

APPENDIX A9.1
DIVE SURVEY REPORT

Appendix 9.1 DIVE SURVEY REPORT

Background information

Subtidal surveys were conducted at Kau Sai Chau, Sai Kung, as part of the Environmental Impact Assessment being conducted according to EIA Study Brief No. ESB-064/2000. The project mainly involves the extension of the public golf course on Kau Sai Chau and related infrastructure.

Two components of the project would involve subtidal works, i.e. a desalination plant and a temporary barging point. Based upon the information from engineers, the construction of the desalination plant would include the installation of two pipelines beneath seabed and dredging would be needed, while the temporary barging point would be needed during the construction phase and will be removed after construction.

To collect ecological information for assessment of direct ecological impacts on marine ecology, a subtidal dive survey was carried out for the Project. There were two major objectives of the present dive survey at Kau Sai Chau:

- 1) To select the preferred site for each of the desalination plant and the temporary barging point, so as to facilitate the follow-up coral mapping survey; and
- 2) Provide baseline information on the coastal waters around Kau Sai Chau, in particular the eastern shore where the proposed golf course extension would be located. Direct and indirect impacts will be assessed in the EIA study based upon this information. .

Study sites

Five potential sites were identified by engineers for the desalination plant and temporary barging point (see **Figure 1**). Two sites were on western Kau Sai Chau, one located within the boundary of the proposed golf course extension (D1), and one within the existing golf course (D2).

Three additional sites were located on eastern Kau Sai Chau. The first was on the east coast of Kau Sai Chau opposite Kai Chau (B1), the second was approximately 300 m south of B1 and close to a small existing pier (B2), while the last was on the west coast of Kau Sai Chau and south of the existing golf course (D3).

Besides the two marine components, surface runoff from Hole 5 and Hole 6 of the proposed golf course extension would discharge into a receiving marsh wetland and then discharge into the sea on the eastern coastline (Location M in **Figure 1**). This site, together with a site studied before in 2000 (Location C) would also be surveyed by REA method.

In addition to REA survey, bounce-dives were also conducted in various locations between the REA sites to provide supplementary information.

Scope

The Study Area for this subtidal survey would cover the potential sites for the desalination plant and temporary barging point, the potential discharge location, the eastern coastline of Kau Sai Chau, and other locations off east Kau Sai Chau.

The survey recorded: :

A) the species, abundance, distribution, locations and the sizes, of (1) the marine benthic assemblages, (2) any coral colonies (hard and soft), (3) any other species of conservation concern or of high ecological value; and

B) the type of substrate, seabed profile, and type of marine communities, within the Study Area.

Methodology

The fieldwork took place from March to May 2005.

For the potential sites for the desalination plant and the temporary barging point:

A single transect (P Transect hereafter) with scale was deployed starting from the low watermark at each of the potential sites (D1, D2, D3, B1, and B2), perpendicular to the coast (surveyors determined on site), and toward the open sea. The exact locations of the starting point of the P transect were recorded with a portable Global Positioning System (GPS). The P transect extended for 100 m or reached the depth of - 10m C.D..

On each P transect, two 100 m transects were set following the contour of the seabed (H Transects hereafter) at any two of the three depths commonly adopted in dive surveys (i.e. -3m CD, -5m CD and -10m CD).

The benthic cover, taxon abundance, and ecological attributes of the P and H transects above were recorded in a swathe 4 m wide, 2 m either side of the transects, following the **Rapid Ecological Assessment (REA)** technique (Annex 1).

Video footage and underwater photographs were taken on the P and H transects. Photographs of representative coral species in the surveyed areas were also taken using an underwater camera.

Benthic cover/ecological attributes of the seabed were filmed at approximately 40 cm above the substrate and at a constant speed (in compliance with standard protocols for coral surveys, i.e. no more than 10 metres per minute). The video footages thus recorded a 40cm swath of seabed. The video camera was perpendicular to the substrate to minimise parallax error and to keep the substrate in focus.

The video footage for the P transect showed the zoning of seabed substrate along the transect, and also the distance of the band in which most corals were found. The present conditions of coral colonies were recorded both on site and extracted from the video footage.

Information concerning the physical nature of the surveyed sites was recorded during the survey. This consisted of observations regarding the degree of exposure of the sites to wave action, the nature of the substrate type and the topographic profile of the sites. The depth and substrate along the P transects were recorded at 5 m intervals.

The ecological importance of all the potential sites was evaluated and ranked. These results constituted part of the site selection process in which all factors including ecology and engineering were considered. One preferred site for the desalination plant and one for the temporary barging point was then recommended according to the outcome of the site selection process.

Detailed coral mapping surveys were conducted at the preferred sites for desalination plant and temporary barging point and reported separately (Appendix B).

For the eastern coast of Kau Sai Chau

Besides the surveys on each of the potential sites for desalination plant and barging point, the ecological profile of the coastline along the boundary of the proposed new golf course was also investigated (**Figure 1**).

REA was conducted at locations of high ecological value (i.e. Location C in **Figure 1**), and potentially affected by discharge from the new golf course (i.e. location M). The method of REA for these locations followed that for the potential sites of desalination plant and barging point above.

Information concerning the physical nature of the surveyed sites was recorded during the survey. This information consisted of observations regarding the degree of exposure of the points and sites to wave action, the nature of the substrate type and the topographic profile of the points and sites. The depth and substrate along the P transects for REA was recorded at 5m intervals.

Seven bounce-dives were conducted along the coastline adjacent to the boundary of the proposed new golf course. Bounce-dive points were selected by the divers on site depending on the site conditions. The location of each bounce-dive was recorded using GPS. Visual reconnaissance was made of the area of each bounce-dive point, by adopting a circular path. Video footages and underwater photographs were taken at each bounce-dive point. Video footage for the bounce-dive points showed any transitions of ecological conditions within the surveyed coastline.

Results

1) Site M

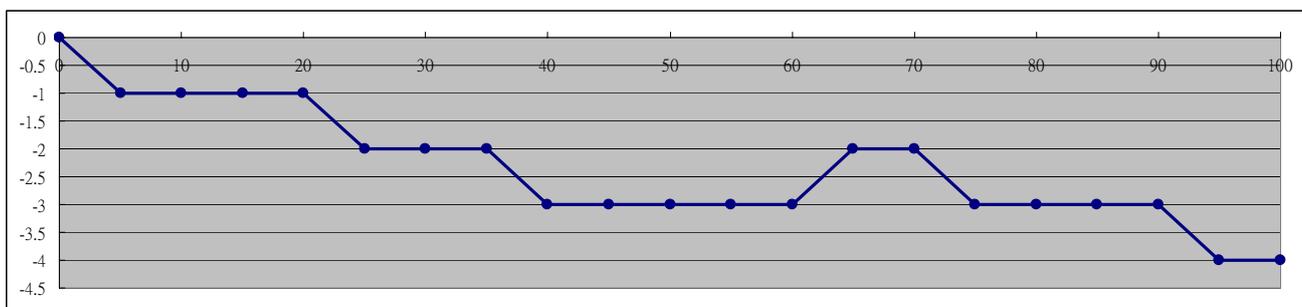
The survey was performed on 23 April 2005. The weather was sunny and the sea was calm and the visibility was poor (approximately 1.0 m).

This site faces Tai Tau Chau to the east of Kau Sai Chau. It is a small embayment at the outlet of a marsh within the existing golf course. Freshwater input from the marsh was discharged into the embayment. The coastline is natural rocky shore with steep gradient.

P transect started at the coastline (22°22.315N, 114°19.027E) and extended 100 m toward the sea at 90 E direction. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

Table 1 The profile of P Transect at Site M and schematic chart

Distance (m)	Depth (m C.D.)	Substratum
0	0	Boulders
5	-1	Muddy
10	-1	Muddy
15	-1	Muddy
20	-1	Muddy sandy
25	-2	Muddy sandy
30	-2	Muddy sandy
35	-2	Muddy sandy
40	-3	Muddy sandy
45	-3	Muddy sandy
50	-3	Muddy sandy
55	-3	Muddy sandy
60	-3	Muddy sandy
65	-2	Muddy sandy
70	-2	Muddy sandy
75	-3	Sandy
80	-3	Sandy
85	-3	Sandy
90	-3	Sandy
95	-4	Sandy
100	-4	Sandy



Except the boulders at the beginning of the P transect and the northern ends of the two H transects, the seabed was almost entirely muddy and sandy substrate.

The seabed was heavily covered by algae. Abundant Brown sea hare *Bursatella leachi* were found in great numbers among the algae. Some of them aggregated in packs or chains of several individuals (**Plate 1**). At the end of March this species comes ashore to breed and to browse the loose algae (Morton and Morton 1983). Green sea urchin *Salmacis sphaeroides*, and starfish *Archaster typicus* were also found at this site.

Only a few coral colonies (less than 10 colonies, including *Favia speciosa* and *Platygyra acuta*) were found at the end of the outer H transect close to the northern side of the embayment opening where marine waters were received from outer sea areas.

Five ecological and seven substratum attributes were assessed on site and by reviewing video footages. Each of the attributes (**Table 2**) was assigned to one of the seven standard ranked categories (from zero to six, representing percentage cover from none to over 76%).

Table 2 REA Ecological and Substratum attributes of P Transect at Site M

Ecological attributes	Rank
Hard coral	0
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	4
Substratum	
Hard substrate	1
Continuous pavement	0
Bedrock/boulders/sand	0
Rubble	0
Cobbles	0
Sand with gravel	4
Mud	3

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

2) Site B1

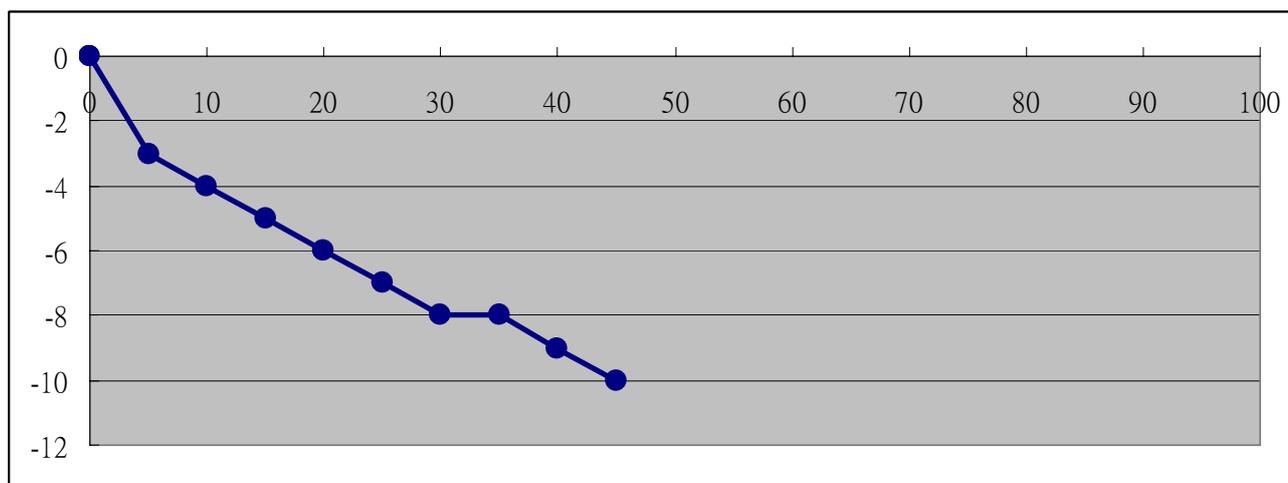
The survey was performed on 2 April 2005. The weather was fair and the sea was calm and the visibility was fair (approximately 3 m).

This site faces toward Kai Chau to the east of Kau Sai Chau. The coastline is natural rocky shore with steep gradient.

P transect started at the coastline (22°22.017N, 114°19.233E) and extended 45 m toward the sea at 90E direction till reaching -10m C.D. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

Table 3 The profile of P Transect at Site B1 and schematic chart

Distance (m)	0	5	10	15	20	25	30	35	40	45
Depth (m C.D.)	0	-3	-4	-5	-6	-7	-8	-8	-9	-10
Substratum	Granite rocks	Sandy with gravel and boulders	Large boulders	Sandy	Sandy	Sandy				



The seabed could be divided into three sections according to the substrate. From 0 m to 3 m along the transect, the substrate was granite rocks. From 3 m to 6 m, the substrate was a steeper slope mainly sandy bottom with occasional boulders. From 7 m to 40 m, it was abundant sandy with gravel and occasional boulders.

Along the P transect, only two coral colonies were found (6.5m and 25.4m from the shore).

Green sea urchin *Salmacis sphaeroides* and barnacles were abundant on and among granite rocks near the shore. Long-spined sea urchin *Diadema setosum* was also found on the top of large boulders 30m from the shore. There were also Sea cucumbers found (33m from the shore).

More corals were recorded on H1 which was at 3m water depth, including at least 22 coral colonies along the H1 transect at 5.3m, 5.7m, 6.5m, 7.5m, 8.2m, 8.8m, 9.6m, 10.4m, 10.9m, 11.2m, 12m, 13.6m, 14m, 15m, 67m (corals with sea urchins *Diadema setosum* and sponges), 68.3m, 68.8m, 72m, 73m, 73.4m, 80.6m, and 89.2m.

On H2 transect which was further offshore (about 6 m of water depth), only one coral colony was found on 89.9m on H2 transect. Other recorded organisms included sea anemones: (41.6m), and sea urchin *Diadema setosum* (51.3m). Some ghost-nets were also sighted at 56 m distance.

Recorded coral species included *Favia speciosa*, and *Turbinaria peltata*. Five ecological and seven substratum attributes were assessed on site and by reviewing video footages. Each of the attributes (**Table 4**) was assigned to one of the seven standard ranked categories (from zero to six, representing percentage cover from none to over 76%).

Table 4 REA Ecological and Substratum attributes of P Transect at Site B1

Ecological attributes	Rank
Hard coral	1
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	2
Substratum	
Hard substrate	3
Continuous pavement	0
Bedrock/boulders/sand	3
Rubble	0
Cobbles	0
Sand with gravel	5
Mud	0

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

3) Site B2

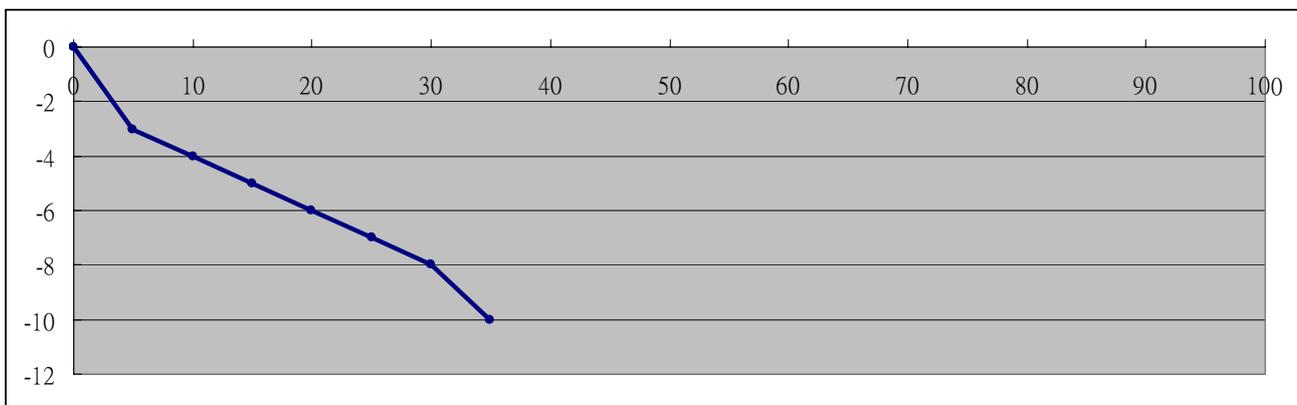
The survey was performed on 3 April 2005. The weather was fair and the sea was calm and the visibility was fair (approximately 3 m).

This site faces toward Kai Chau to the east of Kau Sai Chau. The coastline is natural rocky shore with steep gradient. This site is also adjacent to an abandoned pier which is though used by previous fish culture operators in the nearby Tiu Cham Wan FCZ.

P transect started at the coastline (22°21.887N, 114°19.250E) and extended 60 m toward the sea at 135SE direction till reaching -10m C.D. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

Table 5 The profile of P Transect at Site B2 and schematic chart

Distance (m)	0	5	10	15	20	25	30	35	40	45	50	55	60
Depth (m C.D.)	0	-3	-4	-5	-6	-7	-8	-10					
Substratum	Granite rocks	Sandy with boulders	Sandy with gravel	Sandy with gravel	Sandy	Sandy	Sandy with gravel	Sandy with gravel	Sandy with gravel	Muddy Sandy	Muddy sandy	Muddy	Muddy



Similar to B1 Site, the seabed further offshore was muddy or sandy and not suitable for hard coral colonisation. Only several coral colonies were found on P transect at 3m, 4.2m, 5.9m, 7m, and 13.5m from the shore. Sponges (23.8m) and anemone (46.8m) were also recorded.

24 hard coral colonies were found on the near shore H1 transect (15.8m from the shore and 3m of water depth) at 5.9m, 7.9m, 12m, 12.5m, 13.9m, 14.5m, 18.2m, 28.5m, 70.4m, 70.8m, 72.1m, 74.8m, 75.1m, 79.6m, 80.9m, 81.6m, 88m, 92.1m, 93.6m, 93.9m, 94.2m, 95.1m, 95.6m, and 98m. There were also some sponges (at 17.6m, 19.4m, 45.4m from the shore) on this transect. Only sponges and sea cucumbers, but no corals were found on H2 transect (of 6m water depth). Recorded coral species included *Pavona descussata* and *Platygyra acuta*.

Five ecological and seven substratum attributes were assessed on site and by reviewing video footage. Each of the attributes (**Table 6**) was assigned to one of the seven standard ranked categories (from zero to six, representing percentage cover from none to over 76%).

Table 6 REA Ecological and Substratum attributes of P Transect at Site B2

Ecological attributes	Rank
Hard coral	1
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	2
Substratum	
Hard substrate	2
Continuous pavement	0
Bedrock/boulders/sand	3
Rubble	0
Cobbles	0
Sand with gravel	4
Mud	2

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

4) Site D1

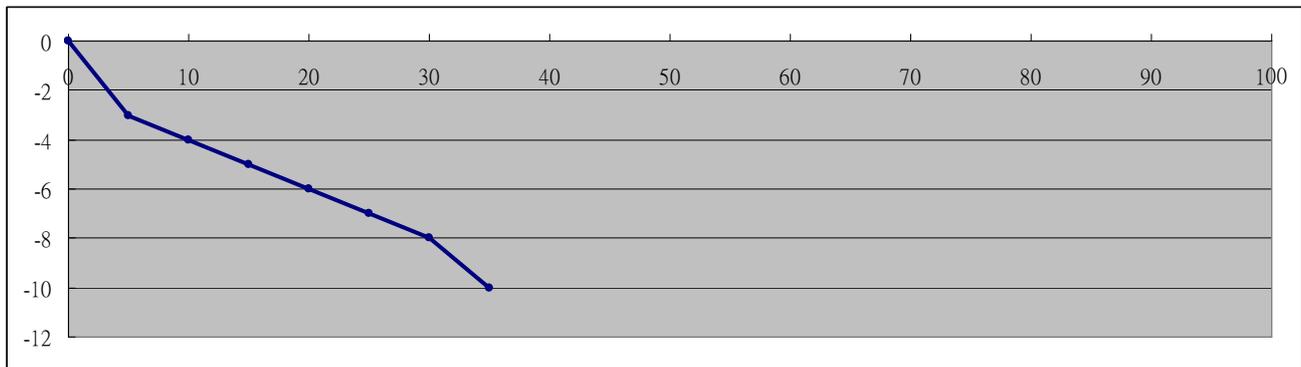
The survey was performed on 20 March 2005. The weather was fair and the sea was calm and the visibility was good (approximately 5 m).

This site faces the West Dam of High Island Reservoir. The coastline is natural rocky shore with steep gradient. This site is located south of a large embayment on east Kau Sai Chau.

P transect started at the coastline (22°21.575N, 114°19.379E) and extended 80 m toward the sea at 45NE direction till reaching -10m C.D. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

Table 7 The profile of P Transect at Site D1 and schematic chart

Distance (m)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Depth (m C.D.)	0	-3	-4	-5	-6	-7	-8	-10									
Substratum	Sandy with boulders	Sandy with gravel	Sandy with gravel	Sandy with gravel	Sandy	Sandy	Sandy	Sandy with occasional boulders	Sandy with occasional boulders	Sandy	Sandy with boulders	Muddy sandy	Muddy				



On P transect abundant corals colonised the seabed from 0 to 23 m (about 20% coverage within this area). Corals found included *Lithophyllon undulatum*, *Goniastrea aspera*, *Acropora tumida*, *Psammocora superficialis*, *Goniopora columna*, and *Platygyra acuta*. And the sizes of these colonies might reach 30 to 40 cm. Further away, the seabed turned into mainly sandy substrate and the corals were sparse.

On the H1 transect, there were also abundant corals from 43m to 90m, especially close to the P transect.. It was sandy bottom from 0 to 43 m. and from 90 to 100 the seabed was mainly sandy gravel with occasional corals. On H2 transect, corals were found only from 89m to 100m.

Table 8 REA Ecological and Substratum attributes of P Transect at Site D1

Ecological attributes	Rank
Hard coral	3
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	1
Substratum	
Hard substrate	2
Continuous pavement	0
Bedrock/boulders/sand	3
Rubble	0
Cobbles	0
Sand with gravel	5
Mud	1

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

5) Site D2

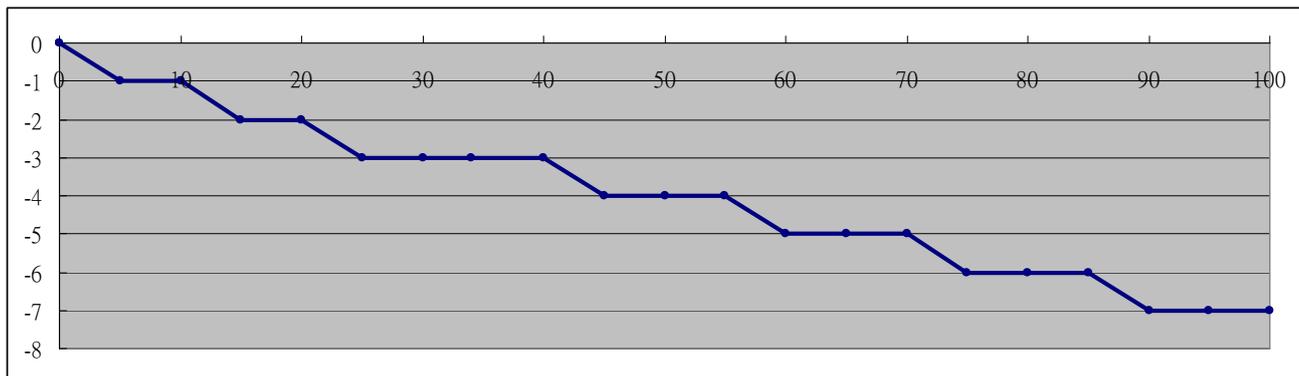
The survey was performed on 25 March 2005. The weather was fair and the sea was calm and the visibility was fair (approximately 3 m).

This site is adjacent to the existing ferry pier. The coastline is a small sandy beach. P transect started at the coastline (22°21.890N, 114°18.307E) and extended 100 m toward the sea at 270W direction. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

On P transect, hard substrate was found from 0 to 15 m, while the remaining was sandy bottom. On H1 transect (about 3m of water depth), sandy bottom occupied the sea bottom from 0 to 80 m, while from 80m to 100m the seabed was bedrock. Corals were found on 82.5m, 83.2m, and 100m distance. H2 transect (about 5m of water depth) had sandy bottom from 0 to 90 m. Corals were found on 318 ft and 99m distance.

Table 9 The profile of P Transect at Site D2 and schematic chart

Distance (m)	Depth (m C.D.)	Substratum
0	0	Boulders
5	-1	Boulders
10	-1	Boulders
15	-2	Sandy
20	-2	Sandy
25	-3	Sandy
30	-3	Sandy
34	-3	Sandy
40	-3	Sandy
45	-4	Sandy
50	-4	Sandy with boulders
55	-4	Sandy
60	-5	Sandy
65	-5	Sandy
70	-5	Sandy
75	-6	Sandy
80	-6	Sandy
85	-6	Sandy
90	-7	Sandy with boulders
95	-7	Sandy with boulders
100	-7	Sandy with boulders



Most of the site had a sandy and muddy-sandy substrate, with the sandy substrate at the shallower part and the muddy-sandy substrate further seaward. At the southern part of the site (starting from approximately 80m south of the pier), the seabed was covered by bedrock. The bedrock cover continued to over 100m south from the pier. There were also some large boulders near the coastline approximately 40m south of the dyke. Less than 5% coverage of corals was found on the bedrock area, but the sizes of those colonies were fairly large (some reach 30cm). Species found included *Favia speciosa*, *Favites abdita*, and *Goniastrea aspera*. There was no coral on the remainder of the site, including the large boulders near the coastline. Some seagrass individuals (*Halophila* sp.) were scattered on the sandy substrate in low density in the southern part of the surveyed area, close to the bedrock area (about 70m to the south of the pier).

Table 10 REA Ecological and Substratum attributes of P Transect at Site D2

Ecological attributes	Rank
Hard coral	1
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	3
Substratum	
Hard substrate	2
Continuous pavement	0
Bedrock/boulders/sand	1
Rubble	0
Cobbles	0
Sand with gravel	6
Mud	0

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

6) Site D3

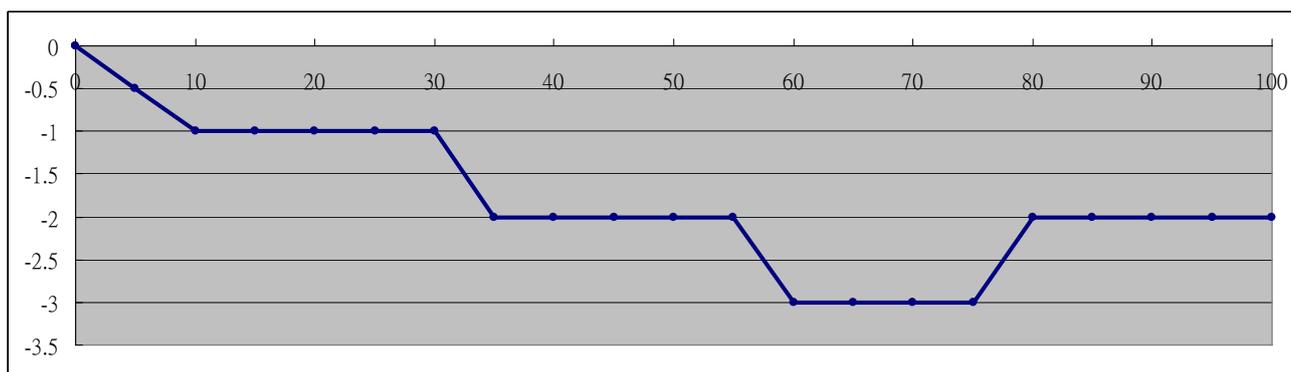
The survey was performed on 26 March 2005. The weather was fair and the sea was calm and the visibility was fair (approximately 3 m).

This site was located outside the outlet of a stream on western Kau Sai Chau. The coastline is natural boulder shore. P transect started at the coastline (22°21.092N, 114°18.388E) and extended 100 m toward the sea at 225SW direction. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

P transect was occupied by abundant seagrasses *Halophila ovalis*, in particular from 5 to 27 m. H1 transect was all sandy bottom. Seagrasses occupied about two third of the transect length. H2 transect was also sandy bottom. Seagrasses occupied about half of its length. No coral was found at this site.

Table 11 The profile of P Transect at Site D3 and schematic chart

Distance (m)	Depth (m C.D.)	Substratum
0	0	Boulders
5	-0.5	Muddy sandy
10	-1	Muddy sandy
15	-1	Muddy sandy
20	-1	Muddy sandy
25	-1	Muddy sandy
30	-1	Muddy sandy
35	-2	Muddy sandy
40	-2	Muddy sandy
45	-2	Muddy sandy
50	-2	Muddy sandy
55	-2	Muddy sandy
60	-3	Muddy sandy
65	-3	Muddy sandy
70	-3	Muddy sandy
75	-3	Muddy sandy
80	-2	Muddy sandy
85	-2	Muddy sandy
90	-2	Muddy sandy
95	-2	Muddy sandy
100	-2	Muddy sandy



This site is also located on the western coast of Kau Sai Chau just offshore the outlet of a stream. It is of the highest conservation importance among the 5 potential sites as it harbours extensive seagrass beds. Almost the entire area covered by the survey had a muddy-sandy substrate. No coral colony was found. However, over 50% of the site is occupied by seagrass bed (*Halophila ovalis*) in which coverage sometimes exceeded 70%.

Table 12 REA Ecological and Substratum attributes of P Transect at Site D3

Ecological attributes	Rank
Hard coral	0
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	3
Substratum	
Hard substrate	2
Continuous pavement	0
Bedrock/boulders/sand	1
Rubble	0
Cobbles	0
Sand with gravel	6
Mud	0

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

7) Site C

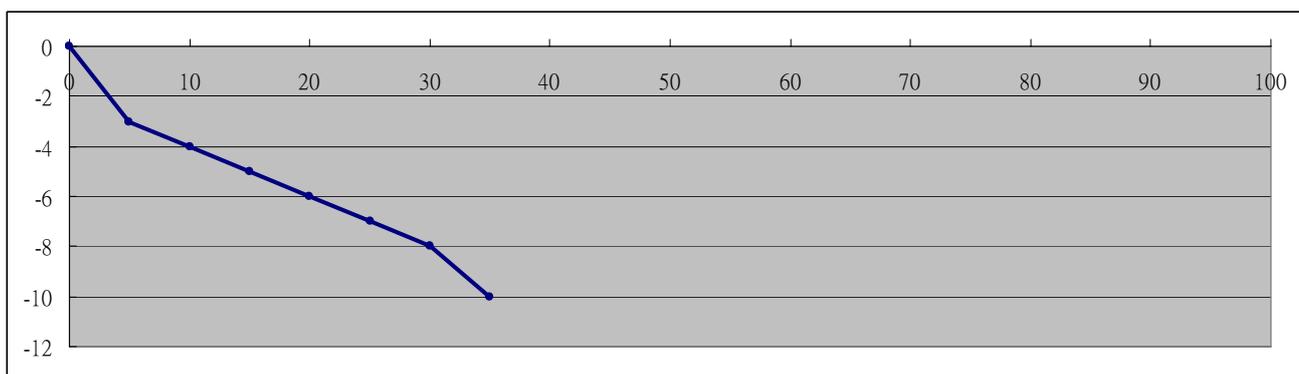
The survey was performed on 29 April 2005. The weather was fair and the sea was calm and the visibility was good (approximately 5 m).

This site is at Lap Lo Kok on the southeast coastline of Kau Sai Chau. The coastline is natural rocky shore with steep gradient. Although the section of coastline was more exposed, Site C was partially protected by a small headland to the south.

P transect started at the coastline (22°21.408N, 114°19.662E) and extended 60 m toward the sea at 90E direction till reaching -10m C.D. Along P transect the seabed composition was identified and conditions were noted as shown in the table below.

Table 13 The profile of P Transect at Site C and schematic chart

Distance (m)	0	5	10	15	20	25	30	35	40	45	50	55	60
Depth (m C.D.)	0	-3	-4	-5	-6	-7	-8	-10					
Substratum	Boulders	Boulders	Sandy with boulders	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy				



On P transect abundant corals (over 30% coverage) had colonised the seabed from 0 to 20 m. From 20m to 30 m, corals could also be found but at a lower frequency. Further away, the seabed turned into mainly sandy substrate and no coral was found.

On the H1 transect, sandy bottom with boulders was found on the full length. There were also abundant corals from 0m to 60m. From 60 to 100 there were only occasional corals.

On H2 transect, much less coral was found. But there were still a patch of continuous *Goniopora columna* and a large table coral *Turbinaria peltata* on the transect.

Table 14 REA Ecological and Substratum attributes of P Transect at Site C

Ecological attributes	Rank
Hard coral	4
Dead standing corals	0
Soft corals	0
Sea anemone beds	0
Macroalgae	1
Substratum	
Hard substrate	0
Continuous pavement	0
Bedrock/boulders/sand	5
Rubble	0
Cobbles	0
Sand with gravel	2
Mud	0

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

Bounce-dives

Besides REA sites, bounce-dives were also conducted at 7 locations in between the REA sites.

Bounce-dive Site 1 was located to the south of Site M. The site was covered by muddy sandy and boulders and the water was turbid. Occasional coral colonies were found. Coral coverage was <5%.

Bounce-dive Site 2 had a better visibility, probably due to the sandy and boulders sea bottom. The seabed was covered by brown algae. Coral coverage was also <5%.

Bounce-dive Site 3 was located on the northern shore of the major embayment in eastern Kau Sai Chau, near the Tiu Cham Wan FZC. On a narrow strip of seabed close to the high tide line, the seabed was shallow and covered by boulders. The seabed turned into deeper sandy bottom further offshore. No coral was found on the area with sandy substrate. In general, the coral coverage was <5%, but a patch of *Gonopora columna* colonies was found.

Bounce-dive Site 4 was located on the southern shore of the major embayment in eastern Kau Sai Chau. It was very similar to Site 3 in terms of topography, and coral coverage. But there was no patch of *Gonopora columna* colonies found.

Bounce-dive Site 5 was located south of Site D1. The near shore part was covered by boulders on which abundant brown algae colonised. Coral coverage at this part was <5%. The more offshore part was sandy bottom with no coral colonies.

Bounce-dive Site 6 was close to Site 5 and was similar in both topography and the general conditions. Purple sea urchins and nudibranchs were found.

Bounce-dive Site 7 was located south of Site C (Kap Lo Kok). The coral coverage was estimated to be higher than at other bounce-dive sites, between 5 to 10%. Some larger coral colonies were found.

The ecological and substratum attributes of all 7 bounce-dive points are shown in the table below (**Table 15**).

Table 15 REA Ecological and Substratum attributes of the seven bounce-dive sites

	1	2	3	4	5	6	7
Ecological attributes							
Hard coral	1	1	1	1	1	1	2
Dead standing corals	0	0	0	0	0	0	0
Soft corals	0	0	0	0	0	0	0
Sea anemone beds	0	0	0	0	0	0	0
Macroalgae	2	4	2	2	3	3	2
Substratum							
Hard substrate	0	0	0	0	0	0	0
Continuous pavement	0	0	0	0	0	0	0
Bedrock/boulders/sand	3	4	2	2	2	3	4
Rubble	0	0	0	0	0	0	0
Cobbles	0	0	0	0	0	0	0
Sand with gravel	2	2	2	2	2	2	2
Mud	2	0	0	0	0	0	0

* Rank of percentage cover: 0 = None recorded; 1 = 1-5%; 2 = 6-10%; 3 = 11-30 %; 4 = 31-50%; 5 = 51-75 %; 6 = 76-100%.

Discussion

Marine Ecological Value of the waters in eastern and western Kau Sai Chau

Established coral communities of any size are regarded as important habitat types in Hong Kong as defined in Annex 8 of EIAO-TM. All hard corals are protected in Hong Kong by the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187).

While the vertical distribution of hermatypic corals is largely controlled by the requirements of their photosynthesising zooxanthellae which require strong light and hence shallower water, the geographical distribution of hard corals in Hong Kong is affected by the salinity of the water.

Hard corals are vulnerable to sediments and prefer clear oceanic water. Hard corals in Hong Kong therefore exhibit strong gradients in distribution, species diversity and abundance, with the cover and diversity decreasing from east to west, toward the influence of the Pearl River (Scott 1984).

The Port Shelter WCZ is within the oceanic zone. In contrast to the low abundance and low diversity of corals in western Hong Kong waters, the oceanic environment of the eastern waters is suitable for the existence of scleractinians (reef-building corals) (Scott 1984). Eastern waters are thus characterized by domination of hermatypic corals.

AFCD conducted underwater surveys in 2001-2002 to survey corals at 240 sites covering about 70 km of coastline in territorial waters (AFCD 2004). The second highest coral coverage of the 240 REA sites was recorded at Sharp Island (> 50 %). Corals here were mainly agariciids (*Pavona decussata*), faviids (*Platygyra*, *Favites*, *Leptastrea* and *Cyphyastrea*) and poritids (*Porites*, *Goniopora*). Kau Sai Chau, however, was not covered by this study.

During an extensive dive survey in Hong Kong waters for CED (Binnie, 1995), only one site at Port Shelter WCZ was surveyed, the north end of Kau Sai Chau. Medium abundance of hard corals was recorded at Kau Sia Chau (Site 39). Other invertebrates in Kau Sai Chau were also recorded as medium in abundance. However, the diversity of both hard corals and invertebrates, as well as the abundance and diversity of soft corals and gorgonians were all considered low. This site was assigned a medium conservation value in terms of the abundance and diversity of hard and soft corals.

A preliminary coral survey was conducted along the east coast of Kau Sai Chau in November 2000 to locate coral communities and recommend locations for detailed coral surveys. Results from the preliminary survey found that the majority of the eastern coast of Kau Sai Chau, in particular within the major embayment at Tiu Tam Wan and to the north of this embayment, had a very low coral coverage, i.e. below 5%. But the most southern part of the coastline had higher coral coverage. Coral found included *Favia*, *Acropora* and *Tubinaria*. The low diversity and abundance of corals in most parts of the eastern coast may be attributed by the stream flows at several locations along the shore. One location at the southern part of the coastline (Kap Lo Kok) had high coral coverage. Detailed coral surveys are recommended at the impact sites of the project and Kap Lo Kok.

In the present dive survey, the eastern and western coastline of Kau Sai Chau were studied by REA at 7 selected locations. There were also 7 bounce-dive sites in eastern Kau Sai Chau.

It was found from the present dive survey that the topography of the subtidal habitats along eastern Kau Sai Chau is generally steep, reaching -7mC.D. within 50 m of the tideline at some locations. Underwater visibility was fair (about 5 m). Western Kau Sai Chau has a gentler gradient and poorer visibility (about 2 m).

The marine organisms found during the dive surveys were shown in the tables below.

Table 16a List of Corals recorded during dive survey

No.	Common name	Scientific name	Rarity
1	Hard corals	<i>Acropora tumida</i>	Uncommon
2		<i>Cyphastrea serailia</i>	Dominant
3		<i>Favia speciosa</i>	Abundant
4		<i>Favites abdita</i>	Dominant
5		<i>Goniastrea aspera</i>	Common
6		<i>Goniopora columna</i>	Abundant
7		<i>Hydnophora exesa</i>	Abundant
8		<i>Leptastrea purpurea</i>	Abundant
9		<i>Lithophyllon undulatum</i>	Common
10		<i>Montipora peltiformis</i>	Common
11		<i>Pavonna descussata</i>	Abundant
12		<i>Platygyra acuta</i>	Dominant
13		<i>Porites lobata</i>	Common
14		<i>Psammocora superficialis</i>	Abundant
15		<i>Turbinaria peltata</i>	Common

* Rarity follows Chan et al. 2005. *Field Guide to Hard Corals of Hong Kong*.

Table 16a List of Marine organisms recorded during dive survey

No.	Common name	Scientific name
1	Brown sea hare	<i>Bursatella leachi</i>
2	Nudibranchs	
3	Long-spined sea urchin	<i>Diadema setosum</i>
4	Green sea urchin	<i>Salmacis sphaeroides</i> ,
5	Purple sea urchin	
6	Starfish	<i>Archaster typicus</i>
7	Sea cucumbers	
8	Seagrass	<i>Halophila ovalis</i>

Except for one uncommon species (*Acropora tumida*), all other coral species found during the REA surveys were common, abundant or dominant in Hong Kong (Chan *et al.* 2005).

Basically, the marine communities showed a trend of increasing diversity and abundance of corals from north to south along eastern Kau Sai Chau. The southern coastline is more exposed to the open sea and higher coral coverage was found there. This trend also matched the higher coral coverage found at D3 site during the site selection surveys. Site C is the location with highest coral coverage and abundance among all sites at Kau Sai Chau.

From the information presented in the previous sections, it is clear that some areas covered by the dive survey can be considered as of high ecological value due to the high coverage of hard coral colony and the sizes of some of the colonies, or the presence of considerable size seagrass beds. But for the rest of the coastline, shallow hard bottom area was narrow and only low coral coverage was found. The ecological value of the waters around Kau Sai Chau should be ranked as moderate.

Table 17 Ecological evaluation of the waters around Kau Sai Chau

Criteria	Remarks
Naturalness	Basically natural. Some areas were designated as fish culture zones and typhoon shelter.

Criteria	Remarks
Size	Over 300 ha within the assessment area.
Diversity	Moderate.
Rarity	Common habitat in Hong Kong. A patch of seagrasses, which are uncommon in Hong Kong, was recorded.
Re-creatability	Not re-creatable.
Fragmentation	Unfragmented.
Ecological linkage	Generally, it is linked with open sea. But not functionally linked to any highly valued habitat (e.g. mudflat) in close proximity.
Potential value	Moderate.
Nursery/breeding ground	Breeding/nursery ground for marine species (the nearby Urn Island has high fish fry production).
Age	N/A
Abundance/Richness of wildlife	Moderate
Overall Ecological value	Moderate

Site selection for desalination plant and temporary barging point

Major findings from the dive surveys and recommendations on the preferred sites are reported here.

Among the REA dive sites, 5 of them were potential sites for temporary barging point (B1 & B2) and desalination plant (D1, D2, & D3). Brief descriptions of the 5 sites were summarised below:

B1: The hard substrate extended only a few metres away from the coastline. Some hard coral colonies were found on the hard substrate, but the coverage was estimated to be below 5%. Recorded coral species included *Favia speciosa*, and *Turbinaria peltata*. Beyond the hard substrate the seabed is covered by mud and no more coral colonies were found.

B2: Similar to B1, B2 site had the hard substrate at the shallowest part and muddy substrate at the deeper part. The extent of hard substrate was slightly greater than that at B1, but still extended less than 10 m from the coastline. The coral coverage on hard substrate was again less than 5%. Recorded coral species included *Pavona descussata* and *Platygyra acuta*. No coral colony was found on the mud substrate.

D1: This site has the highest coral coverage among the five surveyed potential sites, including the two sites for the barging point. From the coastline to about 30 metres offshore, the seabed was hard substrate and the coral coverage was estimated to be about 20% coverage within this area. Corals found included *Lithophyllon undulatum*, *Goniastrea aspera*, *Acropora tumida*, *Psammocora superficialis*, *Goniopora columna*, and *Platygyra acuta*. Among them, *Acropora tumida* is considered uncommon in Hong Kong. And the sizes of these colonies might reach 30 to 40 cm.. The substrate turned muddy beyond 30m.

D2: This site is immediately adjacent to the existing ferry pier. Most of the site had a sandy and muddy-sandy substrate, with the sandy substrate at the shallower part and the muddy-sandy substrate further seaward. At the southern part of the site (starting from approximately 70 m south of the pier), the seabed is covered by bedrock. The bedrock cover continued to over 100 m south from the pier. There were also some large boulders near the coastline approximately 40 m south of the dyke. Less than 5% coverage of corals was found on the bedrock area, but these colonies were fairly large (some reach 30cm), but still smaller than those recorded in D1 site. Species found included *Favia speciosa*, *Favites abdita*, and *Goniastrea aspera*. There

was no coral on the remainder of the site, including the large boulders. Some seagrass (*Halophila* sp.) was scattered on the sandy substrate in low density in the southern part of the surveyed area (about 70m to the south of the pier). But the density was low and not forming a seagrass bed.

D3: This site was also located on the west coast of Kau Sai Chau just offshore from the outlet of a stream. It is of the highest conservation importance among the 5 potential sites as it harbours extensive seagrass beds. Almost the entire area covered by the survey had a muddy-sandy substrate. No coral colony was found. However, over 50% of the site was occupied by seagrass bed (*Halophila ovalis*) in which coverage sometimes exceeded 70%.

Recommendations

Based upon the observations and findings in site selection surveys, it is recommended that B2 should be chosen as the preferred site for temporary barging point. Although the extend of hard substrate in B2 is a few meters larger than that in B1, B1 would be closer to an occupied fish culture zone that might be more sensitive to water quality impacts during the building and demolition of the barging point.

In terms of ecology, D2 is a better site for the desalination plant. Construction at D1 or D3 would cause significant impacts on corals and seagrasses respectively. Although some coral colonies of common species including *Favia speciosa*, *Favites abdita*, and *Goniastrea aspera*, and little seagrasses remained at Site D2, they were both of low coverage or density, and located some distance (at least 80m and 70m away from the pier respectively). Therefore it is possible to avoid or reduce direct impacts by laying the two pipelines closer to the existing pier.

Further southward from D2 site, the sea bottom was also covered by hard substrates and bedrock with coral colonies, and patchy seagrasses. If the location of the desalination plant at D2 is shifted some distance southward from the pier, the potential of causing direct impacts on corals and seagrasses still exists. As there is no obvious ecological advantage, in case Site D2 is selected as the preferred site, it is not recommended to shift the desalination plant location.

Reference

Chan A.L.K., Choi, C.L.S., McCorry D., Chan K.K., Lee, M.W., and Put, A. Jr. 2005. *Field Guide to Hard Corals of Hong Kong*. AFCD.

END

Annex 1 Rapid Ecological Assessment

Five ecological and seven substratum attributes shall be assessed on site and by reviewing video footages. Each of the attributes (Table 1) should be assigned to one of the seven standard ranked categories (from zero to six, representing percentage cover from none to over 76%)(Table 2).

An inventory of benthic taxa should also be compiled for the P transect and bounce five points. Taxa shall be identified in situ to the following levels: 1) Hard corals to species level where possible; 2) Soft corals, anemones and macroalgae to genus level where possible; and 3) Other benthos to genus level where possible or phylum with growth form. Each taxon in the inventory shall also be ranked to one of the six categories (Table 3) in terms of abundance (from 0 to 5, representing from absent to dominant) in the community.

Table 1 Ecological and Substratum attributes used in REA

Ecological attributes
Hard coral
Dead standing corals
Soft corals
Sea anemone beds
Macroalgae
Substratum
Hard substrate
Continuous pavement
Bedrock/boulders/sand
Rubble
Cobbles
Sand with gravel
Mud

Table 2 Ranking of Ecological and substratum attributes

Rank	Percentage cover (%)
0	None recorded
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

Table 3 Ranking of Benthos abundance

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

END

Plate 1 Photos of Site M



Substrate at the starting point of P transect



Substrate in the majority of Site M



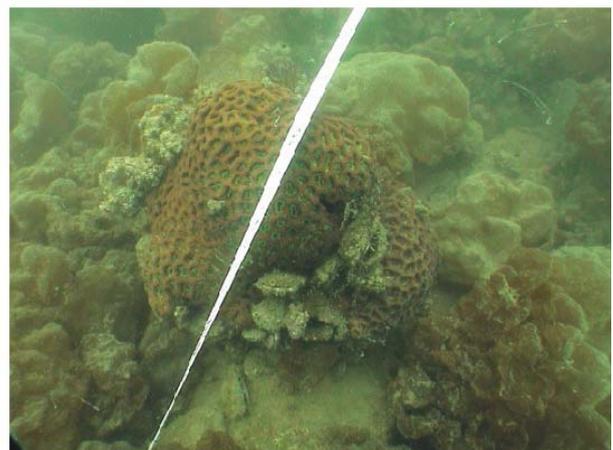
Starfish



Algae

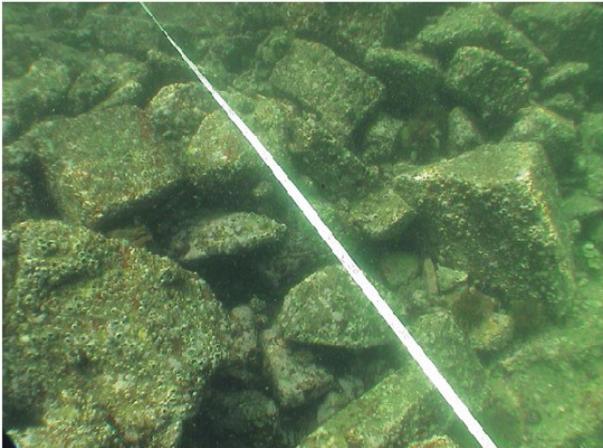


Brown sea hare

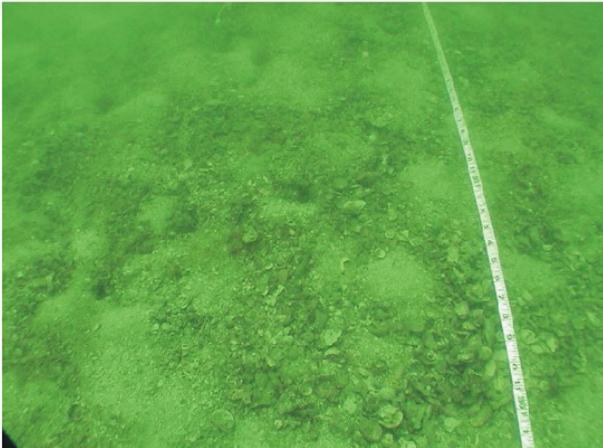


Corals close to the mouth of the embayment

Plate 2 Photos of Site B1



P transect near shore



P transect off shore



Favia



Turbinaria



Sea anemone



Sponges

Plate 3 Photos of Site B2



P transect near the shore



P transect off shore



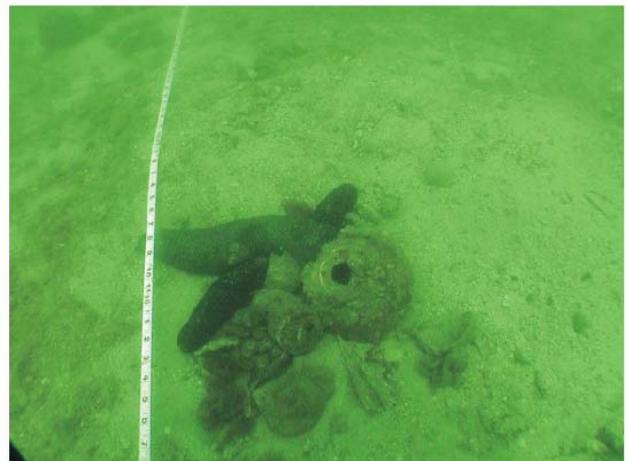
Pavona



Platygyra



Sea urchin



Sea cucumber

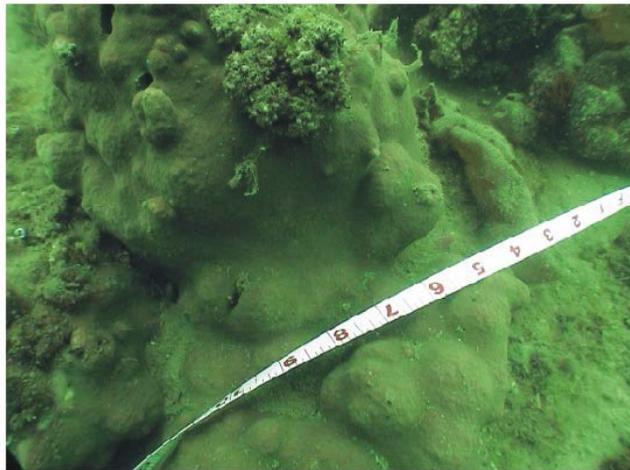
Plate 4 Photos of Site D1



Lithophyllon



Goniastrea



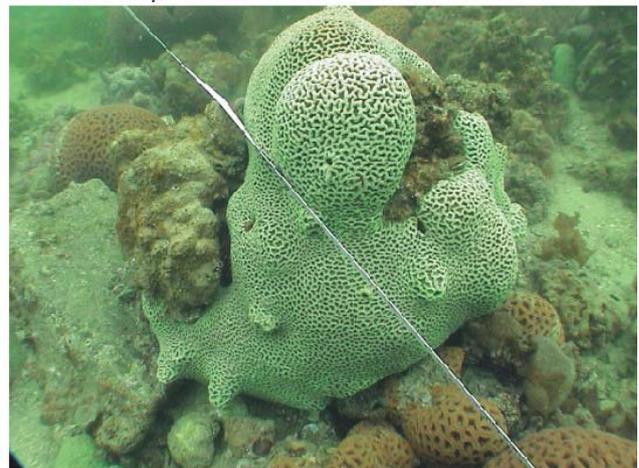
Psammocora



Acropora



Gonopora



Platygyra

Plate 5 Photos of Site D2



Green sea urchin



Sea cucumber



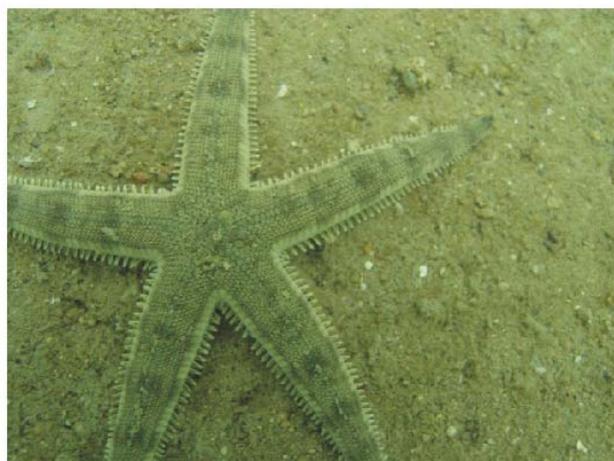
Purple sea urchin



Seagrass *Halophilla ovalis*



Brown sea hare



Starfish

Plate 6 Photos of Site D3

Seagrass
Halophila ovalis



Seagrass
Halophila ovalis



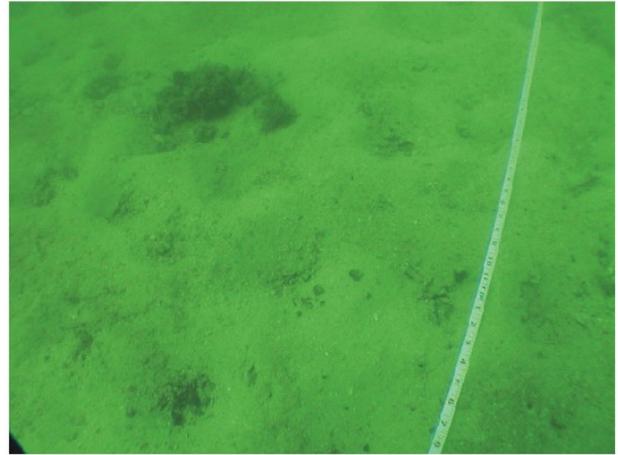
Starfish



Plate 7 Photos of Site C



P transect near the coast



P transect away from the coast



Gonopora colonies



Table corals



Nudibranch



Starfish

