

**Installation of Submarine Gas  
Pipelines and Associated Facilities  
from To Kwa Wan to North Point for  
Former Kai Tak Airport Development**

Third Coral Impact Report

04 September 2012

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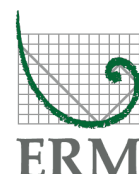
# Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point for Former Kai Tak Airport Development

## Third Coral Impact Report

### Revision 2

**Document Code:**  
*0158059\_Third Impact Coral Monitoring Report\_v2.doc*

Client:  MKJV		Project No:  0158059			
Summary:  This document presents the 3 <sup>rd</sup> Coral Impact Report for the Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point for Former Kai Tak Airport Development.		Date: 4 September 2012			
		Approved by:    <i>Mr Craig Reid</i> Partner			
V2	Third Coral Impact Report	JT	JT	CAR	04/09/12
V1	Third Coral Impact Report	JT	JT	CAR	04/09/12
Revision	Description	By	Checked	Approved	Date
<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		Distribution		  	
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**Installation of Submarine Gas Pipelines and Associated Facilities from To  
Kwa Wan to North Point for Former Kai Tak Airport Development  
Environmental Certification Sheet  
Environmental Permit No. EP-401/2010**

**Reference Document/Plan**

Document/~~Plan~~ to be Certified/ Verified: Third Coral Impact Report  
 Date of Report: 04/09/2012  
 Date prepared by ET: 04/09/2012  
 Date received by IEC: 04/09/2012

**Reference EM&A Manual/ EP Requirement**

EM&A Manual Requirement: Sections 4.5  
 Content: Coral Impact Report  
 4.5 "A Coral Impact Report shall be submitted to the EPD and the AFCD within 5 days of carrying out the actual survey. This survey should be concise and clearly state whether limits have been exceeded."

**ET Certification**

I hereby certify that the above referenced document/~~plan~~ complies with the above referenced condition of the EM&A Manual.

Ms Winnie Ko,  
 Environmental Team Leader:

Date: 04/09/2012

**IEC Verification**

I hereby verify that the above referenced document/~~plan~~ complies with the above referenced condition of EM&A Manual.

Dr Anne Kerr,  
 Independent Environmental Checker:

Date: 13 September 2012

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# 1 INTRODUCTION

## 1.1 BACKGROUND

The Project proposed by the Hong Kong and China Gas Company Limited comprises the construction of a new gas pipeline network from To Kwa Wan to North Point so as to replace the existing one affected by the proposed Cruise Terminal dredging works adjacent to the former Kai Tak runway and the proposed Central Kowloon Route crossing the Kowloon Bay at To Kwa Wan. The location of the Project is shown in *Figure 1.1*.

The Project involves the following key elements associated with the construction of the submarine gas pipeline, landing and pigging stations:

- Dredging of approximately 8.99 ha of seabed to form a trench for laying the twin submarine gas pipelines;
- Construction of two land gas pipelines at To Kwa Wan and North Point, respectively; and
- Construction of two pigging stations for pigging operation at To Kwa Wan and North Point, respectively.

The Environmental Impact Assessment (EIA) report (*Register No.: AEIAR-153/2010*) for the Project was approved by the Director of Environmental Protection (DEP) on 2 August 2010 under the *Environmental Impact Assessment Ordinance (EIAO)*. Subsequent to the approval of the EIA, an Environmental Permit (*EP-401/2010*) for the Project was granted by the DEP on 6 October 2010.

Pursuant to *Condition 3.1* of the EP, an environmental monitoring and audit (EM&A) programme as set out in the *EM&A Manual* is required to be implemented. In accordance with the *EM&A Manual*, a Coral Monitoring Programme should be undertaken when dredging works is being carried out within 250 m from the To Kwa Wan breakwaters.

## 1.2 OBJECTIVES OF THE CORAL MONITORING PROGRAMME

The overall purpose of the Coral Monitoring Programme is to verify the EIA prediction that only minor impact to corals at the To Kwa Wan breakwaters will occur as a result of the dredging operations of the Project, provided that suitable mitigation measures including the placement of a second silt curtain for protecting the coral communities are implemented when dredging works is being carried out within 250 m from the breakwaters. In the event that significant adverse impacts are identified as a consequence of the works, monitoring would also allow for implementation of appropriate remedial actions to reduce such impacts.



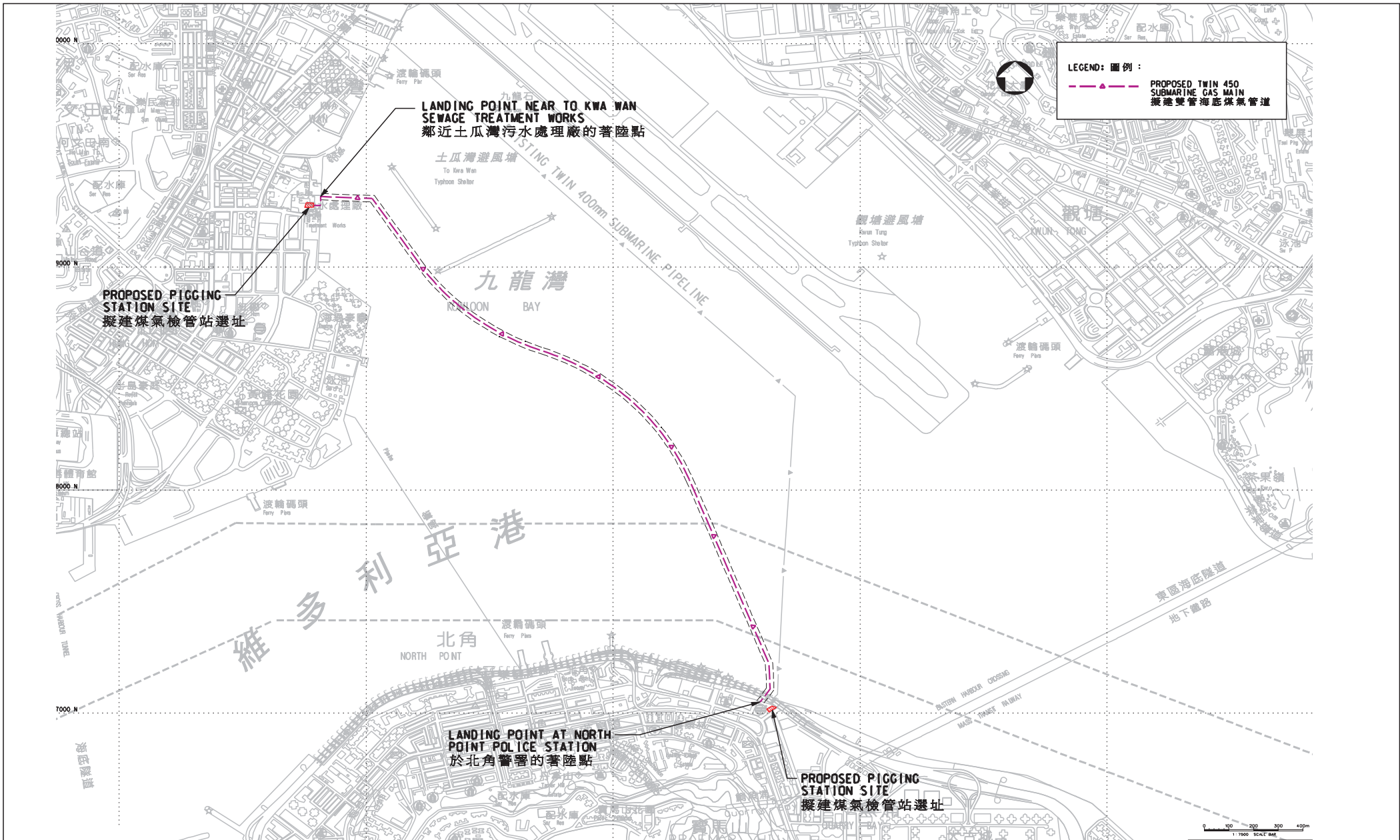


Figure 1.1

General Layout

### 1.3

#### *PURPOSE OF THIS REPORT*

The purpose of this *3<sup>rd</sup> Coral Impact Report* is to report findings of the 3<sup>rd</sup> Impact Coral Monitoring Survey and determine the conditions of corals at the designated monitoring locations when dredging works take place within 250 m from the To Kwa Wan breakwaters. Baseline Coral Monitoring Survey was conducted on 23 May 2012 which provides baseline data prior to the commencement of the concerned dredging operations. Since then, Tropical Cyclones Doksuri and Vicente hit Hong Kong resulting in the hoisting of No. 8 Gale Signal on 30 June and Tropical Cyclone Warning Signal No. 10 on 24 July 2012, respectively. As such, an Updated Baseline Coral Monitoring Survey was undertaken on 6 August 2012 to ensure that the tagged corals were still intact before commencement of the concerned dredging operations and to provide updated baseline data for the Coral Monitoring Programme. The *3<sup>rd</sup> Impact Coral Monitoring Survey* was conducted on 30 August 2012. Impact coral conditions will be used to compare with the baseline conditions in order to identify any impacts on the health and condition of corals during the concerned dredging works near To Kwa Wan breakwaters.

### 1.4

#### *STRUCTURE OF THE REPORT*

The remainder of the report is structured as follows:

***Section 2: Coral Monitoring*** - Details the coral monitoring locations and frequency, monitoring methodology and impact coral monitoring results, and the compliance with the Action and Limit Levels in accordance with the *EM&A Manual*.

***Section 3: Conclusion*** - Concludes the representativeness of the impact coral monitoring results for the Project.

## 2.1 MONITORING LOCATIONS

Coral Monitoring Surveys (ie Baseline, Updated Baseline, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> Impact Coral Monitoring Surveys) have been conducted at three Impact Sites near the pipeline (Areas 1, 2 and 3) and one Control Site (Area 4) at the far end of the seawall which is perpendicular to the pipeline run as shown in *Figure 2.1*. The start and end coordinates of each monitoring site was recorded using a portable GPS unit. Shoreline features for the start and end points of each monitoring sites were also noted to aid the re-location of the points for subsequent coral monitoring surveys. The coordinates of the start and end points for each monitoring site are presented in *Table 2.1*.

*Table 2.1* GPS Coordinates of Coral Monitoring Sites

		GPS				Depth (-mCD)
		Starting Point		Finishing Point		
Impact Sites	Area 1	22°18'50.87"	114°11'40.48"	22°18'49.86"	114°11'41.06"	2.5
	Area 2	22°18'40.90"	114°11'47.35"	22°18'41.73"	114°11'46.73"	1.8
	Area 3	22°18'35.18"	114°11'47.18"	22°18'35.71"	114°11'48.02"	3.0
Control Site	Area 4	22°18'43.57"	114°12'03.87"	22°18'43.05"	114°12'02.84"	3.5

## 2.2 MONITORING METHODOLOGY

Both Baseline (ie including the Baseline and Updated Baseline Surveys) and Impact Coral Monitoring Surveys which included a coral tagging exercise was carried out at Areas 1 to 4. A total of 10 colonies were tagged at each site, allowing 30 impact coral colonies and 10 control colonies. Beside the tagged coral colony, a white cable tie was tied around a rock. The tag which was laminated underwater paper of approximately 3 x 6 cm in size was attached to the cable tie. Tags and the target coral colonies were numbered 1-10 at each site (ie Area 1-4). Each of the tagged coral colonies was identified to species levels and photographed (*Annex A*).

The following data were recorded for each tagged coral colonies during the Baseline and Impact Coral Monitoring Surveys:

- Species
- Size (cm<sup>2</sup>)
- Growth form
- Partial mortality (%)
- Sediment (thickness, type and colour)



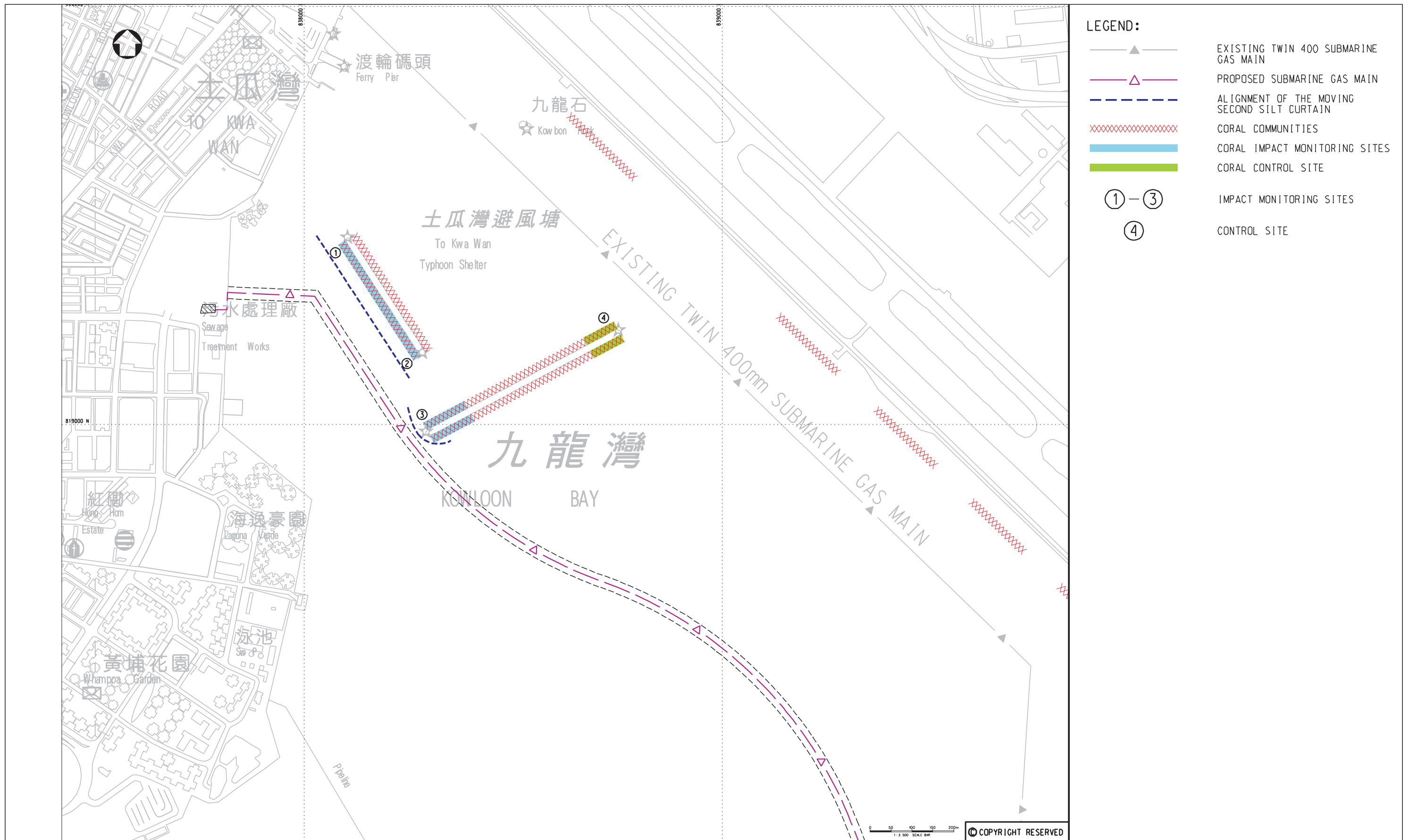


Figure 2.1 Locations of Coral Monitoring Sites at To Kwa Wan Breakwaters

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- The general health of the coral colony using the Asian Coral Watch Chart <sup>(1)</sup>

Photographic records of each coral colony tagged in the Baseline Survey were collected from an angle that best represents the entire colony, and photographs maintaining the same aspect and orientation were taken in subsequent Impact Monitoring Surveys (*Annex A*). The adoption of the same monitoring method would allow for direct comparison of baseline data with the impact monitoring data in order to determine any changes in conditions of corals after commencement of the concerned dredging works. Should impacts caused by the dredging operations to corals be identified, appropriate remedial action can be implemented to reduce such impacts.

### 2.3

#### ***BASELINE & IMPACT MONITORING RESULTS***

The species, size, growth form, partial mortality, sediment cover (thickness, type and colour) and general health of the tagged corals recorded during the Baseline (ie including the Baseline and Update Baseline Surveys) and the 3<sup>rd</sup> Impact Coral Monitoring Surveys were summarized in *Tables 2.2 to 2.5*. Photographic records of the tagged coral colonies are shown in *Annex A*.

The Action and Limit Levels for Partial Mortality of tagged coral colonies were determined in accordance with the criteria stated in the *EM&A Manual* <sup>(2)</sup> which are summarized in *Table 2.6*. If the defined Action or Limit Levels for coral monitoring are exceeded which would indicate potential adverse impacts to corals, a set of stepwise procedures shown in *Table 2.7* will be implemented in order to rectify such impacts.

Findings of the 3<sup>rd</sup> Impact Coral Monitoring Surveys indicated that the Action Levels or Limit Levels for coral monitoring were not exceeded (*Tables 2.2-5*). There did not appear to be any deterioration in the general health and condition of the tagged coral colonies as a result of the dredging activities within 250 m from the To Kwa Wan breakwaters.

- (1) Coral Watch is a rapid assessment on the health of coral colonies by using coral health color charts to monitor bleaching stages of corals. Coral color, or more specifically brightness and saturation, correlate with chlorophyll content and density of symbiotic algae (zooxanthellae) in coral tissue, providing a measure of coral health. Coral bleaching results from a loss of symbiosis or pigmentation from stressed, unhealthy coral.
- (2) Mott MacDonald 2010. Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point for Former Kai Tak Airport Development: Environmental Monitoring and Audit Manual.

Table 2.2

*Species, Size, Growth Form, Partial Mortality, Sediment Cover and General Health of Tagged Coral Colonies at Area 1 (Impact Site)*

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality (%)	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness (mm)	Sediment Type (Mud/Sand)	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
Baseline Survey on 23 May 2012									
1	<i>Oulastrea crispata</i>	12	Encrusting	0	N/A	0	N/A	N/A	4.5
2	<i>Oulastrea crispata</i>	9.2	Encrusting	0	N/A	0	N/A	N/A	4.5
3	<i>Oulastrea crispata</i>	12.2	Encrusting	0	N/A	0	N/A	N/A	4.5
4	<i>Oulastrea crispata</i>	4.8	Encrusting	0	N/A	0	N/A	N/A	5
5	<i>Oulastrea crispata</i>	6.2	Encrusting	0	N/A	0	N/A	N/A	4.5
6	<i>Oulastrea crispata</i>	4.4	Encrusting	0	N/A	0	N/A	N/A	5
7	<i>Oulastrea crispata</i>	12.1	Encrusting	0	N/A	0	N/A	N/A	4.5
8	<i>Oulastrea crispata</i>	3.6	Encrusting	0	N/A	0	N/A	N/A	5.5
9	<i>Oulastrea crispata</i>	34.6	Encrusting	<1	N/A	0	N/A	N/A	5
10	<i>Oulastrea crispata</i>	3.2	Encrusting	0	N/A	0	N/A	N/A	4.5
Updated Baseline Survey on 6 August 2012									
1	<i>Oulastrea crispata</i>	12	Encrusting	0	N/A	0	N/A	N/A	4
2	<i>Oulastrea crispata</i>	9.2	Encrusting	0	N/A	0	N/A	N/A	4
3	<i>Oulastrea crispata</i>	12.2	Encrusting	0	N/A	0	N/A	N/A	4.5
4	<i>Oulastrea crispata</i>	4.8	Encrusting	0	N/A	0	N/A	N/A	5
5	<i>Oulastrea crispata</i>	6.2	Encrusting	0	N/A	0	N/A	N/A	5
6	<i>Oulastrea crispata</i>	4.4	Encrusting	0	N/A	0	N/A	N/A	5
7	<i>Oulastrea crispata</i>	12.1	Encrusting	0	N/A	0	N/A	N/A	4.5
8	<i>Oulastrea crispata</i>	3.6	Encrusting	0	N/A	0	N/A	N/A	5
9	<i>Oulastrea crispata</i>	34.6	Encrusting	<1	N/A	0	N/A	N/A	4.5
10	<i>Oulastrea crispata</i>	3.2	Encrusting	0	N/A	0	N/A	N/A	4.5
Third Impact Coral Monitoring Survey on 30 August 2012									
1	<i>Oulastrea crispata</i>	12	Encrusting	0	0	0	N/A	N/A	4
2	<i>Oulastrea crispata</i>	9.2	Encrusting	0	0	0	N/A	N/A	4
3	<i>Oulastrea crispata</i>	12.2	Encrusting	0	0	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	4.8	Encrusting	0	0	0	N/A	N/A	5

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality (%)	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness (mm)	Sediment Type (Mud/Sand)	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
5	<i>Oulastrea crispata</i>	6.2	Encrusting	0	0	0	N/A	N/A	4.5
6	<i>Oulastrea crispata</i>	4.4	Encrusting	0	0	0	N/A	N/A	4
7	<i>Oulastrea crispata</i>	12.1	Encrusting	0	0	0	N/A	N/A	4.5
8	<i>Oulastrea crispata</i>	3.6	Encrusting	0	0	0	N/A	N/A	5
9	<i>Oulastrea crispata</i>	34.6	Encrusting	<1	0	0	N/A	N/A	4
10	<i>Oulastrea crispata</i>	3.2	Encrusting	0	0	0	N/A	N/A	4

- (1) The general health of the coral is assessed by using the Asian Coral Watch Chart. The brightness of colour range from 1 (pale or bleached corals) to 6 (dark corals with high quantities of algae and chlorophyll in their tissues), representing different stages of bleaching and recovery which correspond to varying concentrations of symbiotic algae and chlorophyll within coral tissues. Generally, the coral health is considered to be better with higher value on the Coral Watch Chart.
- (2) Represents percentage increase in partial mortality from the Updated Baseline Survey to the Impact Coral Monitoring Survey.

Table 2.3

*Species, Size, Growth Form, Partial Mortality, Sediment Cover and General Health of Tagged Coral Colonies at Area 2 (Impact Site)*

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality (%)	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness (mm)	Sediment Type (Mud/Sand)	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
Baseline Survey on 23 May 2012									
1	<i>Oulastrea crispata</i>	6.8	Encrusting	0	N/A	0	N/A	N/A	4.5
2	<i>Oulastrea crispata</i>	1.7	Encrusting	0	N/A	0	N/A	N/A	4
3	<i>Oulastrea crispata</i>	1.3	Encrusting	0	N/A	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	2.6	Encrusting	0	N/A	0	N/A	N/A	5
5	<i>Oulastrea crispata</i>	14.6	Encrusting	0	N/A	0	N/A	N/A	4.5
6	<i>Oulastrea crispata</i>	4.6	Encrusting	0	N/A	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	8.1	Encrusting	0	N/A	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	13.1	Encrusting	0	N/A	0	N/A	N/A	4.5
9	<i>Oulastrea crispata</i>	5.7	Encrusting	0	N/A	0	N/A	N/A	5
10	<i>Oulastrea crispata</i>	6.9	Encrusting	0	N/A	0	N/A	N/A	5
Updated Baseline Survey on 6 August 2012									
1	<i>Oulastrea crispata</i>	6.8	Encrusting	0	N/A	0	N/A	N/A	4
2	<i>Oulastrea crispata</i>	1.7	Encrusting	0	N/A	0	N/A	N/A	5
3	<i>Oulastrea crispata</i>	1.3	Encrusting	0	N/A	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	2.6	Encrusting	0	N/A	0	N/A	N/A	5
5	<i>Oulastrea crispata</i>	14.6	Encrusting	0	N/A	0	N/A	N/A	4
6	<i>Oulastrea crispata</i>	4.6	Encrusting	0	N/A	0	N/A	N/A	4
7	<i>Oulastrea crispata</i>	8.1	Encrusting	0	N/A	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	13.1	Encrusting	0	N/A	0	N/A	N/A	4.5
9	<i>Oulastrea crispata</i>	5.7	Encrusting	0	N/A	0	N/A	N/A	5
10	<i>Oulastrea crispata</i>	6.9	Encrusting	0	N/A	0	N/A	N/A	4.5
Third Impact Coral Monitoring Survey on 30 August 2012									
1	<i>Oulastrea crispata</i>	6.8	Encrusting	0	0	0	N/A	N/A	5
2	<i>Oulastrea crispata</i>	1.7	Encrusting	0	0	0	N/A	N/A	5
3	<i>Oulastrea crispata</i>	1.3	Encrusting	0	0	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	2.6	Encrusting	0	0	0	N/A	N/A	5

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality (%)	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness (mm)	Sediment Type (Mud/Sand)	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
5	<i>Oulastrea crispata</i>	14.6	Encrusting	0	0	0	N/A	N/A	5
6	<i>Oulastrea crispata</i>	4.6	Encrusting	0	0	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	8.1	Encrusting	0	0	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	13.1	Encrusting	0	0	0	N/A	N/A	4
9	<i>Oulastrea crispata</i>	5.7	Encrusting	0	0	0	N/A	N/A	4
10	<i>Oulastrea crispata</i>	6.9	Encrusting	0	0	0	N/A	N/A	4.5

- (1) The general health of the coral is assessed by using the Asian Coral Watch Chart. The brightness of colour range from 1 (pale or bleached corals) to 6 (dark corals with high quantities of algae and chlorophyll in their tissues), representing different stages of bleaching and recovery which correspond to varying concentrations of symbiotic algae and chlorophyll within coral tissues. Generally, the coral health is considered to be better with higher value on the Coral Watch Chart.
- (2) Represents percentage increase in partial mortality from the Updated Baseline Survey to the Impact Coral Monitoring Survey.

Table 2.4

*Species, Size, Growth Form, Partial Mortality, Sediment Cover and General Health of Tagged Coral Colonies at Area 3 (Impact Site)*

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality (%)	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness (mm)	Sediment Type (Mud/Sand)	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
Baseline Survey on 23 May 2012									
1	<i>Oulastrea crispata</i>	7.2	Encrusting	0	N/A	0	N/A	N/A	4.5
2	<i>Oulastrea crispata</i>	0.9	Encrusting	0	N/A	0	N/A	N/A	4
3	<i>Oulastrea crispata</i>	3.4	Encrusting	0	N/A	0	N/A	N/A	4
4	<i>Oulastrea crispata</i>	106.8	Encrusting	0	N/A	1	Mud	Light brown	4.5
5	<i>Oulastrea crispata</i>	7.3	Encrusting	0	N/A	1	Mud	Light brown	4.5
6	<i>Oulastrea crispata</i>	32.4	Encrusting	0	N/A	0	N/A	N/A	5
7	<i>Oulastrea crispata</i>	3.6	Encrusting	0	N/A	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	5.3	Encrusting	0	N/A	1	Mud	Light brown	4.5
9	<i>Oulastrea crispata</i>	20.5	Encrusting	0	N/A	0	N/A	N/A	4
10	<i>Oulastrea crispata</i>	11.6	Encrusting	0	N/A	0	N/A	N/A	5
Updated Baseline Survey on 6 August 2012									
1	<i>Oulastrea crispata</i>	7.2	Encrusting	0	N/A	0	N/A	N/A	5
2	<i>Oulastrea crispata</i>	0.9	Encrusting	0	N/A	0	N/A	N/A	5
3	<i>Oulastrea crispata</i>	3.4	Encrusting	0	N/A	0	N/A	N/A	4
4	<i>Oulastrea crispata</i>	106.8	Encrusting	0	N/A	1	Mud	Light brown	4
5	<i>Oulastrea crispata</i>	7.3	Encrusting	0	N/A	1	Mud	Light brown	5
6	<i>Oulastrea crispata</i>	32.4	Encrusting	0	N/A	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	3.6	Encrusting	0	N/A	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	5.3	Encrusting	0	N/A	0	N/A	N/A	4.5
9	<i>Oulastrea crispata</i>	20.5	Encrusting	0	N/A	0	N/A	N/A	5
10	<i>Oulastrea crispata</i>	11.6	Encrusting	0	N/A	0	N/A	N/A	5
Third Impact Coral Monitoring Survey on 30 August 2012									
1	<i>Oulastrea crispata</i>	7.2	Encrusting	0	0	0	N/A	N/A	5
2	<i>Oulastrea crispata</i>	0.9	Encrusting	0	0	0	N/A	N/A	5
3	<i>Oulastrea crispata</i>	3.4	Encrusting	0	0	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	106.8	Encrusting	0	0	1	Mud	Light brown	4



Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality (%)	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness (mm)	Sediment Type (Mud/Sand)	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
5	<i>Oulastrea crispata</i>	7.3	Encrusting	0	0	1	Mud	Light brown	4
6	<i>Oulastrea crispata</i>	32.4	Encrusting	0	0	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	3.6	Encrusting	0	0	0	N/A	N/A	4.5
8	<i>Oulastrea crispata</i>	5.3	Encrusting	0	0	0	N/A	N/A	4
9	<i>Oulastrea crispata</i>	20.5	Encrusting	0	0	0	N/A	N/A	5
10	<i>Oulastrea crispata</i>	11.6	Encrusting	0	0	0	N/A	N/A	5

- (1) The general health of the coral is assessed by using the Asian Coral Watch Chart. The brightness of colour range from 1 (pale or bleached corals) to 6 (dark corals with high quantities of algae and chlorophyll in their tissues), representing different stages of bleaching and recovery which correspond to varying concentrations of symbiotic algae and chlorophyll within coral tissues. Generally, the coral health is considered to be better with higher value on the Coral Watch Chart.
- (2) Represents percentage increase in partial mortality from the Updated Baseline Survey to the Impact Coral Monitoring Survey.

Table 2.5

*Species, Size, Growth Form, Partial Mortality, Sediment Cover and General Health of Tagged Coral Colonies at Area 4 (Control Site)*

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness	Sediment Type	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
Baseline Survey on 23 May 2012									
1	<i>Oulastrea crispata</i>	7.8	Encrusting	0	N/A	0	N/A	N/A	5
2	<i>Oulastrea crispata</i>	3.9	Encrusting	0	N/A	0	N/A	N/A	5
3	<i>Oulastrea crispata</i>	15.2	Encrusting	0	N/A	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	6.2	Encrusting	0	N/A	0	N/A	N/A	5
5	<i>Oulastrea crispata</i>	8.2	Encrusting	0	N/A	0	N/A	N/A	4.5
6	<i>Oulastrea crispata</i>	7.3	Encrusting	0	N/A	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	12.2	Encrusting	0	N/A	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	14.4	Encrusting	0	N/A	0	N/A	N/A	5
9	<i>Oulastrea crispata</i>	5.2	Encrusting	0	N/A	0	N/A	N/A	4
10	<i>Oulastrea crispata</i>	13.5	Encrusting	0	N/A	0	N/A	N/A	5
Updated Baseline Survey on 6 August 2012									
1	<i>Oulastrea crispata</i>	7.8	Encrusting	0	N/A	0	N/A	N/A	4.5
2	<i>Oulastrea crispata</i>	3.9	Encrusting	0	N/A	0	N/A	N/A	5
3	<i>Oulastrea crispata</i>	15.2	Encrusting	0	N/A	0	N/A	N/A	4.5
4	<i>Oulastrea crispata</i>	6.2	Encrusting	0	N/A	0	N/A	N/A	5
5	<i>Oulastrea crispata</i>	8.2	Encrusting	0	N/A	0	N/A	N/A	5
6	<i>Oulastrea crispata</i>	7.3	Encrusting	0	N/A	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	12.2	Encrusting	0	N/A	0	N/A	N/A	5
8	<i>Oulastrea crispata</i>	14.4	Encrusting	0	N/A	0	N/A	N/A	4.5
9	<i>Oulastrea crispata</i>	5.2	Encrusting	0	N/A	0	N/A	N/A	4
10	<i>Oulastrea crispata</i>	13.5	Encrusting	0	N/A	0	N/A	N/A	4
Third Impact Coral Monitoring Survey on 30 August 2012									
1	<i>Oulastrea crispata</i>	7.8	Encrusting	0	0	0	N/A	N/A	4.5
2	<i>Oulastrea crispata</i>	3.9	Encrusting	0	0	0	N/A	N/A	4.5
3	<i>Oulastrea crispata</i>	15.2	Encrusting	0	0	0	N/A	N/A	5
4	<i>Oulastrea crispata</i>	6.2	Encrusting	0	0	0	N/A	N/A	5

Coral No.	Species	Size (cm <sup>2</sup> )	Growth Form	Partial Mortality	Percentage Increase in Partial Mortality (%) <sup>(2)</sup>	Sediment Thickness	Sediment Type	Sediment Color	General Health of Tagged Coral <sup>(1)</sup>
5	<i>Oulastrea crispata</i>	8.2	Encrusting	0	0	0	N/A	N/A	5
6	<i>Oulastrea crispata</i>	7.3	Encrusting	0	0	0	N/A	N/A	4.5
7	<i>Oulastrea crispata</i>	12.2	Encrusting	0	0	0	N/A	N/A	4
8	<i>Oulastrea crispata</i>	14.4	Encrusting	0	0	0	N/A	N/A	4.5
9	<i>Oulastrea crispata</i>	5.2	Encrusting	0	0	0	N/A	N/A	5
10	<i>Oulastrea crispata</i>	13.5	Encrusting	0	0	0	N/A	N/A	5

(1) The general health of the coral is assessed by using the Asian Coral Watch Chart. The brightness of colour range from 1 (pale or bleached corals) to 6 (dark corals with high quantities of algae and chlorophyll in their tissues), representing different stages of bleaching and recovery which correspond to varying concentrations of symbiotic algae and chlorophyll within coral tissues. Generally, the coral health is considered to be better with higher value on the Coral Watch Chart.

(2) Represents percentage increase in partial mortality from the Updated Baseline Survey to the Impact Coral Monitoring Survey.

**Table 2.6** *Determination of Action and Limit Level for Partial Mortality of the Tagged Coral Colonies*

Parameter	Action Level
Partial Mortality	If during Impact Monitoring, a 15% increase in the percentage of partial mortality of corals occurs at more than 20% of the tagged coral colonies at either of the Impact Monitoring Stations (ie Areas 1, 2 and 3) that is not recorded at the Control Station (ie Area 4).
	<b>Limit Level</b> If during Impact Monitoring, a 25% increase in the percentage of partial mortality at more than 20% of any tagged coral colonies occurs that is not recorded at the Control Station (ie Area 4).

**Table 2.7** *Stepwise Procedures for Action and Limit Levels Exceedances*

Event	The Marine Biologist
Action Level Exceedance	<b>Step 1</b> – Inform the Contractor, the Project Designer and AFCD and discuss the most appropriate method of reducing sediment in the discharge. <b>Step 2</b> – Implement mitigation measures on site. <b>Step 3</b> – If non-compliance continues, check and confirm the effectiveness of mitigation measures and repeat monitoring survey measurements.
Limit Level Exceedance	Undertake Steps 1 – 3. If further exceedance of Limit Level, suspend construction works until an effective solution is identified. Once the solutions have been identified and agreed with all parties, construction works may commence

The 3<sup>rd</sup> Impact Coral Monitoring Survey has been carried out on 30 August 2012 at four designated monitoring sites (including 3 Impact Sites and 1 Control Site) in accordance with the *EM&A Manual*. During the monitoring, 10 tagged coral colonies were re-visited and monitored at each site. The conditions of the tagged coral colonies during the Impact Coral Monitoring Survey are compared with the baseline conditions which were recorded prior to the commencement of the concerned dredging operations within 250 m from the To Kwa Wan breakwaters.

Action and Limit Levels for the partial mortality of tagged corals were established based on the baseline coral data (*Table 3.1*). No exceedances of the Action and Limit Levels were identified during the 3<sup>rd</sup> Impact Coral Monitoring Survey on 30 August 2012. There thus did not appear to be any deterioration in the general health and condition of the tagged coral colonies as a result of the dredging activities within 250 m from the To Kwa Wan breakwaters.

**Table 3.1** *Determination of Action and Limit Level for Partial Mortality of the Tagged Coral Colonies*


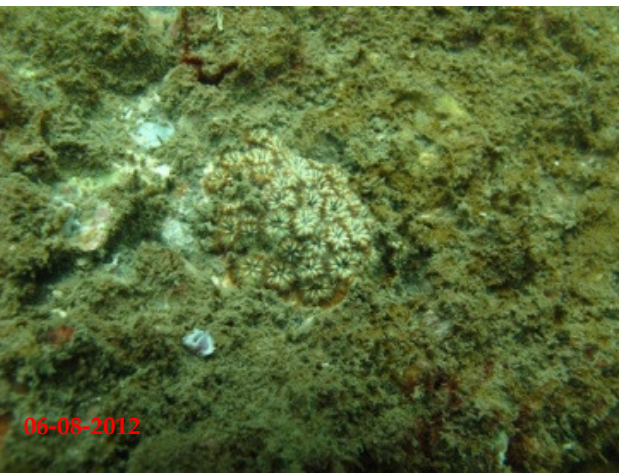


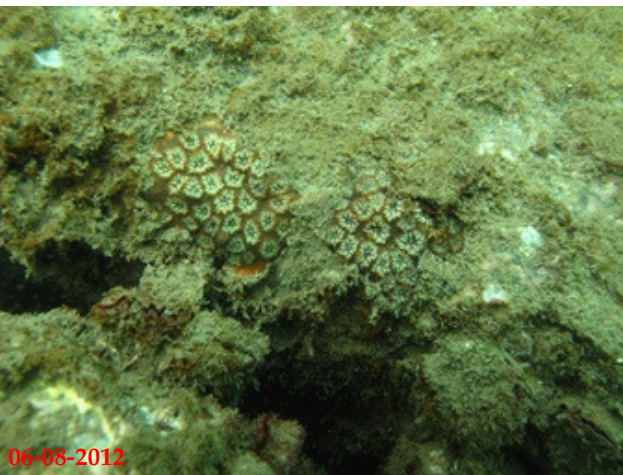

Parameter	Action Level
Partial Mortality	If during Impact Monitoring, a 15% increase in the percentage of partial mortality of corals occurs at more than 20% of the tagged coral colonies at either of the Impact Monitoring Stations (ie Areas 1, 2 and 3) that is not recorded at the Control Station (ie Area 4).
	<b>Limit Level</b> If during Impact Monitoring, a 25% increase in the percentage of partial mortality at more than 20% of any tagged coral colonies occurs that is not recorded at the Control Station (ie Area 4).

Impact Coral Monitoring Surveys will be conducted weekly under the Coral Monitoring Programme when dredging operations are being undertaken within 250 m from the To Kwa Wan breakwaters. Findings of further Impact Coral Monitoring Surveys will be presented in subsequent Coral Impact Reports in order to determine any observable impacts to the tagged corals as a result of the concerned dredging operations. In the event that significant adverse impacts are identified as a consequence of the works, monitoring would also allow for implementation of appropriate remedial actions to reduce such impacts.

Annex A

## Photographic Records of Tagged Coral Colonies

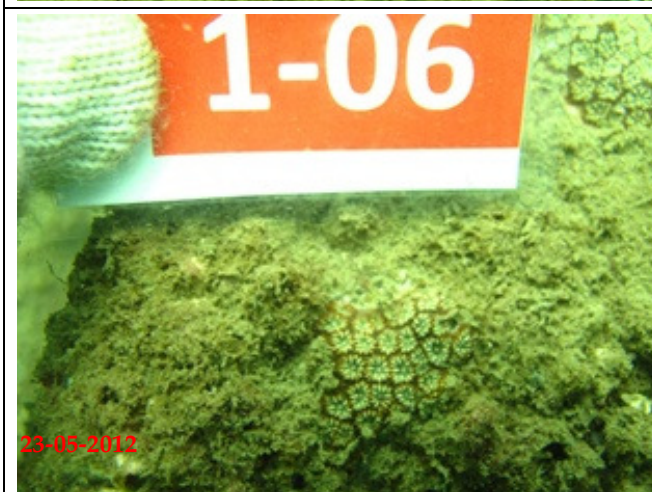
*Annex A1 Photographic Records of Tagged Coral Colonies at Impact Monitoring Site (Area 1) during the Baseline and Impact Monitoring Surveys*

Baseline 23 May 2012	Updated Baseline 6 August 2012	Impact 30 Aug 2012
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 <p>23-05-2012</p>	 <p>06-08-2012</p>	 <p>30-08-2012</p>





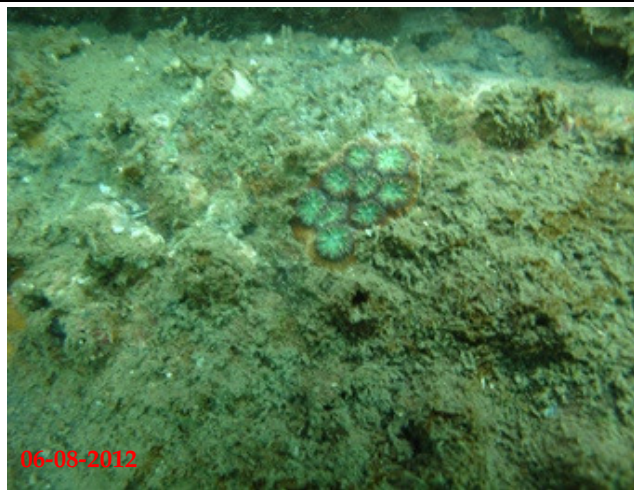
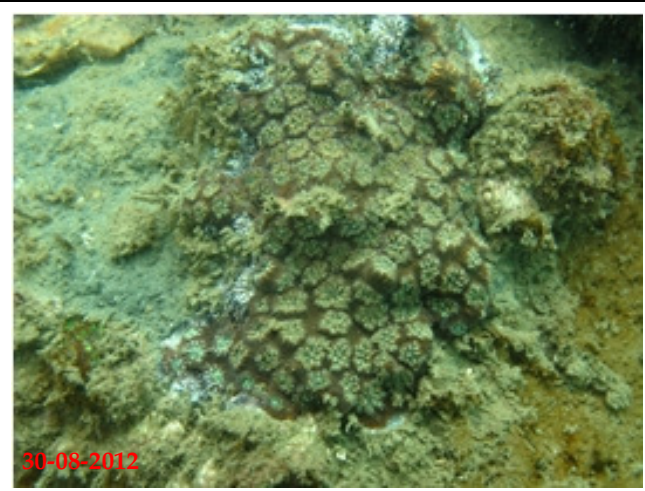
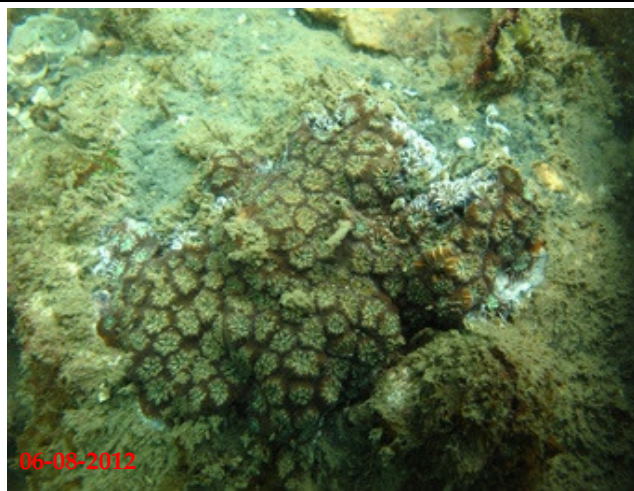






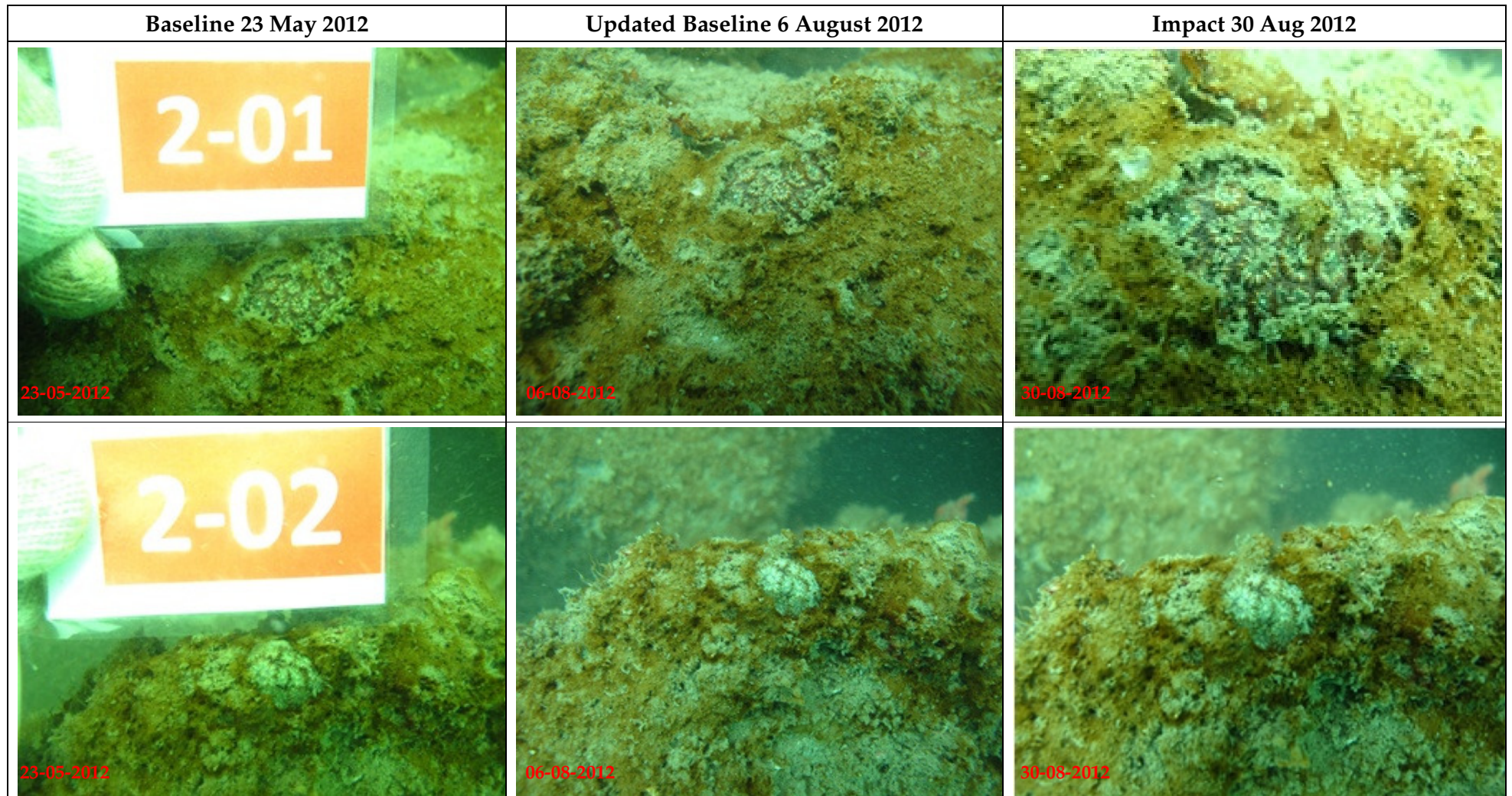




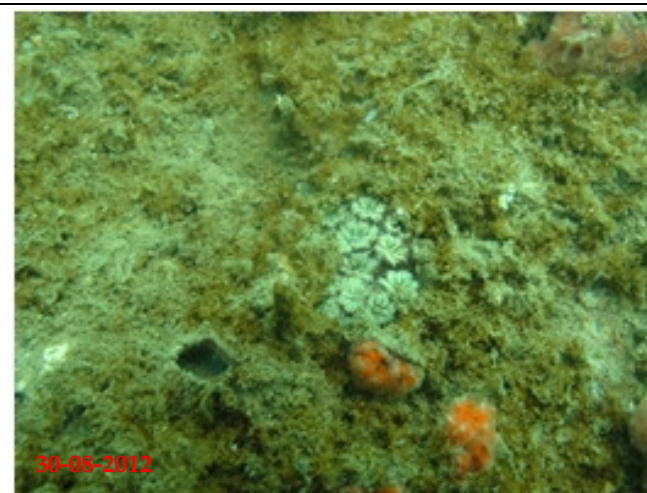
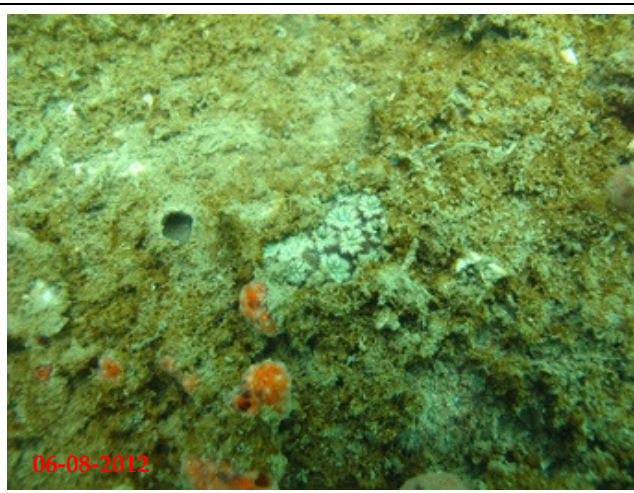
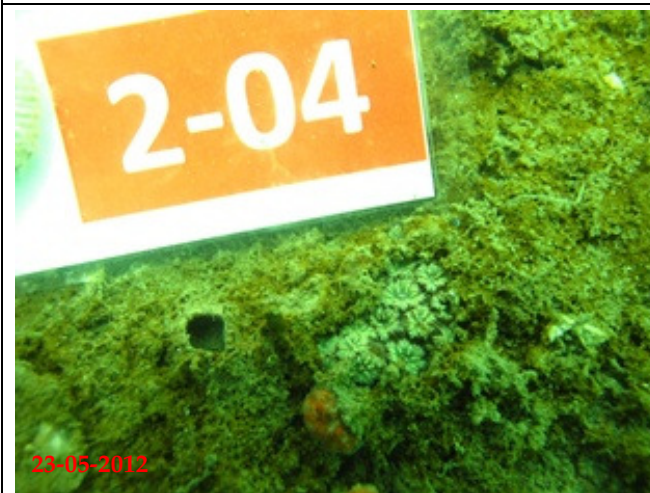
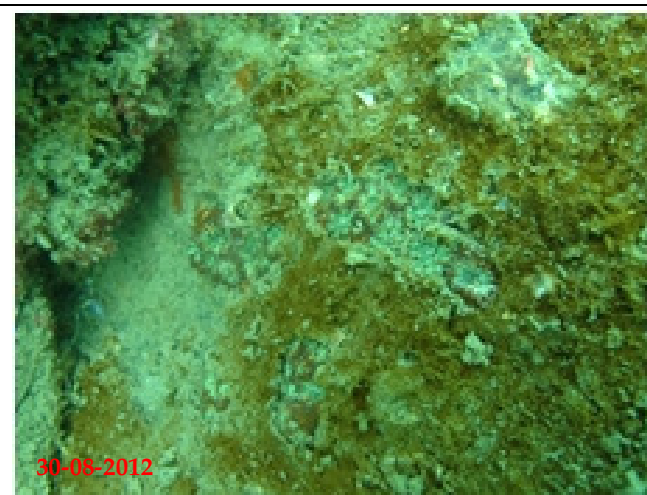
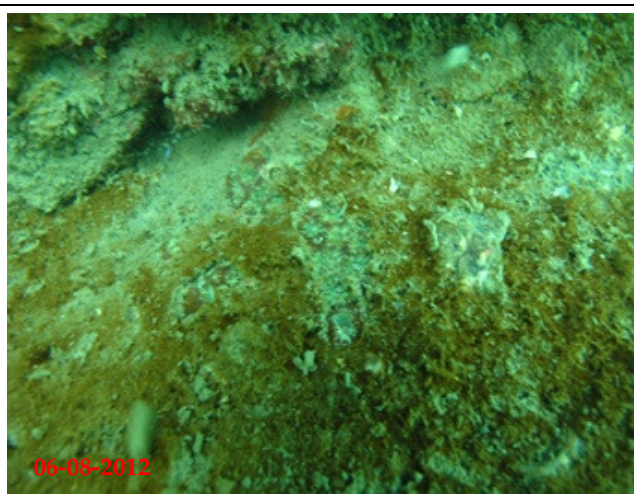
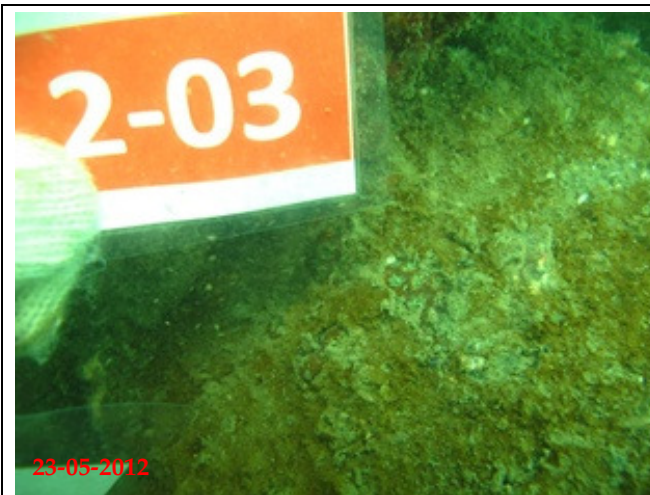




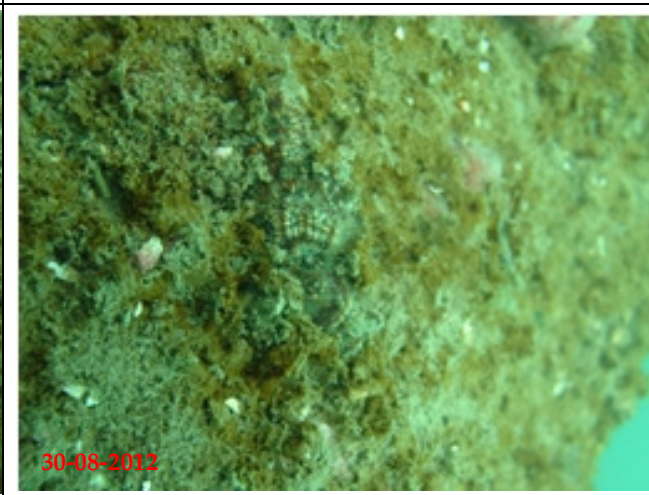
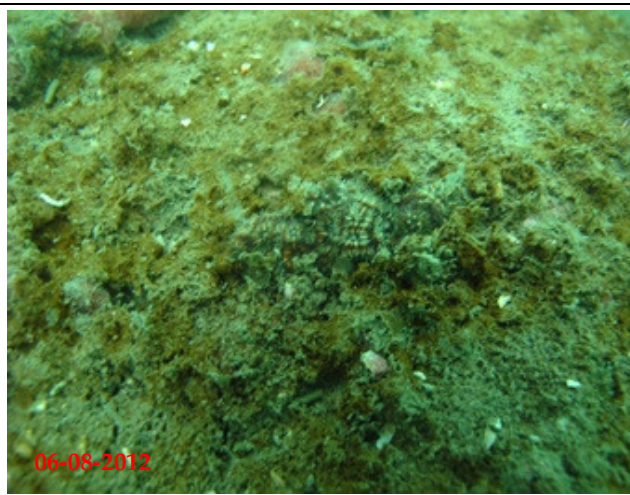
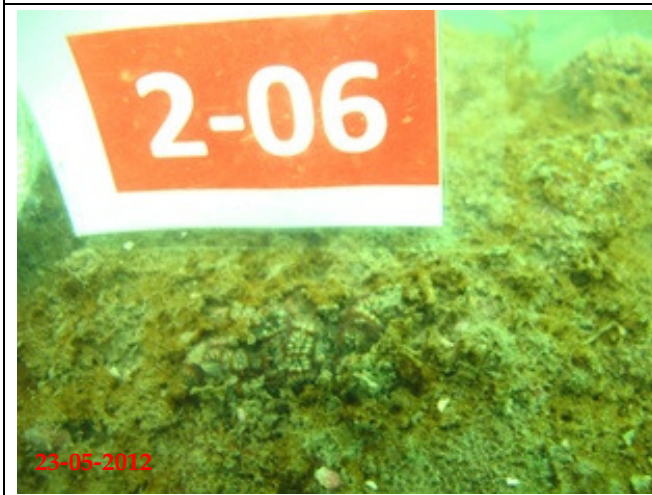
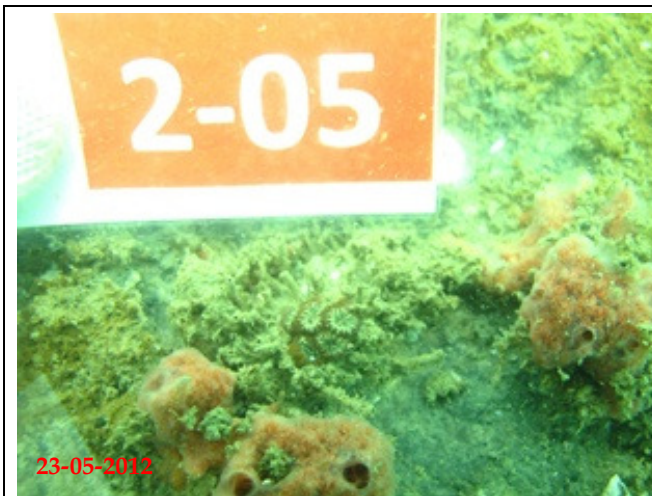
*Annex A2 Photographic Records of Tagged Coral Colonies at Impact Monitoring Site (Area 2) during Baseline and Impact Monitoring Surveys*



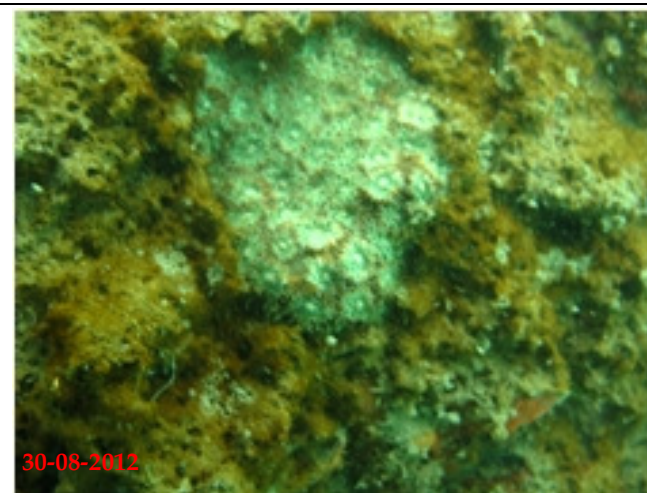
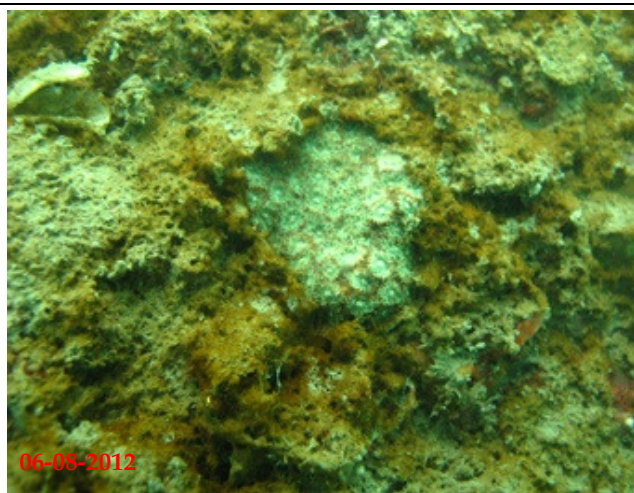
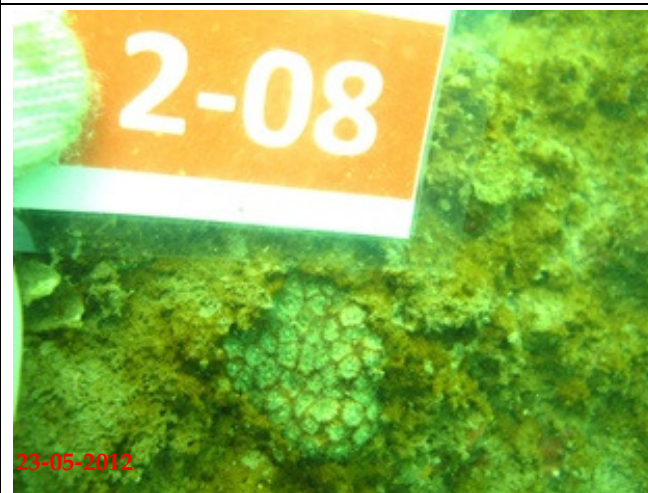




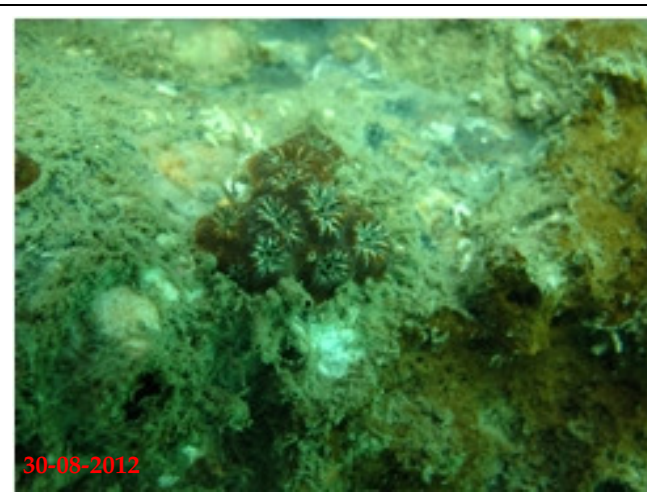
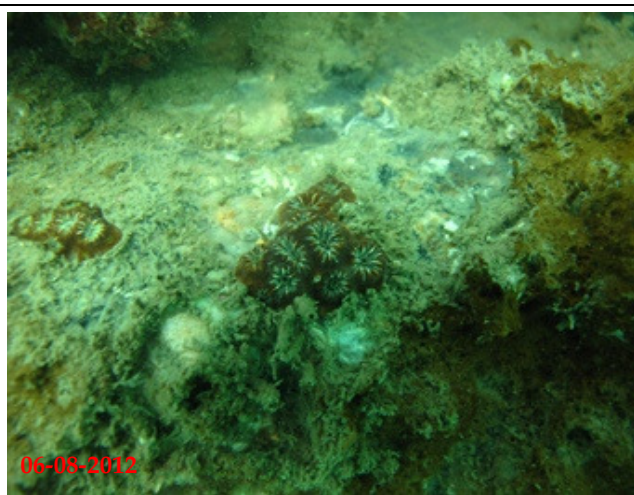







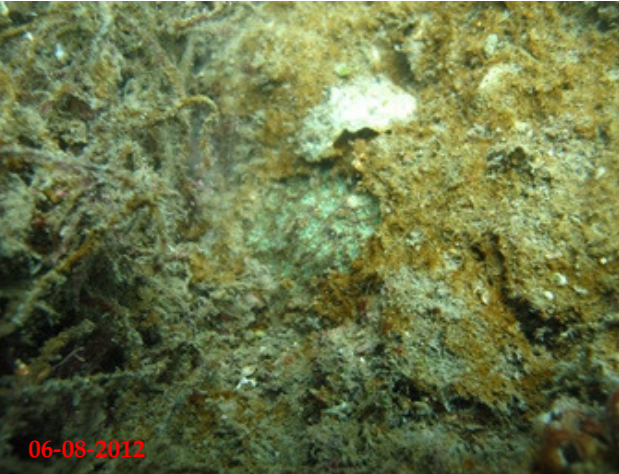

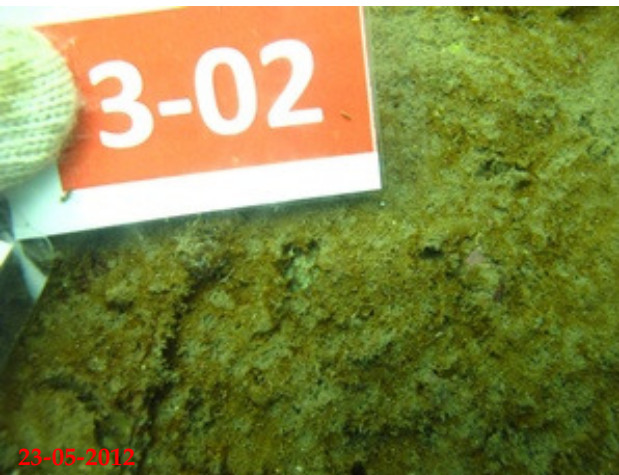
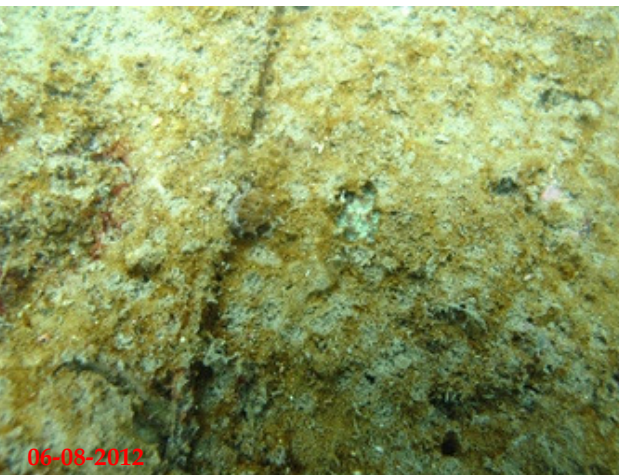
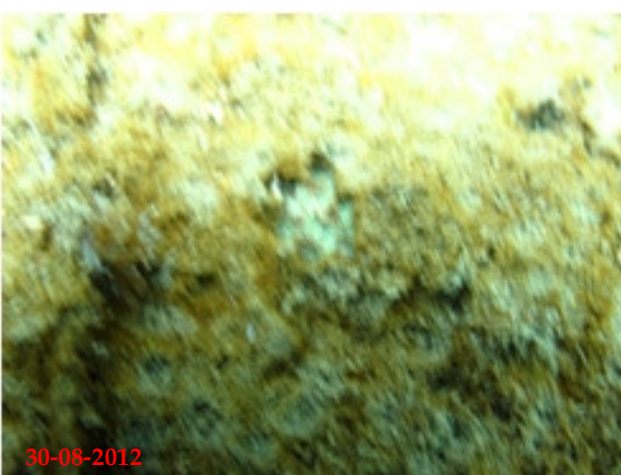




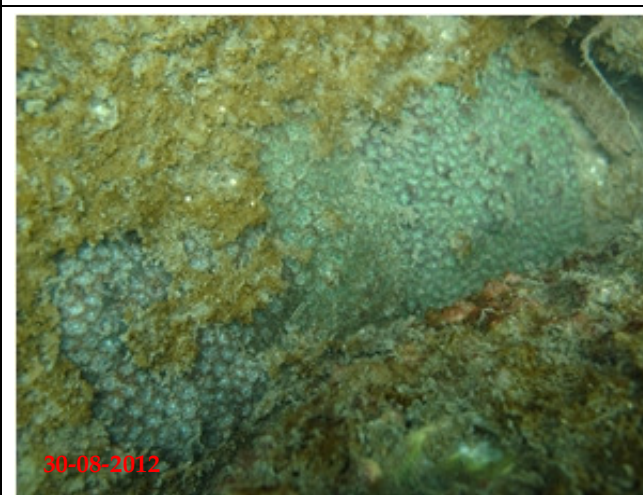
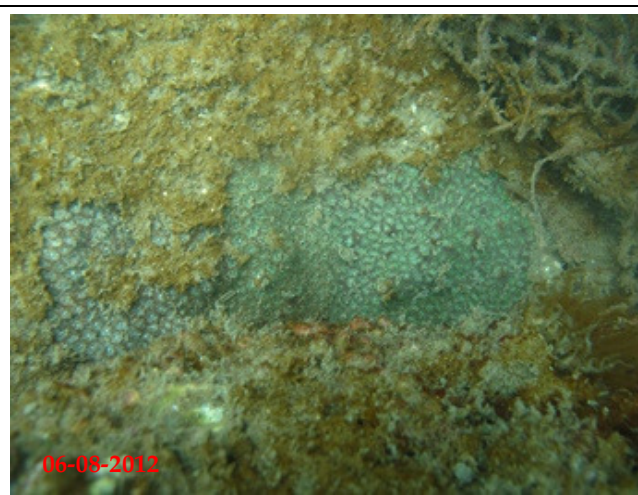
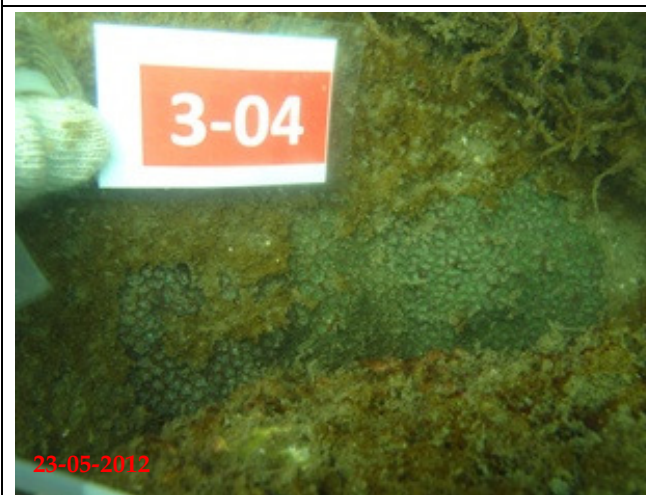
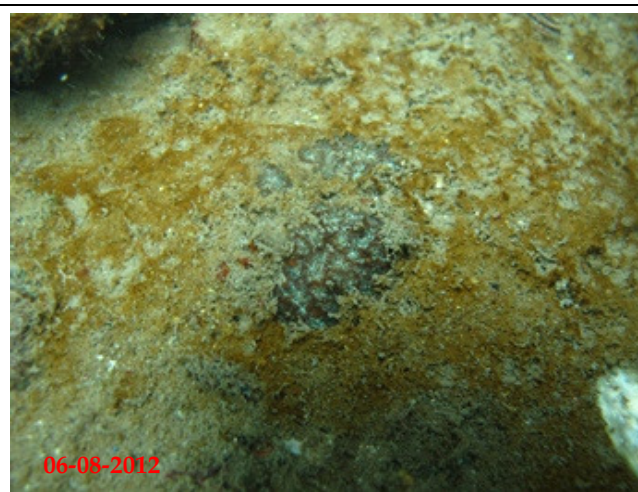
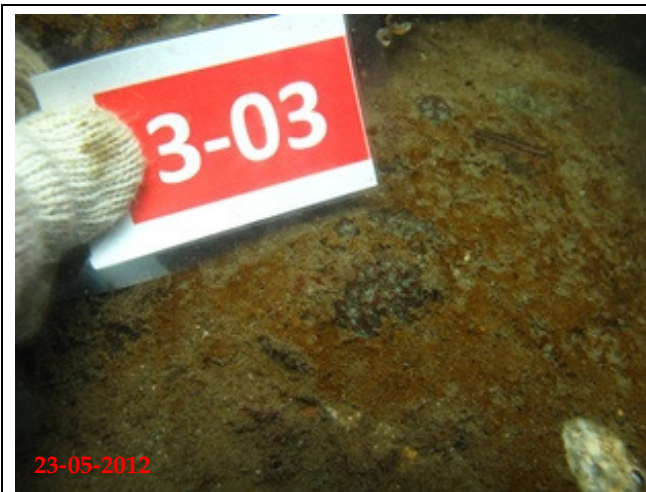




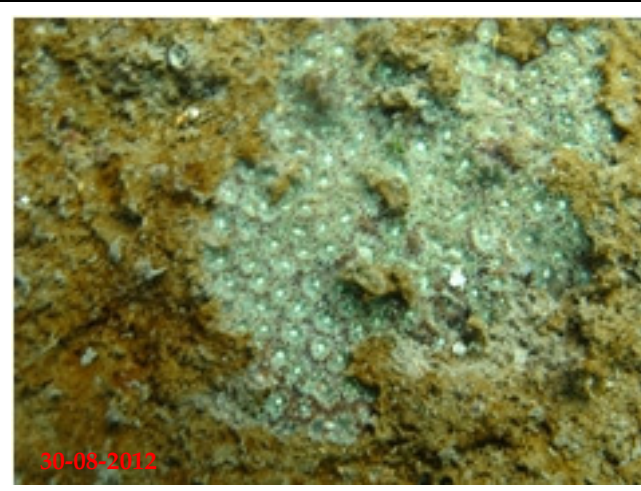
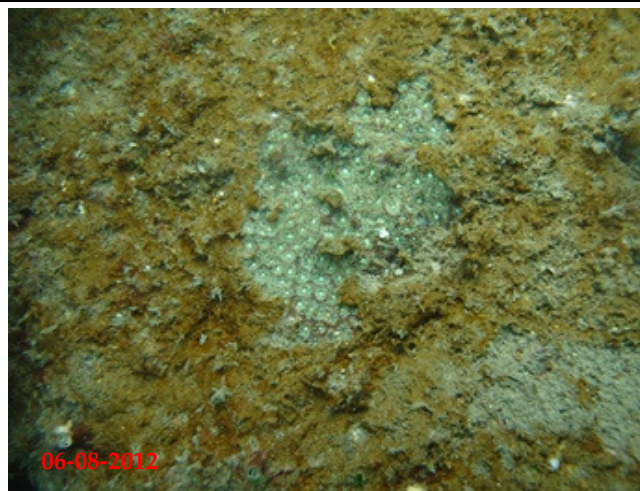
*Annex A3 Photographic Records of Tagged Coral Colonies at Impact Monitoring Site (Area 3) during Baseline and Impact Monitoring Surveys*

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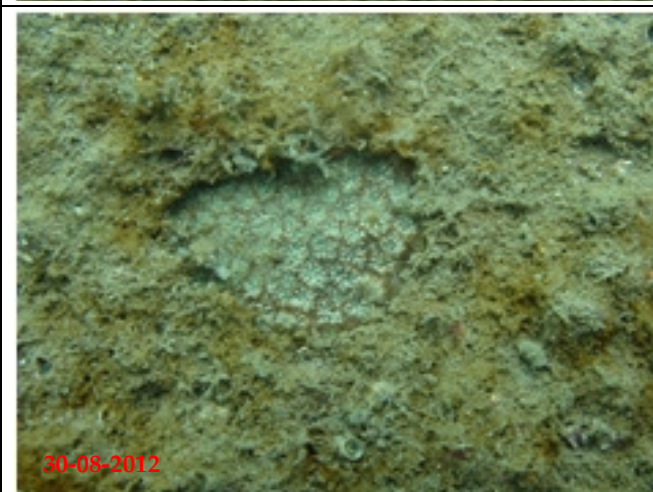
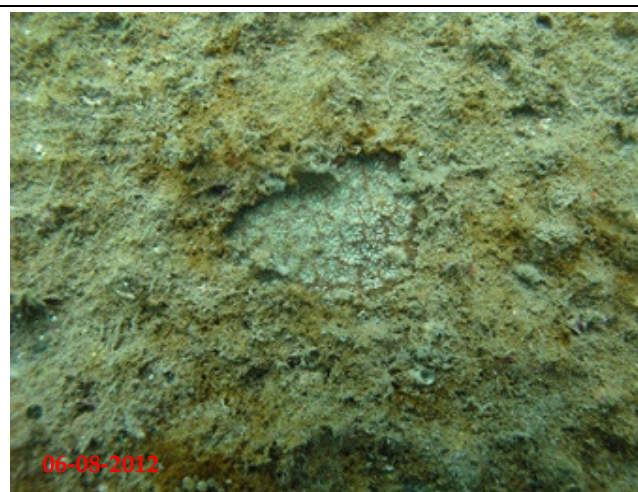












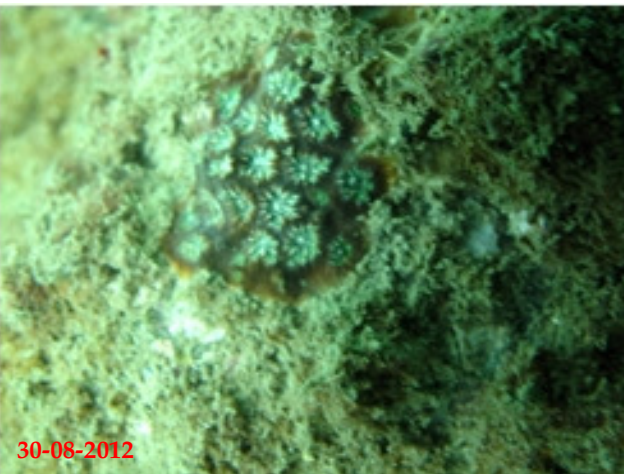

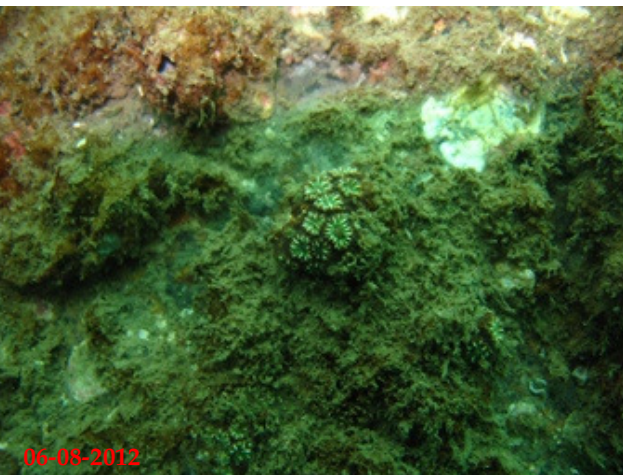









*Annex A4 Photographic Records of Tagged Coral Colonies at Control Site (Area 4) during Baseline and Impact Monitoring Surveys*

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