Shin & Thompson 1982	APH Consultants 1992
Physical (%)		
gravel (>2 mm)	2.1	0
sand (0.062-2 mm)	19.4	4.5
silt (2-62 Fm)	74.0	66.3
clay (<2 Fm)	4.6	29
organic content	1.62	NA
Biological (%)		
Polychaetes	82.5	83.3
Molluscs	1.7	7.9
Crustaceans	3.7	0
Echinoderms	5.2	0
Other groups	6.8	8.8

Table 8.3b ***Five Most Abundant Benthic Species Recorded in the Western Harbour/ North Lantau Area.***

Shin & Thompson 1982 Polychaete Species	% by number	APH Consultants 1992 Polychaete Species	% by number
Paraprionospio pinnata	11.0	*Notomastus latericeus*	47
Aglaophamus lyrochaeta	5.7	*Aglaophamus lyrochaeta*	10
Sternaspis scutata	3.4	*Paraprionospio pinnata*	9.7
Marphysa stragulum	3.3	*Glycera chiori*	9.7
Trebellides stroemi	3.0	*Marphysa stragulum*	8

The benthos was also studied by using a 0.05 m^2 Van Veen grab at 4 stations within the proposed area for the Lantau Port & Western Harbour Development study [2]. The first survey was carried out in December 1991 and the second survey took place during June 1992 with station 5 in the Study Area being investigated (marked as G2 in *Figure 8.3b*). The bottom sediment was fairly homogeneous, with silt content of 66%. As in the Shin & Thompson (1982) study, polychaetes were the most abundant group of organisms found at the study site, comprising 83 % of the total species recorded (*Table 8.3a*). The species composition was similar to the previous study with polychaete species most abundant. *Notomastus latericeus*, was the most abundant of all species, composing 47% of the samples, with *Paraprionospio pinnata* (most abundant in the previous study) ranked third (*Table 8.3b*).

[2] APH Consultants (1992) Lantau Port & Western Harbour Development Studies, Environmental Survey Data Report, for Civil Engineering Department, Port Development Office

During the Baseline Performance Monitoring and Verification for the SSDS Stage I Outfall a number of benthic surveys were undertaken [3], of which one grab sampling station (marked as S03 in *Figure 8.3b*) lies within the Study Area and is considered as representative of its benthic communities. The five most abundant benthic species recorded at this site are presented below in *Table 8.3c*.

Table 8.3c Five Most Abundant Benthic Species recorded at the site S03

Station	Phylum	Species	% of total by number
S03	Hemichordata	*Balanoglossus* sp	47
	Annelida	*Aglaophamus dibranchia*	11
	Annelida	*Prionospio malmgreni*	5
	Annelida	*Prionospio* sp	4
	Annelida	*Mediomastus californiensis*	2

The results from this survey demonstrate that the benthic communities within the Sham Tseng Study Area are primarily made up of polychaetes (Phylum Annelida) in common with the majority of Hong Kong's benthos. The most striking feature of the results is the abundance of the species *Balanoglossus* sp (Phylum Hemichordata) within nearly all of the stations sampled. This highly primitive species is typically found within muddy seabeds where there is a mixture of sand and fine sediment [4]. The abundance of this species in this study is in contrast to the low records of this species recorded by other benthic surveys undertaken within the Study Area. In order to investigate the community structure further, the results have been presented below in terms of total number of individuals and total biomass for each phylum (*Table 8.3d*).

Table 8.3d Summary of Organisms recorded from the Mouchel SSDS Sampling

Station	Phylum	Total Number of Individuals Recorded	Total Biomass (g)
S03	Hemichordata	83	14.7
	Annelida	62	41.6
	Arthropoda	22	3.1
	Echinodermata	2	0.009
	Chordata	2	6.9
	Nemertea	1	0.007

Although the Hemichordate *Balanoglossus* sp is the most abundant species within most of the stations sampled, the Annelid polychaetes are the major component of the benthic assemblages. As stated previously this is in common with the majority of Hong Kong's benthos which are primarily characterised by soft bottom sediments dominated by polychaetes.

[3] Mouchel Asia Limited (1998) Strategic Sewage Disposal Scheme Stage 1 Baseline Monitoring and Performance Verification. First Annual Report for Environmental Protection Department, July 1998.

[4] Morton B & Morton J (1983) *The Sea Shore Ecology of Hong Kong.* Hong Kong University Press, First edition.

In summary, findings from the majority of these studies were that the benthos of the seabed within or proximal to the Study Area was dominated by polychaetes and characterised by low species diversity and low species biomass. All species recorded had been previously reported in Hong Kong and no environmentally sensitive nor rare species were found. This pattern was also observed by REMOTS studies [5].

Epifaunal Benthic Assemblages

Three trawl surveys were conducted to collect epifaunal benthic community data in South Tsing Yi in January 1995 [6]. One of the three trawl surveys (T1, *Figure 8.3b*) is located within the Study Area. A total of 16 species and 40 individuals were recorded from three replicates of the trawl. Five colonies of gorgonians (*Junceella juncea* and *Gorgonacea* sp) were recorded but crab and shrimp species were dominant in the trawl samples. The demersal community was diverse but abundances were low. Of the species identified, gorgonian soft corals were considered in that study to be of ecological value. The study concluded that in comparison with other areas in Hong Kong, the diversity of fish and macroinvertebrate communities found in the trawl surveys at South Tsing Yi was low.

A benthic community study by trawling at North of Lantau [7] (marked as T2 in *Figure 8.3b*) showed that the habitats were dominated by gastropods. It is unlikely that there are any large hard coral colonies in the Study Area of this project due to the ambient conditions of high levels of suspended solids, low light penetration and the influence of low salinity waters of Pearl River.

8.3.2 Intertidal Habitats

The hydrodynamic characteristics of the Study Area are determined to a large extent by the influence of tidal currents and flows from the Pearl River Delta. Ebb tides flow down through the Urmston Road into Ma Wan Channel which diverts the flows southward. This flow pattern reverses during the flood tides. The circulation pattern creates a variety of intertidal habitats. When exposed to the current flows, the shorelines mainly consist of boulder and rocky habitat (eg North of Lantau and West of Ma Wan). However, in sheltered areas, mainly sandy shores are found (eg beaches near the reclamation area).

The Sham Tseng coastline where the reclamation will be undertaken consists of an approximately 200m stretch of natural hard bottom coastline and a length of approximately 900 m of artificial seawalls. Under Sham Tseng Development, it is proposed that Anglers' Beach and its adjacent sandy shore (approximately 300m) will be reclaimed (*Figure 8.3a*).
Rocky Shores

(5) Science Applications International Corporation (1993). REMOTS Survey of Soft-bottom Environments in Coastal Waters of Hong Kong, for Binnie Consultants and Civil Engineering Department.

(6) ERM Hong Kong Ltd (1995) Backfilling of South Tsing Yi and North of Lantau MBAs: Final Environmental Impact Assessment, for Civil Engineering Department

(7) Wu RSS and Richard J (1981). Variations in Benthic Community Structure in a Sub-tropical Estuary. Marine Ecology:64: 191-198.

Rocky shore organisms originated in purely marine habitats and have evolved and adapted to live on intertidal shores. The extent of their adaptations to this habitat will dictate where they are found on the shores. The more adapted the species is to terrestrial conditions, the higher it will be found on the shore. This cause zonation patterns on the shore. The abundance of intertidal organisms will be affected by their recruitment period and the primary productivity of the shore. Typical exposed rocky shore communities consist of periwinkles, barnacles and limpets. Encrusting algae were common in the low intertidal zone.

Intertidal surveys near Kwai Shek undertaken by ERM in 1998 and 1999 [8] (see *Figures 8.3a* and *8.3b*) showed that the assemblages were typical of exposed rocky shore communities with high quantities of barnacles (*Capitulum mitella* and *Tetraclita squamosa*), chitons (*Acanthopleura japonica*), limpets (*Cellana toreuma* and *Patelloida saccharina*) and periwinkles (*Nodilittorina radiata* and *N. trochoides*). Bivalves and sea anemones were also found but in low abundance. Of the algae present, encrusting species were dominant in the wet season.

An intertidal survey was conducted by ERM at Sham Tseng Development area in September 1999 (*Figure 8.3a;* marked as S2 in *Figure 8.3b*). It showed that the assemblages contained species found on semi-exposed rocky shores communities such as near Kwai Shek on the North Lantau coast, with high quantities of barnacles (*Capitulum mitella*, *Tetraclita squamosa* and *Balanus amphitrite*), limpets (*Patelloida saccharina*) and periwinkles (*Nodilittorina radiata* and *N. trochoides*). Low numbers of chitons (*Acanthopleura japonica*), whelks (*Thais* sp) and rock oysters (*Saccostrea* sp) were recorded.

Natural Sandy Shores

ERM have previously surveyed two small intertidal sandy shores on the north-eastern coast of Lantau [9] (marked as S3 in *Figure 8.3b*). Results indicated that these sandy shores supported benthic assemblages of low diversity. The lower shore was bordered by cobbles which provided habitats for snails (*Monodonta australis*), limpets (*Notoacmaea concinna*) and polychaetes (*Hydroides elegans*). The sand-hopper *Orchestia* sp was the most abundant species observed on the shore. These survey results are taken as representative of the baseline information for the intertidal sandy shore habitats in the Study Area. The Study Area contains many very small sandy shore areas which are illustrated on the habitat map presented in *Figure 8.3a*. The impact assessment has been performed on the assumption that the many small sandy shores in the area support similar assemblages to those reported during the surveys of north-eastern Lantau.

An intertidal survey conducted by ERM at Sham Tseng Development area in September 1999 (marked as S2 in *Figure 8.3b*) showed that the naturalness of the intertidal soft shore adjacent to the Anglers' Beach is intensively impacted

([8]) Scott Wilson (1999). Northshore Lantau Development Feasibility Study: Draft Initial Assessment Report.
([9]) *Ibid.*

by human activities and benthic assemblages are found to be composed of modified sandy shores as discussed in the following section.

Modified Sandy Shores (Gazetted Beaches)

Along the coastlines of Sham Tseng, there are sheltered sandy beaches including Anglers' Beach, Lido Beach, Casam Beach, Ho Mei Wan Beach, Gemini Beach and Dragon Beach. Of the gazetted beaches, all were categorised as "Grade 3" beaches of poor water quality under EPD's monitoring system [10] and Anglers' Beach will be reclaimed under this Study[11]. The annual geometric mean *E coli* densities in marine water were recorded in the range of 180 - 610 per 100mL. A recent survey at Anglers' Beach in September 1999 indicated that only a few small unidentified crabs were found on the beach (*Figure 8.3a*).

Artificial Seawalls

Few surveys have been conducted on the colonisation of organisms on artificial seawalls in Hong Kong but examples can be found [12][13]. Fouling organisms have, however, been anecdotally recorded as common on artificial seawalls, wharf piles and other marine structures [14]. Various species of algae, coelenterates, ascidians, bryozoans, sponges, crustaceans, molluscs and polychaetes are commonly observed on these artificial structures (*Table 8.3e*). Therefore, it can be presumed that species commonly found on these surfaces in Hong Kong waters will be found on the artificial seawalls of the established complexes at Sham Tseng.

Table 8.3e Common Organisms present on Artificial Seawalls in Hong Kong (Adapted from Morton and Morton 1983)

Group	Species
Algae	*Ulva fasciata* *Enteromorpha prolifera* *Codium cylindricum* *Colpomenia sinuosa*
Polychaete	*Hydroides elegans* *Spirorbis foraminosus*
Bryozoan	*Bugula neritina*
Bivalve	*Perna virdis* *Septifer virgatus* *Saccostrea cucullata* *Electroma liratum*
Barnacle	*Balanus amphitrite* *Capitulum mitella* *Tetraclita squamosa*
Ascidian	*Ascidia sydniensis* *Ciona intestinalis* *Styela plicata*

(10) EPD Waste and Water Division (1998). Beach Water Quality in Hong Kong 1998.
(11) Scott Wilson (1998). Planning and Engineering Feasibility Study for Development on Sham Tseng Further Reclamation: Draft EIA - Stage I Report.
(12) Binnie Consultants Limited (1996). Fill Management Study - Phase IV Investigation and Development of Marine Borrow Areas: Coral Growth at High Island Dam. Report submitted to CED GEO, July 1996.
(13) Binnie Consultant Limited (1997). Chek Lap Kok Qualitative Survey. Final Report to CED GEO, December 1997.
(14) Morton B & Morton J (1983). *op cit.*

8.3.3 Marine Mammals

The Chinese White Dolphin (*Sousa chinensis*) and the Finless Porpoise (*Neophocaena phocaenoides*) are the only species of marine mammal regularly sighted in Hong Kong waters. Sightings of the Finless Porpoise have mainly been in southern waters of Hong Kong and thus this species is not considered to be a key issue of concern for this Study. The population of *Sousa chinensis*, however, is reported to be centred around the Pearl River Estuary and Hong Kong waters are thought to represent the eastern portion of its range [15]. North Lantau represents the major areas of distribution of dolphins in Hong Kong waters, and is the only place in Hong Kong where dolphins are seen year round. Schools of dolphins are most frequently sighted in the western part of these waters around the Sha Chau, Lung Kwu Chau Marine Park and the new Airport (*Figure 8.3c*).

The East Lantau waters show a seasonal pattern in sightings of the dolphin. During the spring and early summer months few dolphins have been observed near the Study Area, however, during autumn and winter they have been regularly sighted [16] (*Figure 8.3c*). Sightings of dolphins were found to be rare near the reclamation area.

8.4 ECOLOGICAL IMPORTANCE

According to the *EIAO TM Annex 8* the ecological value / importance of a habitat can be evaluated using the following criteria:

- Naturalness;
- Size;
- Diversity;
- Rarity;
- Re-creatability;
- Ecological Linkage;
- Potential Value;
- Nursery Ground;
- Age; and
- Abundance.

The criteria listed above have been applied to the information gathered or reviewed on the marine ecology of the intertidal hard bottom, and the intertidal and subtidal soft bottom habitats within the proposed Sham Tseng Development. The application of these criteria has led the intertidal hard bottom habitat to be classified as low, whereas, the intertidal and subtidal soft

[15] Jefferson T A (1998). Population Biology of the Indo-Pacific Hump-backed Dolphin (*Sousa chinensis* Osbeck, 1765) in Hong Kong Waters. Final Report to AFD.

[16] *Ibid.*

bottom habitats have also been classified as low (*Table 8.4a*).

Based on the field surveys conducted for other studies presented in *Section 8.3*, it shows that marine ecological resources of the Study Area are dominated by soft bottom assemblages of low ecological value and hard bottom assemblages of medium ecological value (*Tables 8.4b* and *8.4c*).

Table 8.4a Ecological Value of Marine Habitats within the Reclamation Site at Sham Tseng

Criteria	Intertidal Hard Bottom Habitat	Intertidal Soft Bottom Habitat	Subtidal Soft Bottom Habitat
Naturalness	The habitat is disturbed by human impacts through nullah discharges and development of residential & industrial areas, with the existing artificial seawalls.	Anglers' Beach (250 m) and its adjacent sandy shore (50 m) are highly disturbed and polluted by human impacts through nullah discharges and development for recreation.	The subtidal area is almost entirely in its natural state, except that the area will probably be polluted by discharges from two adjacent nullahs.
Size	The affected area covers a natural coastline of 200 m and 900 m artificial seawalls.	The affected area covers a coastline of 300 m.	The area to be reclaimed is of 15.2 hectares.
Diversity	The intertidal communities appear to be typical of semi-exposed shores in Hong Kong.	Reviewed literature indicates that such highly polluted beach supports low diversity assemblages.	Soft bottom benthos of low diversity.
Rarity	None.	None.	None.
Re-creatability	The habitat can be recreated.	The habitat cannot be recreated on site.	The habitat cannot be recreated on site.
Ecological Linkage	Is considered as low. The surrounding environment mainly contains gazetted beaches and man-made seawalls.	The surrounding environment contains similar intertidal habitats.	The surrounding environment contains similar subtidal soft bottom habitats.
Potential Value	High levels of human disturbance signify that it is unlikely that the habitat could develop conservation interest.	High levels of human disturbance signify that it is unlikely that the habitat could develop conservation interest.	It is unlikely that the site can develop conservation interest.
Nursery Area	None identified during the literature review.		
Age	Not applicable for these assemblages as the life cycle of the fauna is very short.	Not applicable for these assemblages as the life cycle of the fauna is very short	The subtidal fauna is generally short lived.
Abundance	Intertidal assemblages appear to be typical of other semi-exposed shores in Hong Kong.	Reviewed literature indicates that such highly polluted beach supports low abundance of intertidal organisms.	Reviewed literature indicates that high abundance of organisms but are of low diversity and biomass.
SUMMARY	The natural hard bottom assemblages and artificial seawalls are of **low ecological value** due to intensive human impacts to these habitats such as nullah discharges and development of residential & industrial areas.	Literature reviews indicate that gazetted beaches support low diversity and abundance of assemblages typical of other recreational beaches in Hong Kong. Natural sandy shore in the vicinity of the gazetted beaches will be impacted by nullah discharges and development for recreation, and they shall support assemblages of low abundance and diversity. **Ecological Value - Low.**	The sediments support low diversity and abundance of infaunal and epifaunal organisms that are typical to Hong Kong's benthos. **Ecological Value - Low.**

Table 8.4b *Ecological Value of Marine Soft Substrate Habitats in the Study Area (Reclamation Area Excluded)*

Criteria	Natural Sandy Shore	Beach (near Sham Tseng and Tsing Lung Tau)	Subtidal Soft Bottom Habitat
Naturalness	Sandy shores at north-eastern Lantau are natural habitats.	Some of the shores are highly disturbed by human impacts through development for recreation as gazetted beaches.	Some parts of the Study Area serve as navigation channels that are dredged for maintenance periodically. This indicates that the assemblages present there at some point in the past been disturbed.
Size	Based on the operational constraints on minimise release of materials from the reclamation area, area indirectly impacted will be small and located in the vicinity of the reclamation area.		
Diversity	The intertidal communities appear to be typical of sandy shores in Hong Kong.	Reviewed literature indicates that beaches that are frequently used for recreational purposes support low diversity assemblages.	Soft bottom benthos of low diversity.
Rarity	None.	None.	None.
Re-creatability	The habitat cannot be re-created on site.		
Ecological Linkage	The surrounding environment contains similar intertidal habitats.	The surrounding environment contains similar intertidal habitats.	The surrounding environment contains similar subtidal soft bottom habitats.
Potential Value	It is unlikely that the site can develop conservation interest.	High levels of human disturbance signify that it is unlikely that the habitat could develop conservation interest.	It is unlikely that the site can develop conservation interest.
Nursery Area	None identified during the literature review.		
Age	Not applicable for these assemblages as the life cycle of the fauna is very short.	Not applicable for these assemblages as the life cycle of the fauna is very short.	The subtidal fauna is generally short lived.
Abundance	Reviewed literature indicates that low abundance of intertidal organisms are supported.	Reviewed literature indicates that beaches that are frequently used for recreational purposes supporting low abundance of intertidal organisms.	Reviewed literature indicates that high abundance of organisms but are of low diversity and biomass.
SUMMARY	The sandy shores support low diversity and abundance of intertidal organisms that are typical to Hong Kong. **Ecological Value - Low.**	Literature reviews indicate that gazetted beaches support low diversity and abundance of assemblages typical of other recreational beaches in Hong Kong. **Ecological Value - Low.**	The sediments support low diversity and abundance of infaunal and epifaunal organisms that are typical to Hong Kong's benthos. **Ecological Value - Low.**

Table 8.4c Ecological Value of Hard Bottom Habitats in the Study Area (Reclamation Area Excluded)

Criteria	Natural Rocky Shore
Naturalness	The habitat is undisturbed by human impact due to the steep rocky terrain of much of the intertidal zone and remoteness of the shore.
Size	Based on the small-scale dredging/reclamation works, area indirectly impacted will be small and located in the vicinity of the construction site.
Diversity	The intertidal communities are typical of semi-exposed rocky shores in Hong Kong
Rarity	No species recorded are considered rare.
Re-creatability	The habitat can be re-created.
Ecological Linkage	The surrounding environment contains similar intertidal habitats.
Potential Value	In terms of typical undisturbed exposed shores in Hong Kong, the shores have conservation interest.
Nursery Area	None identified during the literature review or field survey.
Age	Not applicable for these assemblages as the life cycle of the fauna and flora is very short.
Abundance	Assemblages appear to be typical of other exposed shores in Hong Kong.
SUMMARY	The assemblages of the intertidal region appear to be typical of exposed shores in Hong Kong. The sites appear to have suffered little human disturbance. **Ecological Value - Medium.**

The same assessment criteria have been applied to the marine waters off the reclamation area. This habitat has been classified as of medium ecological value resulting from the reported use of the areas by Chinese White Dolphin *Sousa chinensis* (*Table 8.4d*).

Table 8.4d Ecological Value of the Marine Waters off the Reclamation Area

Criteria	Marine Waters off Sham Tseng
Naturalness	Disturbed through residential discharges. Close proximity to one of the busiest shipping lanes in Hong Kong.
Rarity	The Chinese White Dolphin (*Sousa chinensis*) has been recorded in these waters.
Re-creatability	The habitat cannot be recreated.
Ecological Linkage	Preferred marine mammal habitats occur to the west of this area (around the Sha Chau and Lung Kwu Chau Marine Park, and the new Airport).
Potential value	Limited value due to heavy navigational use of the area.
Nursery Area	No nursery areas were identified in the review of marine ecology baseline conditions.
Abundance	Seasonal changes in the distribution patterns of dolphins were observed, with comparatively higher abundances in autumn and winter. However, these abundances are low when compared with preferred habitats to the west.
SUMMARY	Sightings of the Chinese White Dolphin (*Sousa chinensis*) have been made in the area. However, the number of sightings varies seasonally and the area is not regarded as preferred habitat. This area is heavily used by marine traffic at present. **Ecological Value - Medium.**

8.5 MARINE ECOLOGICAL SENSITIVE RECEIVERS

Based on the preceding review of the available information on baseline ecology of the waters in the Study Area (see *Section 8.3*) and an assessment of ecological iportance of the habitats (see *Section 8.4*), both the natural intertidal rocky shores and sandy shores (including gazetted beaches) within the reclamation site at Sham Tseng have been classified as low ecological value. The subtidal soft bottom habitats in the Study Area have been classified as of low ecological value. Both the natural intertidal rocky shores and intertidal sandy shores (including gazetted beaches) at Sham Tseng have been classified as low ecological value. However, natural intertidal rocky shores on the north-eastern Lantau coastline (within the Study Area) have been classified as medium ecological value. For the marine mammal habitats, waters off the reclamation area have been classified as medium ecological value. Ecological sensitive receivers are considered to be those habitats or species of medium or high ecological value. The sensitive receivers which may be affected by the proposed project have been identified as natural intertidal rocky shores on the north-eastern Lantau coastline and the seasonally variable population of the Chinese White Dolphin, *Sousa chinensis*.

8.6 POTENTIAL IMPACTS

Impacts to marine ecological resources may arise during the reclamation. They may be derived from direct disturbance to the habitat and indirect disturbances through changes to key water quality parameters.

8.6.1 *Construction Impacts*

Direct Impacts

Direct impacts mainly come from habitat loss of areas proposed to be reclaimed at Sham Tseng. According to the proposed reclamation works plan, potential habitat loss will occur by reclaiming areas of intertidal habitat (including 250 m of natural shoreline, 250 m gazetted beach and 900 m artificial seawalls) of low ecological value and soft-bottom subtidal habitat (15.2 ha) of low ecological value. Despite that 250 m of natural coastline, 250 m of gazetted beach, 900 m of artificial seawalls and 15.2 ha of subtidal soft-bottom habitat will be affected, the impacts due to habitat loss are not expected to be unacceptable as the reclaimed area contains assemblages of low ecological value (see *Section 8.4*) and seawalls will be constructed as mitigation measure to enhance recolonisation of benthic organisms.

Recent information from dive surveys conducted as part of *Agreement CE 1/96* has indicated that some solitary colonies of octocorals and hard corals are present along the stretch of shoreline close to the Sham Tseng Study Area[17]. The recorded corals included a species of reef-building coral (*Oulastrea crispate),* a species of non-reef building cup-coral (either *Balanophyllia* or *Phyllangia sp.*), two species of gorgonians (*Euplexaura* sp. and

[17] Mouchel Halcrow JV (2001) Castle Peak Road Improvement between Area 2 and Ka Loon Tsuen, Tsuen Wan D & C Consultancy. Marine Ecology Baseline Survey. August 2001.

Echinomuricea sp.) and two species of soft corals (*Dendronephthya* species). All the stony corals recorded in the area are described as common throughout Hong Kong waters (Scott, 1984). The octocorals are also regarded as common and widespread. The total coral cover in the survey areas was less than 1%. It is expected that the area to be reclaimed at Sham Tseng will contain corals of similar abundance and ecological value as those reported in the recent dive surveys. It is expected that the overall impact to the corals within the areas to be reclaimed will be minor as only a few common species will be lost and percentage cover was reported at less than 1%. The provision of seawalls, as discussed above, is likely to provide a suitable hard surface for colonisation by rock shore epibenthic fauna that may include corals. It is noted that the gorgonian *Echinomuricea* sp. has been reported colonizing the granite seawall on Lamma Power Station in a relatively short period of time (less than 5 years) following extensive marine works.

Indirect Impacts

Indirect impacts to marine ecology mainly arise from sediment release during dredging and reclamation works. Potential impacts to water quality from sediment release are listed below:

- increased concentrations of suspended solids (SS);
- a resulting decrease in dissolved oxygen (DO) concentrations; and
- an increase in nutrient concentrations in the water column.

Suspended Solids

The potential impacts of suspended solids to the corals in the vicinity of the project site are anticipated to be minimal. The corals in the area are sparse and in poor condition. Furthermore, they should be well-adapted to short term elevated suspended solid, as the western waters is typically composed of relatively high level of sediment and the seabed in the area is frequently disturbed. It is expected that the affected corals would recover with a relatively short timeframe. Damage (sublethal effects) or mortality (lethal effects) occur as the deposition of sediment onto the organisms surface physically blocks the respiratory and feeding apparatus. Sessile organisms within the benthos will be susceptible to the effects of increased sediment loads. Effects can be lethal or sublethal (eg reduction in reproductive potential due to stress incurred by constantly having to flush out the depositing material). The effects of sedimentation on organisms will also depend on other factors, such as an organism's tolerance, growth orientation of sessile organisms and water movement.

Based on the prediction that only a total volume of approximately 0.16 Mm^3 sediment will be dredged for the construction of seawalls at Sham Tseng, the release of suspended sediment is expected to be negligible. Water quality modelling results (detailed in *Section 3*) indicated that depth-averaged total SS concentrations never exceeded 20mg L^{-1} under Constructions 1 and 2 at all the sensitive receivers for wet and dry seasons (see *Section 3*). When compared to the baseline SS concentrations of 10-20 mg L^{-1} during wet season and of 10-

15 mg L^{-1} during dry season, the SS elevations due to construction works constituted less than 30% of the baseline SS concentrations at those sensitive receivers. Therefore, SS elevations shall be in compliance with WQO criterion.

Sediment testing results showed that sediments to be dredged from Sham Tseng were found to be uncontaminated (see *Section 6.6*), with the exception of the sediments at the outfall of the nullah. As the seawalls will be constructed far beyond the outfall of the nullah, the release of contaminated sediments and dissolved contaminants would likely be minimal and not a key issue of concern to this Study.

Dissolved Oxygen

The relationships between SS originated from reclamation work and DO are complex. Increased SS in the water column combines with a number of other effects to reduce DO concentrations in water. Elevated SS (and turbidity) reduces light penetration, lowers the rate of photosynthesis of phytoplankton (primary productivity) and thus lowers the rate of oxygen production in the water column. This has a particularly adverse effect on the eggs and larvae of fish, as at these stages of development high levels of oxygen in the water are required for growth due to high metabolic rate. Although respiratory responses and tolerance of hypoxia have been studied in Hong Kong in two marine fish [18], it is not possible to set critical thresholds for this parameter for other marine organisms due to lack of tolerance data for species in Hong Kong. DO depletions are most likely to affect sessile organisms as they cannot move away from areas where DO is low. As SS release due to the construction works will be minimal, impacts derived from DO depletion are predicted to be negligible (depth-averaged total DO > 4 mg L^{-1} which are in compliance with WQO for both wet and dry seasons, see *Section 3*) and therefore acceptable to intertidal benthic assemblages, subtidal benthos and marine mammals in the Study Area.

Nutrients

High levels of nutrients in seawater can cause rapid increases in phytoplankton often to the point where an algal bloom occurs. An intense bloom of algae can lead to a sharp decrease in the levels of dissolved oxygen in the water as dead algae fall through the water column and decompose on the bottom. Anoxic conditions may result if DO concentrations are already low or are not replenished. This may result in mortality to marine organisms due to oxygen deprivation. As SS release due to the construction works will be minimal, impacts derived from the elevation of nutrients are likely to be negligible and, therefore, acceptable to intertidal benthic assemblages, subtidal benthos and marine mammals in the Study Area.

[18] Wu RSS & Woo NYS (1984). Respiratory Responses and Tolerance to Hypoxia in Two Marine Teleosts, *Epinephelus akaara* (Temminck & Schlegel) and *Mylio macrocephalus* (Basilewsky). Hydrobiologia 119: 209-217.

Based on the discussion in the preceding paragraphs and conclusion in *Section 3*, there are no insurmountable water quality impacts associated with the construction phase. The SS elevations are predicted to be low and acceptable to intertidal benthic assemblages, subtidal benthos and marine mammals in the Study Area.

Other Indirect Impacts

The Sham Tseng Development could potentially result in an increase in marine traffic and underwater noise affecting the Chinese White Dolphin *Sousa chinensis*. Studies have shown that because of the efficient transfer of sound in water, dolphins can detect noises associated with vessels similar to dredgers at distances up to approximately 5 km. Noise disturbance interferes with communication and echolocation pulses which are used for navigation and feeding, leading to behavioural changes. There is evidence suggesting that some cetacean species will minimise their use of areas affected by underwater noise. In addition, increase in marine traffics may disturb normal cetacean movement patterns through potential collision with vessels, increased turbidity generated by propellers and submerged equipment.

Most dolphins can hear within the range of 1-150 kHz though the peak for a variety of species is between 8-90 kHz [19]. Dredging and large vessel traffic generally results in mostly low frequency noise typically in the range of 0.02-1 kHz [20] which are below the peak range of 8-90 kHz reported for dolphins and therefore, would not likely cause problems.

The reclamation works may cause perturbations to water quality which may potentially impact the fisheries resources of the North-eastern Lantau area. *Sousa chinensis* is known to feed on fish species that are abundant in North-eastern Lantau waters. These species are generally of low commercial value and are pelagic in nature (Anchovies - Family Engraulidae, Croakers - Family Sciaenidae, Sardines - Family Clupeidae). They are thus likely to be indirectly affected by changes in key water quality parameters (such as SS and DO) arising from the reclamation project. A significant deterioration in water quality is likely to cause fish to move out of the impacted area thus interfering with the dolphins' normal feeding patterns. Information from the water quality section indicates that perturbances to key water quality parameters are not expected to exceed environmentally acceptable levels (as defined by the WQOs) and thus impacts to marine mammal via impacts to their fishery food sources are not anticipated.

As highlighted in the preceding paragraphs, marine traffic underwater noise and perturbations to water quality derived from the reclamation works have the potential to cause *Sousa chinensis* to move away from the Study Area. However, these impacts are expected to be transient (dredging will last for approximately 18 weeks during the 50 months of reclamation works) and low magnitude and therefore acceptable as dolphins will resume their activities in

[19] Richardson et al (1995). Marine Mammals and Noise. Academic Press.
[20] *Ibid.*

the area once the reclamation is complete. Furthermore, as areas near the reclamation site are not the preferred locations for the dolphins, these impacts to their activities are not likely to be unacceptable.

8.6.2 Operational Impacts

Discharge of sewage effluents are predicted to increase with increasing number of residents. Provided that there is no illegal discharge of untreated sewage and all the treated sewage effluents are in compliance with criteria (Western Buffer WCZ and North Western WCZ WQO, and specifications in relevant discharge licences), the impacts due to increased discharge of treated sewage effluents are unlikely to be unacceptable.

8.7 IMPACT EVALUATION

The severity of ecological impact associated with the proposed reclamation project is considered low. An evaluation of the impact in accordance with the *EIAO TM Annex 8 Table 1* is presented as follows:

- *Habitat Quality:* Areas covering intertidal and subtidal assemblages of low ecological value will be lost and replaced with artificial seawalls. Soft bottom habitats in the vicinity of the reclamation area at Sham Tseng may be perturbed by small SS elevations and DO depletion, but the assemblages are of low ecological value.

- *Species:* Information indicates that no rare species are likely to be occur in the areas near Sham Tseng. The only ecologically important species recorded in the Study Area is the Chinese White Dolphin. Impacts to the dolphins are predicted to be minimal and transient (dredging will last for approximately 18 weeks during the 50 months of reclamation works) such that they can resume normal activities after the reclamation works. Although some solitary coral colonies have been recorded in the Study Area their diversity and abundance was low and they are considered to be common species in Hong Kong.

- *Size:* Areas covering intertidal assemblages (200 m natural rocky shore, 250 m gazetted beach, 50 m natural sandy shore, and 900 m artificial seawalls) of low ecological value and subtidal assemblages (15.2 hectares) of low ecological value will be lost and replaced with artificial seawalls. Based on the constraints applied on the dredging and reclamation works with predicted acceptable SS elevations (*Section 3*), the size of the indirectly impacted area is expected to be small.

- *Duration:* Increases in SS levels outside of the reclamation area are expected to be low and temporary (dredging will last for approximately 18 weeks during the 50 months of reclamation works), and are within environmentally acceptable levels as defined by the WQO (*Section 3*).

- *Reversibility:* Except the habitat loss of the intertidal assemblages covering 1400 m coastline (including 250 m of natural coastline, 250 m of gazetted beach, and 900 m artificial seawalls) and subtidal soft benthos covering an area of approximately 15.2 hectares at Sham Tseng, impacts to the benthic communities outside the reclamation area are expected to be temporary and recolonisation of seawalls at the reclamation site is expected to occur after the reclamation works.

- *Magnitude:* The impacts to the habitats identified will be of low magnitude.

8.8 MITIGATION MEASURES

In accordance with the guidelines in the TM on marine ecology impact assessment the general policy for mitigating impacts to marine ecological resources, in order of priority, are:

Avoidance: Potential impacts should be avoided to the maximum extent practicable by adopting suitable alternatives.

Minimisation: Unavoidable impacts should be minimised by taking appropriate and practicable measures such as constraints on intensity of works operations (eg dredging rates) or timing of works operations.

Compensation: The loss of important species and habitats may be provided for elsewhere as compensation. Enhancement and other conservation measures should always be considered whenever possible.

Impacts resulting from the proposed reclamation works are predicted to be confined to within the reclamation area and, therefore, will not cause any adverse impacts to any habitats or species of conservation importance. Constraints on reclamation operations recommended to control impacts to water quality (see *Section 3*) to within acceptable levels during reclamation are expected to also control impacts to marine ecology. In addition, the loss of the assemblages within the reclamation area can be mitigated through the subsequent recolonisation of fauna on the seawalls after construction. Therefore, no special mitigation measures are recommended for marine ecological sensitive receivers. Cumulative impacts predicted to arise from the proposed reclamation operations in conjunction with concurrent projects are not expected to result in greater adverse impacts to marine ecological sensitive receivers than impacts arising from the concurrent projects independently.

8.9 RESIDUAL IMPACT

Taking into consideration the ecological value of the habitats discussed in the previous sections the residual impact can be determined. The residual impact occurring as a result of the proposed Sham Tseng Development Project is as follows:

- The loss of the intertidal hard bottom assemblages covering 250 m natural coastline, 250m of gazetted beach, 900 m of artificial coastline and intertidal soft bottom assemblages covering an area of approximately 15.2 ha at Sham Tseng Development area.

The loss of the assemblages within the reclamation area can be mitigated through the subsequent recolonisation of fauna on the seawalls after construction. The residual impact is considered to be acceptable as the habitat is of low ecological value and only a total area of 15.2 hectares is expected to be impacted.

8.10 ENVIRONMENTAL MONITORING AND AUDIT

The Study includes the development of an operational design which consists of appropriate mitigation measures to reduce environmental impacts to acceptable levels. Actual impacts during reclamation operations will be monitored through an EM&A programme which is specified in an EM&A Manual released as a separate document to the EIA. Monitoring and audit activities designed to detect and mitigate any unacceptable impacts to water quality will also serve to protect against unacceptable impacts to ecologically valuable species and habitats. The EM&A programme will provide management actions and supplemental mitigation measures to be employed should impacts arise, thereby ensuring the environmental acceptability of the project. As no unacceptable impacts to marine ecology are expected to occur, the development and implementation of a monitoring and audit programme specifically designed to assess the effects associated with the Sham Tseng Development on marine ecology is not necessary.

8.11 CONCLUSIONS

A review of existing information supplemented with a summary of the results of recent intertidal surveys near Sham Tseng and Kwai Shek during 1998-99 indicate that the Study Area supports intertidal hard-bottom and soft-bottom assemblages and subtidal soft benthos. From the literature review, the Study Area was considered as important to one marine mammal, *Sousa chinensis.*

Direct impacts during the construction phase will occur through habitat loss in the area that is to be dredged or reclaimed and will affect the soft benthos as well as hard surface assemblages at Sham Tseng. The assemblages lost are of low ecological value and reclamation size is small (approximately 15.2 ha).

Indirect impacts during the construction phase such as an increase in suspended sediment concentrations and decrease in dissolved oxygen in the water column may impact filter feeders living on intertidal and subtidal habitats. However, these indirect impacts are anticipated to be localised and transient. The impacts to Chinese White Dolphin are predicted to be minimal and transient (dredging will last for approximately 18 weeks during the 50 months of reclamation works) such that they can resume normal activities after the reclamation works. Sightings of dolphins was found to be rare in and near the reclamation area. In addition, any constraints on construction operations recommended to reduce impacts to water quality to acceptable levels are expected to also mitigate for effects on marine ecology. Impacts during the operational phase are predicted to be negligible and should not be a cause of concern.

The residual impact occurring as a result of construction and operation of the Sham Tseng Development is the loss of the intertidal hard bottom assemblages covering 250 m of natural coastline and 250 m of gazetted beach, 900 m of artificial coastline and intertidal soft bottom assemblages covering an area of approximately 15.2 ha at the area of Sham Tseng Development.

The loss of the assemblages within the construction site can be mitigated through the subsequent recolonisation of fauna on the seawalls after construction. The monitoring and audit activities designed to detect and mitigate any unacceptable impacts to water quality *(Section 3)* will also serve to protect against unacceptable indirect impacts to ecologically valuable marine species and habitats. As no unacceptable impacts to marine ecology are expected to occur, the development and implementation of a monitoring and audit programme specifically designed to assess the effects associated with the Sham Tseng Development on marine ecology is not necessary.