



Agreement No. CE 32/2021 (CE) Improvement Works at Lai Chi Wo Pier and Tung Ping Chau Public Pier -Design and Construction

Pre-construction Dive Survey Report &
Translocation Proposal
at Lai Chi Wo Pier (Rev 4)
(5207869-OR017A-04a)

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Not Used

1. Introduction

1.1 Background

- 1.1.1 Hong Kong is an international metropolis and comprises many natural scenic spots, rare geological features, attractions with traditional culture and heritage, and hiking trails with rich biological diversity. The famous Hong Kong UNESCO Global Geopark (Geopark), Marine Parks, old temples, eco-tourism sites and beautiful beaches in coastal areas are some examples. Many attractions are located at remote rural areas without land access and rely on marine transport. In recent years, number of local and non-local visitors attracted to these remote destinations has been constantly increasing.
- 1.1.2 Public piers play an important role in accessing these remote destinations. There are about 120 public piers in Hong Kong. Majority of these piers are built, maintained and managed by the Government.
- 1.1.3 Although regular inspections and maintenance for the remote public piers are carried out by the Government to ensure its structural integrity, some public piers at remote rural areas have been in place for many years and cannot cope with the current needs / usages, such as:
- a) small or primitive piers leading to safety concerns during berthing and unsatisfactory boarding conditions especially for kids and elderly;
 - b) inadequate depth of water for berthing during low tide;
 - c) limited berthing space or narrow accesses which cannot cater for the fluctuating utilization during festive times or weekends; and
 - d) aged pier structures with a need for improvement works.
- 1.1.4 Civil Engineering and Development Department (CEDD) commissioned an Investigation Study (IS), “Study for Pier Improvement at Lai Chi Wo and Tung Ping Chau – Investigation” (Agreement No. CE 2/2018 (CE)), in June 2018 to verify the technical feasibility of improving two potential pier items located within Yan Chau Tong Marine Park and Tung Ping Chau Marine Park in the northeast region of Hong Kong. The improvement of these two piers are designated project under Item Q.1, Part 1 of Schedule 2 of the EIAO.
- 1.1.5 EIA study has been carried out in accordance with the requirement of the EIA Study Briefs including assessment of the potential environmental impacts, in particular water quality impact and ecological impact, and specified environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and mitigation measures. The EIA Reports of the two piers were approved by DEP under the EIAO on 29 December 2020 and Environmental Permits (EPs) for construction and operation of the improvement works were granted on 19 February 2021. The EIA study made recommendations on the scope of improvement to the Lai Chi Wo Pier and Tung Ping Chau Public Pier with preliminary engineering studies for individual pier taking into account public aspiration and other constraints, prepared preliminary engineering layouts, and evaluated the feasibility of adopting innovative design elements for the piers.

- 1.1.6 Atkins China Ltd. was commissioned by the Civil Engineering and Development Department of the Hong Kong Government Special Administrative Region on 16 September 2021 to provide consultancy services for Agreement No. CE 32/2021 (CE) Design Consultancy for Improvement Works at Lai Chi Wo Pier and Tung Ping Chau Public Pier - Design and Construction (hereinafter called “the Assignment”).

1.2 Project Description

- 1.2.1 Pier Improvement at Lai Chi Wo (the Project) is governed by the Environmental Permit, EP-586/2021, under the EIAO. The scale and scope of the Project includes:

- Modification of the existing pier and construction of new pier structures. The improved pier would be of approximately 155m long and 6m to 15m wide;
- Construction and removal of a temporary pier of approximately 70m long and 3m wide;
- Site investigation works for detailed design; and
- Associated facilities (e.g. barrier-free access, canopy, seats) and landscaping works, etc under the Project.

- 1.2.2 The Project Site is located in the vicinity of Lai Chi Wo Pier, which falls within the Yan Chau Tong Marine Park. Its location is shown in **Appendix A**.

- 1.2.3 The site investigation (SI) works for detailed design will be commenced on 16 February 2021 to collate necessary engineering and sediment quality information for the study for pier improvement at Lai Chi Wo.

1.3 EP Requirements and Relevant Licenses

- 1.3.1 Pursuant to Condition 3.4 of EP-586/2021, the Permit Holder shall undertake a pre-construction dive survey to verify the conditions of the small coral colonies on the existing Lai Chi Wo pier; and shall deposit with the DEP a pre-construction dive survey report (the Report) no later than 1 month before the commencement of any construction works.

- Coral translocation methodology, including the stabilization of the translocated corals, identification of coral recipient site; and
- Post- translocation monitoring methodology

According to Section 15B of Marine Parks and Marine Reserves Regulation (Cap. 476A), no person shall collect any marine life and resources in or from a marine park or marine reserve. A Marine Park Permit shall be applied under Section 17 of Cap. 476A for the coral translocation work / monitoring survey within Yan Chau Tong Marine Park.

1.4 Objective of the Report / Proposal

- 1.4.1 The objectives of the Report / Proposal are to record the species, number, locations and the sizes of coral colonies on the existing LCW pier (**Figure 1**) identified during

the pre-construction dive survey conducted by the Qualified Ecologist, Mr. Keith L W Kei; to present the coral translocation methodology, including the stabilization of the translocated corals and identification of coral recipient site for all translocatable coral colonies; and, to propose post-translocation monitoring methodology. The Report / Proposal will also verify the results of the previously conducted coral survey(s) by comparing the species and number of corals recorded during the pre-construction dive survey.

2. Introduction

2.1 Methodology

2.1.1 Coral colonies were recorded at the existing pier of LCW during the EIA. In order to identify all affected coral colonies (suitable size for translocation), a detail coral survey at the direct impact site and suggested recipient sites will be conducted before starting any coral translocation work.

Coral Mapping Survey at Direct Impact Site (Donor Site) – Existing LCW Pier

2.1.2 A coral mapping will be conducted at the donor site (LCW Pier) as part of the detailed coral survey to locate all translocatable (suitable size).

2.1.3 Any translocatable corals will be identified to species level as far as practicable and their locations will be recorded. A specific code will be assigned to each recorded coral colony.

2.1.4 The results will be presented as a map showing the approximate locations of all translocatable coral colonies along the existing LCW pier. The total number of coral colonies, their sizes and species will be provided according to their assigned codes. The health condition (including percentage cover of bleaching, mortality, degree of sedimentation) of the corals will also be recorded and the feasibility of translocation of corals of conservation value will be assessed.

2.1.5 Upon completion of the surveys, the requirement for translocation and the required dimensions of the recipient site will be identified. Based on the results of the donor site, all corals with suitable size be considered feasible for translocation

Detailed Coral Survey at Potential Recipient Sites

Spot Check Dive

2.1.6 A spot-check dive survey covering the potential recipient site (**Figure 3**) will be conducted. The survey is to check the presence of coral species similar to the donor site and the presence of suitable substratum to allow the translocated boulders/rocks to be permanently stabilized. The spot-check dive survey requires suitably trained and qualified SCUBA divers and marine ecologists swimming in a search pattern, at random depths within the spot-check dive area. Subtidal substrata (hard substratum seabed) within the proposed spot-check dive area will be surveyed for the presence of coral communities, including hard coral (order Scleractinia), octocorals (sub-class Octocorallia) and black-corals (order Antipatharia). Surface parameters such as water temperature, salinity and pH will be recorded. Target species parameters including estimated number of species, coral cover, partial mortality and the presence of any rare corals will also be recorded during the spot-check dive. The divers will also pay attention to the presence of non-typical reef structures, unusual coral species associations, unique or peculiar assemblages of the local reef formations, and reefs that are almost completely dominated by one particular species. Data will be recorded during the dives on water proof paper in preparation for a later consolidation and analysis.

2.1.7 During the spot-check dive, the general environmental conditions of the potential recipient site will also be observed (e.g. presence of healthy coral community with similar coral species as the donor site, presence of suitable substratum to allow the translocated boulders/rocks to be permanently stabilized, sufficient space to receive the newly translocated coral colonies, etc.). If the preliminary survey findings reveal that the potential recipient site is not suitable, alternative recipient site(s) (**Figure 3**) will be searched.

Rapid Ecological Assessment (REA)

2.1.8 If corals are recorded during the spot-check dives and the potential recipient site is found suitable during the preliminary screening, a more detailed Rapid Ecological Assessment (REA) will be carried out with reference to DeVantier *et al.* (1998). The substrate type and taxonomic composition of the recipient site will be assessed.

2.1.9 The REA survey will be conducted along 100 m transect(s) parallel to the coastline (based on the preliminary results from the spot-check dives). The substrate type along the length of the transect(s) will be recorded at 1 m intervals. The benthic cover, taxon abundance, and ecological attributes along the transects will also be recorded in a swathe of 2 m wide, 1 m either side of the transect.

2.1.10 The locations of the REA transects will be recorded on-site using a portable GPS unit. The number of colonies, sizes and types of corals, their coverage, abundance, depth, health status of coral species will also be recorded. Photographs of representative taxa along the transects will also be taken during the surveys.

2.1.11 Health status of coral will be assessed by the following criteria and recommendation of the translocation plan would be provided in reference with the PER report:

- Gorgonian coral: Percentage of branches exhibiting partial mortality and secretion of mucus; and
- Hard coral: Percentage of surface area exhibiting partial mortality and blanched/bleached.

Tier I – Categorization of Benthic Cover

2.1.12 Upon the completion of each transect, ecological and substratum attributes (refer to **Table 2.1**) will be assigned to standard ranked ordinal categories (refer to **Table 2.2**).

Table 2.1 - Tier I Benthic Attribute Categories

Ecological Attributes	Substratum Attributes
Coral	Hard substrata
Dead Coral	Bedrock / continuous pavement
Octocoral (Soft corals – black and Gorgonians)	Boulders blocks (diam. >50 cm)
Anemone beds	Cobble
Dead Standing corals	Rubble
Other benthos (sponges, zoanthids, ascidians and bryozoans)	Other
Macro-algae	Soft substrata
-	Sand
-	Mud / Silt

Ecological Attributes	Substratum Attributes
-	Mud

Table 2.2 - Tier II Ordinal Ranks of Percentage Cover of Benthic Attributes

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

2.1.13 For substratum attributes, it is preferable to record actual estimates of coverage. The percentage of hard substrata vs. soft substrata can be provided (e.g. 80% and 20% respectively). The percentage cover of the types of hard or soft substrata could also then be presented (e.g. bedrock pavement 60%, rubble 20%, sand 15%, mud/silt 5%). Similarly, recording and presenting actual estimates of, for instance, hard and soft coral cover may be more informative (e.g. <1%)

Tier II – Taxonomic Inventories to Define Types of Benthic Communities

2.1.14 An inventory of benthic taxa along each transect will be compiled during the survey. Taxa will be identified in situ to the following levels:

- Corals to species, where possible;
- Soft corals, anemones and conspicuous macroalgae to genus level, where possible;
- Other benthos (including sponges, zoanthids, ascidians ,and bryozoans) to genus level, where possible.

2.1.15 For each transect, each taxon in the inventory will be ranked in terms of abundance in the community (refer to **Table 2.3**). The taxon categories will be ranked in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are visual assessments of abundance, rather than quantitative counts of each taxon. Representative photos of organisms will be taken.

Table 2.3 - Ordinal Ranks of Taxon Abundance

Rank	Percentage Cover
0	Absent
1	Rare
2	Uncommon
3	Common

Rank	Percentage Cover
4	Abundant
5	Dominant

2.1.16 To verify the suitability of the coral recipient site, data collected including environmental conditions, bathymetry, benthic composition at the coral recipient site will be compared with the donor site. It is preferable to select the recipient site with the following characteristics:

- Presence of a healthy coral community of the similar coral species as the donor site;
- Similar environmental conditions, or better than the donor site, such as bathymetry, water depth, benthic composition, etc.;
- Presence of suitable substratum to allow the translocated boulders/rocks to be permanently stabilized;
- In the vicinity of the original coral colony;
- Sufficient space to receive the newly translocated coral colonies; and
- Presence of protection from storm/typhoon damage.

2.1.17 In addition, the survey will be confirmed if the proposed recipient site had the space requirements to accommodate the number of corals to be translocated, and the absence of identified constraints to their future growth and proliferation.

2.2 Survey Findings

Coral Mapping Survey at Direct Impact Site (Donor Site) – Existing LCW Pier

2.2.1 Coral mapping surveys were conducted on 6th and 7th December 2021 along LCW existing pier (Figure 1) and the weather condition on Table 2.4.

Table 2.4 Weather Condition for Coral Mapping on 6th and 7th December 2021

Date	Condition	Average Underwater Visibility
6th December 2021	Northeast force 3-4, Sunny	1 m
7th December 2021	Northeast force 4 to 5, Sunny i	1 m

2.2.2 During the mapping survey, a total of four coral colonies (Figure 2 and Photo Plate A) were found to have suitable size for translocation and their species name, size and health condition were shown in Table 2.5.

Table 2.5 Species, Health Condition, Size and Abundance in Hong Kong of the Recorded Coral Colonies

Coral #	Coral species	Health Condition	Size (Diameter)	Abundance in Hong Kong
01	<i>Porites lutea</i>	Good	35 cm	Dominant
02	<i>Leptastrea purpurea</i>	Good	25 cm	Dominant
03	<i>Cyphastrea serailia</i>	Good	20 cm	Dominant
04	<i>Porites lutea</i>	Good	20 cm	Dominant

2.2.3 All recorded translocatable coral colonies showed good in health condition

Detailed Coral Survey at Potential Recipient Sites (Original)

Spot Check Dive

2.2.4 The spot-check dive was carried out on 28th December 2021 and the weather conditions were summarized in **Table 2.6**.

Table 2.6 Weather Condition for the Spot-Check Dive on 28th December 2021

Date	Condition	Average Underwater Visibility
28th December 2021	Northeast force 3-4, Sunny	1 m to 1.5 m

2.2.5 Spot check dive was carried out at the suggested recipient site (Figure 3). The GPS coordinates, route distance, maximum depth, bottom substrate and bottom visibility each surveyed sites were summarized in **Table 2.7**.

Table 2.7 GPS Coordinates, Route Distance, Maximum Depth, Minimum Depth, Bottom Substrate and Bottom Visibility of Spot-Check Dive Site SC1

Site	Location (GPS) (Starting Point)	Route Distance (m)	Min. Depth (m)	Max. Depth (m)	Bottom Substrate	Visibility (m)
SC1	E 114°16'02.17" N 22°32'13.27"	200	1.5	4.5	Natural Bedrock	1-1.5

2.2.6 The spot check site was mainly composed of natural bedrock. Substrates beyond the maximum depth are all sandy with scattered boulders and rocks with visibility around 1m to 1.5 m. Sponges, bryozoans, *Diadema* sea urchin and tubeworms *Sabelastarte japonica* were the dominant animal species in the surveyed site in which they are commonly found in Hong Kong waters.

2.2.7 A total of 26 (**Table 2.8**) coral species were recorded along the suggested recipient site during the spot check survey. Most of the recorded coral species are common in Hong Kong. REA transect was laid along the coral area.

Table 2.8 Coral species and their Abundance in Hong Kong

Coral Species	Abundance in Hong Kong
<i>Acanthastrea echinata</i>	Uncommon
<i>Bernardpora stutchburyi</i>	Common
<i>Coelastrea aspera</i>	Common
<i>Cyphastrea japonica</i>	Abundant
<i>Cyphastrea serailia</i>	Abundant
<i>Dipsastraea favus</i>	Abundant
<i>Dipsastraea lizardensis</i>	Common
<i>Dipsastraea rotumana</i>	Abundant
<i>Dipsastraea veroni</i>	Common
<i>Duncanopsammia peltata</i>	Common
<i>Echinophyllia aspera</i>	Common
<i>Favites chinensis</i>	Dominant
<i>Favites flexuosa</i>	Uncommon
<i>Goniopora columna</i>	Abundant
<i>Goniopora lobata</i>	Common
<i>Leptastrea purpurea</i>	Abundant
<i>Lithophyllon undulatum</i>	Common
<i>Oulastrea crispata</i>	Abundant
<i>Pavona decussata</i>	Abundant
<i>Platygyra acuta</i>	Dominant

<i>Platygyra carnosa</i>	Common
<i>Platygyra verweyi</i>	Uncommon
<i>Platygyra yaeyamaensis</i>	Uncommon
<i>Porites lutea</i>	Abundant
<i>Psammocora profundacella</i>	Uncommon
<i>Stylocoeniella guentheri</i>	Common

Rapid Ecological Assessment Survey

2.2.8 The REA survey was performed on 29th December 2021 right after the spot check survey. One 100 m transects were laid parallel to the coastline along spot check site SC1 (**Figure 4**). The GPS coordinates, maximum depth, bottom substrate and bottom visibility were shown in Table 2.9

Table 2.9 GPS of Transect Starting and Ending, Maximum Depth, Bottom Substrate and Bottom Visibility of the Four REA Transects

Transect	Location (GPS) (Starting Point)	Location (GPS) (End Point)	Max. Depth (m)	Bottom Substrate	Visibility (m)
1	E 114°16'02.30" N 22°32'11.43"	E 114°16'03.66" N 22°32'08.55"	3.5	Artificial Sloping Boulders	1.5

2.2.9 A 100 m transect was laid down along the coastline which covered part of spot check site SC1 (**Figure 3**). The average depth for the transect was about 3.5 m and visibility around 1.5 m

2.2.10 The substrate along the transect line is mainly composed of natural bedrocks (**Table 6**). Common marine life such as common sponges, bryozoans, rock oyster *Saccostrea cucullata*, common green mussel *Perna viridis*, *Diadema* sea urchin and tubeworm *Sabelastarte japonica* were found on survey area.

Table 2.10 Ecological Attributes on SC1 REA Transect 1

Ecological Attributes	Rank
Hard Coral	4
Dead Coral	0
Octocoral (Soft corals black and gorgonians)	0
Anemone Beds	0
Dead Standing Corals	0
Other Benthos (sponges, zoanthids, ascidinas and bryozoans)	0.5
Macro-algae	0

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

Table 2.11 Substratum Attributes on SC1 REA Transect 1

Hard Substrata	Rank
Bedrock/continuous pavement	0
Boulder Blocks (diam.>50cm)	5
Boulder Blocks (diam.<50cm)	1
Rubble	0
Other	0

Soft Substrata	Rank
Sand	0
Mud/Silt	0
Mud	0

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

Table 2.12 Ranks of Taxon Abundance along the SC1 REA Transect 1

Benthic Taxa	Rank
Coelastrea aspera	3
Cyphastrea serailia	4
Dipsastraea favus	4
Dipsastraea lizardensis	3
Dipsastraea rotumana	4
Duncanopsammia peltata	3
Echinophyllia aspera	3
Favites chinensis	5

Goniopora columna	4
Goniopora lobata	3
Leptastrea purpurea	4
Oulastrea crispata	4
Pavona decussata	4
Platygyra acuta	5
Platygyra carnosa	3
Porites lutea	4
Psammocora profundacella	4
Stylocoeniella guentheri	3
Sponges	3
Bryozoan	3
Saccostrea cucullata	3
Perna viridis	3
Common Black Sea Cucumber	2

* Rank of Abundance: 0 = Absent; 1 = Rare; 2 = Uncommon; 3 = Common; 4= Abundant; 5 = Dominant.

2.2.11 This site supported high percentage (>50%) of hard coral. A total of 18 coral species (**Table 2.12**) were recorded during the REA survey. They were of large to medium size (about 15 to 120 cm in diameter) and in high coverage. All the coral colonies were in good condition.

Detailed Coral Survey at Potential Recipient Sites (Updated)

2.2.12 Due to adverse weather condition with strong wind and wave during the translocation activities performed on 27 and 28 January 2022, the original proposed recipient site was not suitable for putting the translocated corals. For safety and health of the translocated coral, another site with the same species of corals identified in **Table 2.5** was selected (**Figure 5**). Detailed survey for the new recipient site was shown in **Appendix B**. The GPS location, Average Depth and Bottom Substrates of translocated corals in the new recipient site were summarized in **Table 2.13**.

Table 2.13 GPS Coordinates, Average Depth and Bottom Substrate of Translocated Corals in Potential Recipient Sites (Updated)

GPS Location at Starting Point	Average Depth	Bottom Substrate
E 114°17'05.74"	2.3 m	Natural Boulders and Sandy
N 22°31'23.55"		

2.2.13 The updated potential recipient site supported high percentage (>50%) of hard coral. A total of 14 coral species were recorded during the REA survey. They were of large to medium size (about 15 to 85 cm in diameter) and in high coverage. Both

Porites lutea and *Cyphastrea serailia* were recorded in the suggested recipient site. All the coral colonies were in good condition.

- 2.2.14 Since the same species of coral were recorded at the updated potential recipient site, the updated potential recipient site will be a suitable site to adopt the 4 coral colonies recorded at the existing pier.

2.3 Conclusion

- 2.3.1 The pre-translocation surveys were conducted in December 2021. A total of 4 suitable size for coral translocation coral colonies were recorded along the existing LCW pier.
- 2.3.2 The size of the recorded 4 coral colonies were ranging from 20 cm to 35 cm in diameter with two species (*Porites lutea*: 3, *Cyphastrea serailia*:1) and they were all in good health condition.
- 2.3.3 The original proposed recipient site is one of the Reef Check sites (Lai Chi Wo Reef Check Site) within Yan Chau Tong Marine Park in Hong Kong with high percentage of coral coverage (>50%). A total of 18 coral species were recorded during the REA survey. Both *Porites lutea* and *Cyphastrea serailia* were recorded in the original proposed recipient site. Since the same species of coral were recorded at the original proposed recipient site, the original proposed recipient site will be a suitable site to adopt the 4 coral colonies recorded at the existing pier.
- 2.3.4 Nevertheless, due to adverse weather condition with strong wind and wave during the translocation activities performed on 27 and 28 January 2022, the original proposed recipient site was not suitable for putting the translocated corals. For safety and health of the translocated coral, another site with the same species of corals was selected.
- 2.3.5 The updated recipient site is also located inside the Marine Park and the site is dominated by different species of *Porites* with high percentage of coral coverage (>50%). A total of 14 coral species were recorded during the REA survey. Both *Porites lutea* and *Cyphastrea serailia* were recorded in the updated recipient site. Since the same species of coral were recorded at the updated recipient site, the updated recipient site will be a suitable site to adopt the 4 coral colonies recorded at the existing pier.

3. Coral Translocation

3.1 Coral Translocation Procedures

- 3.1.1 Translocation of all identified translocatable coral colonies in the direct impact site will be needed in order to minimize the impact to existing coral communities. All coral colonies with diameter over 9 cm (smallest size of translocated coral colonies in Shek Kwu Chau Coral Translocation 2017, EP/SP/66/12) on the seawall of the existing pier will be translocated.
- 3.1.2 The translocatable coral colonies identified during the Pre-translocation Survey will be translocated before any construction works.
- 3.1.3 During the coral translocation, divers will carefully remove coral colonies from the existing pier by using hammer and chisel. Each coral colonies will be marked, and photographs of each colony will be taken and additional information for each of the coral colonies will also be collected (water depth, orientation and size).
- 3.1.4 The coral colony will be moved and lifted from the sea bottom and loaded to ship/boat with lifting bag immediately.
- 3.1.5 The translocated coral colonies transferred onto the vessel will be submerged in seawater tanks (e.g. 80 cm x 100 cm x 40 cm in dimension and 32 liters in volume each) with continuous aeration onboard. Each seawater tank will hold no more than 4 coral colonies to avoid overcrowding.
- 3.1.6 Ambient water quality parameters of sea surface temperature and dissolved oxygen will be measured once (with at least triplicate sampling) at the coral donor site on the day of coral translocation.
- 3.1.7 Corals will be transported to the suitable recipient site as soon as possible following the removal. The vessel will progress at a slow and steady speed (<5 knots) to the recipient site.
- 3.1.8 When arriving at the suggested coral recipient site, scuba divers, with the supervision of the marine ecologist, will carefully place the coral colonies one by one to the seabed in order to minimize disturbance to the seabed and/or sediment. The coral colonies will then be attached to suitable boulders by using underwater epoxy and positioned to similar water depths with orientations as their previous location at the donor site as much as possible.
- 3.1.9 Divers will tag translocated colonies at the recipient site by using plastic tags with colony number (~3.5 cm diameter), which will be glued onto boulders by just adjacent to the coral colonies. All tags will be anchored in the vicinity of the coral colonies but not so near as to interfere with potential growth. This would allow the revisit of the coral colonies during the post-translocation monitoring. Ten natural coral colonies with the same species of the translocated coral colonies at the recipient site will also be tagged for post-monitoring and their size, health conditions (percentage of mortality and bleaching), the percentage of sediment cover will be monitored.

- 3.1.10 Divers will keep records of size, location, health conditions (percentage of mortality and bleaching), the percentage of sediment cover of each translocated coral colony after the completion of translocation works. Photographs of each translocated coral upon completion of translocation will be taken and used as a baseline for future monitoring.

3.2 Post-translocation Monitoring

- 3.2.1 In order to monitoring the health of all translocated coral colonies, post-translocation monitor will be conducted right after the all translocation work has been done. All or minimum of twenty translocated colonies will be monitored during the monitoring period.
- 3.2.2 The post-translocation monitoring will be proposed to Agriculture, Fisheries and Conservation Department for agreement. Following coral translocation in the recipient site, the translocated coral colonies as well as the tagged natural coral colonies at the recipient site will be monitored quarterly for one year (i.e. a total of four post-translocation monitoring as suggested in previous translocation plan, e.g. Shek Kwu Chau Coral Translocation Plan). Monitoring will record the following parameters; the size, presence, survival, health conditions (percentage of mortality/bleaching) and percentage of sediment of each translocated coral colony and each tagged natural colony. The general environmental conditions including weather, sea, and tidal conditions of the coral recipient site will also be monitored.
- 3.2.3 Photographic records of the translocated and natural coral colonies will be taken as far as possible maintaining the same aspect and orientation as photographs taken for the pre-translocation surveys. All the tags for marking the translocated and natural coral colonies will be removed / retrieved once the monitoring programme is completed.
- 3.2.4 The results of the post-translocation monitoring surveys should be reviewed with reference to findings of the baseline survey and the data from original colonies at the recipient site.
- 3.2.5 If observations of any die-off / abnormal conditions of the translocated corals are made during the post-translocation monitoring, the Environmental Team (ET) should inform the Contractor, Independent Environmental Checker (IEC), EPD and AFCD, and liaise with AFCD to investigate any mitigation measures needed.
- 3.2.6 Post-translocation monitoring results will be evaluated against Action and Limit Levels. Evaluation will be based on recorded changes in percentage of partial mortality of the corals. Action and Limit Levels are defined in **Table 3.1**.

Table 3.1 Action and Limit Levels for Post-Translocation Coral Monitoring

Parameter	Action Level Definition	Limit Level Definition
Mortality	If during Impact Monitoring a 15% increase in the percentage of partial mortality on the corals occurs at more than 20% of the translocated coral colonies that are not recorded on the original corals at the receptor site, then the Action Level is exceeded.	If during Impact Monitoring a 25% increase in the percentage of partial mortality on the corals occurs at more than 20% of the translocated coral colonies that are not recorded on the original corals at the receptor site, then the Limit Level is exceeded.

*If the defined Action Level or Limit Level for coral monitoring as listed in **Table 3.1** is exceeded, the actions as set out in **Appendix 1** will be implemented.

3.3 Reporting

- 3.3.1 The coral translocation activities before the commencement of construction will be reported in the first Monthly EM&A Report. Findings from Post-Translocation Monitoring will be presented in the Monitoring Results Section under monthly EM&A Report of the respective reporting month and submitted to EPD and AFCD after completion of each Post-Translocation Monitoring. The results of the post-translocation monitoring surveys should be reviewed with reference to the pre-translocation survey results and findings.

4. Reference

Brian Morton and John Morton. 1983. The Sea Shore Ecology of Hong Kong. Hong Kong University Press.

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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.

Figure

Figure 1 Layout of the Project Area

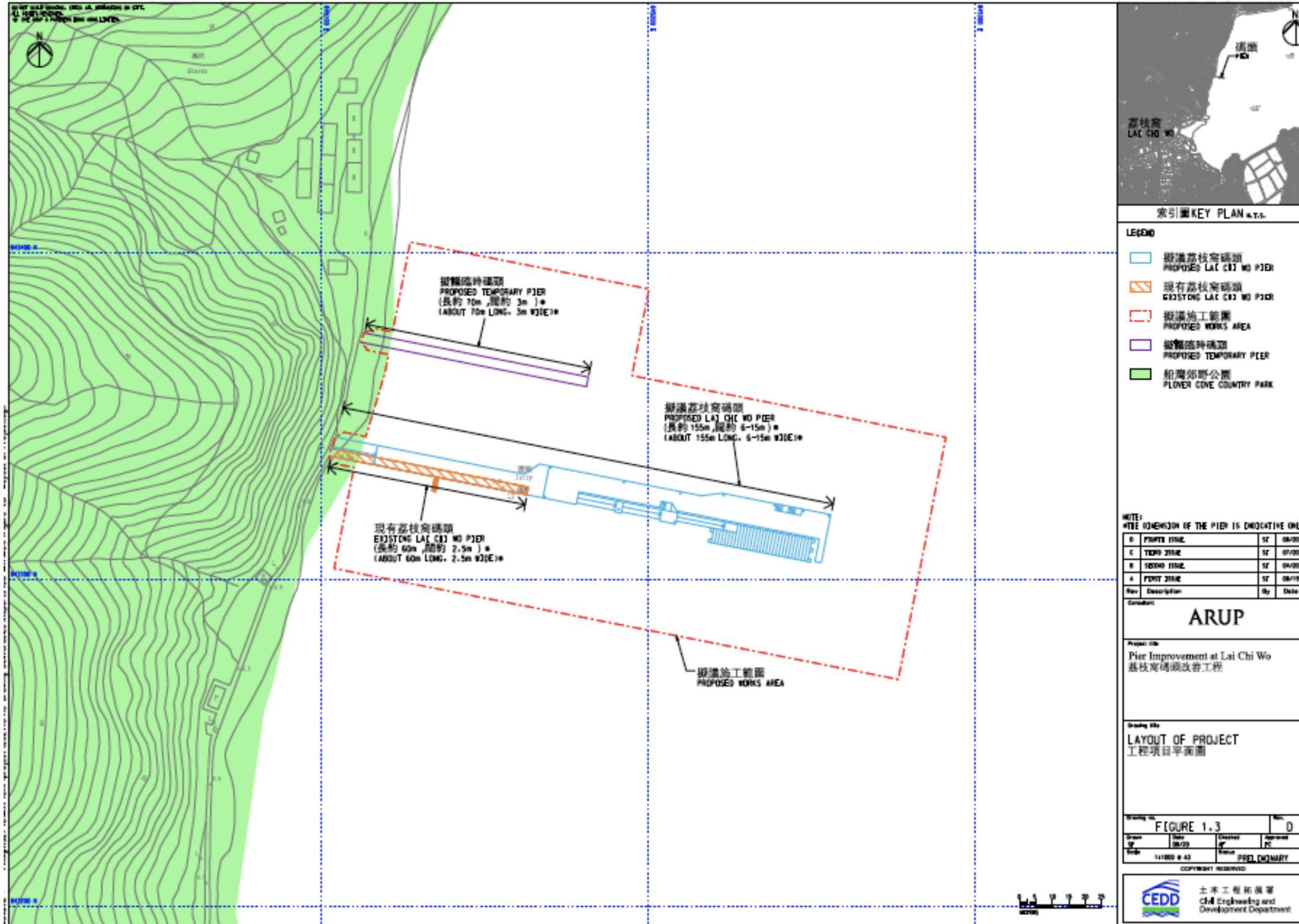


Figure 2 Locations of Coral Colonies Recorded on the Existing Pier



Figure 3 Suggested Recipient Site (Original)



Figure 4 Location of Spot Check and REA Survey



Figure 5 Suggested Recipient Site (Updated)



Photos

	
<p>Coral #1 <i>Porites lutea</i></p>	<p>Coral #2 <i>Porites lutea</i></p>
	
<p>Coral #3 <i>Cyphastrea serailia</i></p>	<p>Coral #4 <i>Porites lutea</i></p>
	
<p><i>Porites lutea</i> recorded at suggested recipient site</p>	
	
<p><i>Cyphastrea serailia</i> recorded at suggested recipient site</p>	

Appendix A

Event and Action Plan for Post- Translocation Monitoring

Appendix 1 Event and Action Plan for Post-Translocation Monitoring

Event	Action			
	ET Leader	IEC	Resident Engineer (RE)	Contractor
Action Level Exceedance	<ol style="list-style-type: none"> 1. Check monitoring data 2. Inform the IEC, RE, and Contractor of the findings; 3. Increase the monitoring to at least once a month to confirm findings; 4. Propose mitigation measures for consideration 	<ol style="list-style-type: none"> 1. Discuss monitoring with the ET and the Contractor; 2. Review proposals for additional monitoring and any other measures submitted by the Contractor and advise the RE accordingly. 	<ol style="list-style-type: none"> 1. Discuss with the IEC additional monitoring requirements and any other measures proposed by the ET; 2. Make the agreement on the measures to be implemented. 	<ol style="list-style-type: none"> 1. Inform the RE and confirm notification of the non-compliance in writing; 2. Discuss with the ET and the IEC and propose measures to the IEC and the RE; 3. Implement the agreed measures.
Limit Level Exceedance	<ol style="list-style-type: none"> 1. Undertake Steps 1-4 as in the Action Level Exceedance. If further exceedance of Limit Level, propose enhancement measures for consideration. 	<ol style="list-style-type: none"> 1. Discuss monitoring with the ET and the Contractor; 2. Review proposals for additional monitoring and any other measures submitted by the Contractor and advise the RE accordingly. 	<ol style="list-style-type: none"> 1. Discuss with the IEC additional monitoring requirements and any other measures proposed by the ET; 2. Make the agreement on the measures to be implemented. 	<ol style="list-style-type: none"> 1. Inform the RE and confirm notification of the non-compliance in writing; 2. Discuss with the ET and the IEC and propose measures to the IEC and the RE; 3. Implement the agreed measures.

Appendix B

Detailed Coral Survey at Potential Recipient Sites (Updated)

1. Introduction

1.1 Background

1.1.1 Due to the bad weather condition during the coral translocation work carried out on 27th and 28th January 2022, translocated coral colonies were not able to translocate to the suggested recipient site. The four translocated coral colonies were translocated to a new suitable recipient site inside the Marine Park area (Figure 1)

1.2 Objective of the Report / Proposal

1.2.1 The objective of this Report is to record the findings of spot check and REA survey for the new suitable recipient site.

2. Dive Survey

2.1 Methodology

Spot Check Dive

2.1.1 A spot-check dive survey covering the new suggested recipient site (**Figure 1**) will be conducted. The survey is to check the presence of coral species similar to the donor site and the presence of suitable substratum to allow the translocated boulders/rocks to be permanently stabilized. The spot-check dive survey requires suitably trained and qualified SCUBA divers and marine ecologists swimming in a search pattern, at random depths within the spot-check dive area. Subtidal substrata (hard substratum seabed) within the proposed spot-check dive area will be surveyed for the presence of coral communities, including hard coral (order Scleractinia), octocorals (sub-class Octocorallia) and black-corals (order Antipatharia). Surface parameters such as water temperature, salinity and pH will be recorded. Target species parameters including estimated number of species, coral cover, partial mortality and the presence of any rare corals will also be recorded during the spot-check dive. The divers will also pay attention to the presence of non-typical reef structures, unusual coral species associations, unique or peculiar assemblages of the local reef formations, and reefs that are almost completely dominated by one particular species. Data will be recorded during the dives on waterproof paper in preparation for a later consolidation and analysis.

2.1.2 During the spot-check dive, the general environmental conditions of the potential recipient site will also be observed (e.g. presence of healthy coral community with similar coral species as the donor site, presence of suitable substratum to allow the translocated boulders/rocks to be permanently stabilized, sufficient space to receive the newly translocated coral colonies, etc.).

Rapid Ecological Assessment (REA)

2.1.3 If corals are recorded during the spot-check dives and the potential recipient site is found suitable during the preliminary screening, a more detailed Rapid Ecological Assessment (REA) will be carried out with reference to DeVantier *et al.* (1998). The substrate type and taxonomic composition of the recipient site will be assessed.

2.1.4 The REA survey will be conducted along 100 m transect(s) parallel to the coastline (based on the preliminary results from the spot-check dives). The substrate type

along the length of the transect(s) will be recorded at 1 m intervals. The benthic cover, taxon abundance, and ecological attributes along the transects will also be recorded in a swathe of 2 m wide, 1 m either side of the transect.

2.1.5 The locations of the REA transects will be recorded on-site using a portable GPS unit. The number of colonies, sizes and types of corals, their coverage, abundance, depth, health status of coral species will also be recorded. Photographs of representative taxa along the transects will also be taken during the surveys.

2.1.6 Health status of coral will be assessed by the following criteria:

- Gorgonian coral: Percentage of branches exhibiting partial mortality and secretion of mucus;
- Hard coral: Percentage of surface area exhibiting partial mortality and blanched/bleached

Tier I – Categorization of Benthic Cover

2.1.7 Upon the completion of each transect, ecological and substratum attributes (refer to **Table 2.1**) will be assigned to standard ranked ordinal categories (refer to **Table 2.2**).

Table 2.1 - Tier I Benthic Attribute Categories

Ecological Attributes	Substratum Attributes
Coral	<u>Hard substrata</u>
Dead Coral	Bedrock / continuous pavement
Octocoral (Soft corals – black and Gorgonains)	Boulders blocks (diam. >50 cm)
Anemone beds	Cobble
Dead Standing corals	Rubble
Other benthos (sponges, zoanthids, ascidians and bryozoans)	Other
Macro-algae	<u>Soft substrata</u>
-	Sand
-	Mud / Silt
-	Mud

Table 2.2 - Tier II Ordinal Ranks of Percentage Cover of Benthic Attributes

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

2.1.8 For substratum attributes, it is preferable to record actual estimates of coverage. The percentage of hard substrata vs. soft substrata can be provided (e.g. 80% and 20% respectively). The percentage cover of the types of hard or soft substrata could also then be presented (e.g. bedrock pavement 60%, rubble 20%, sand 15%,

mud/silt 5%). Similarly, recording and presenting actual estimates of, for instance, hard and soft coral cover may be more informative (e.g. <1%)

Tier II – Taxonomic Inventories to Define Types of Benthic Communities

2.1.9 An inventory of benthic taxa along each transect will be compiled during the survey. Taxa will be identified in situ to the following levels:

- Corals to species, where possible;
- Soft corals, anemones and conspicuous macroalgae to genus level, where possible;
- Other benthos (including sponges, zoanthids, ascidians ,and bryozoans) to genus level, where possible.

2.1.10 For each transect, each taxon in the inventory will be ranked in terms of abundance in the community (refer to **Table 2.3**). The taxon categories will be ranked in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are visual assessments of abundance, rather than quantitative counts of each taxon. Representative photos of organisms will be taken.

Table 2.3 - Ordinal Ranks of Taxon Abundance

Rank	Percentage Cover
0	Absent
1	Rare
2	Uncommon
3	Common
4	Abundant
5	Dominant

2.1.11 To verify the suitability of the coral recipient site, data collected including environmental conditions, bathymetry, benthic composition at the coral recipient site will be compared with the donor site. It is preferable to select the recipient site with the following characteristics:

- Presence of a healthy coral community of the similar coral species as the donor site;
- Similar environmental conditions, or better than the donor site, such as bathymetry, water depth, benthic composition, etc.;
- Presence of suitable substratum to allow the translocated boulders/rocks to be permanently stabilized;
- In the vicinity of the original coral colony;
- Sufficient space to receive the newly translocated coral colonies; and,
- Presence of protection from storm/typhoon damage.

2.1.12 In addition, the survey will be confirmed if the proposed recipient site had the space requirements to accommodate the number of corals to be translocated, and the absence of identified constraints to their future growth and proliferation.

2.2 Survey Findings

Spot Check Dive

2.2.1 The spot-check dive was carried out on 22nd February 2022 and the weather conditions were summarized in **Table 2.4**.

Table 2.4 Weather Condition for the Spot-Check Dive on 22nd February 2022

Date	Condition	Average Underwater Visibility
22 nd February 2022	- East force 3-4, - Sunny	1 m to 1.5 m

2.2.2 Spot check dive was carried out at the suggested new recipient site (Figure 1). The GPS coordinates, route distance, maximum depth, bottom substrate and bottom visibility each surveyed sites were summarized in **Table 2.5**.

Table 2.5 GPS Coordinates, Route Distance, Maximum Depth, Minimum Depth, Bottom Substrate and Bottom Visibility of Spot-Check Dive Site SC1

Site	Location (GPS) (Starting Point)	Route Distance (m)	Min. Depth (m)	Max. Depth (m)	Bottom Substrate	Visibility (m)
SC1	E 114°17'05.07" N 22°31'17.82"	200	1.5	3	Natural Bedrock and Boulders	1-1.5

2.2.3 The spot check site was mainly composed of natural bedrock. Substrates beyond the maximum depth are all sandy with scattered boulders and rocks with visibility around 1m to 1.5 m. Sponges, bryozoans, *Diadema* sea urchin and tubeworms *Sabelastarte japonica* were the dominant animal species in the surveyed site in which they are commonly found in Hong Kong waters.

2.2.4 A total of 22 (**Table 2.6**) coral species were recorded along the suggested recipient site during the spot check survey. Most of the recorded coral species are common in Hong Kong. REA transect was laid along the coral area.

Table 2.6 Coral species and their Abundance in Hong Kong

Coral Species	Abundance in Hong Kong
<i>Bernardpora stutchburyi</i>	Common
<i>Cyphastrea japonica</i>	Abundant
<i>Cyphastrea serailia</i>	Abundant
<i>Dipsastraea favus</i>	Abundant
<i>Dipsastraea lizardensis</i>	Common
<i>Dipsastraea rotumana</i>	Abundant
<i>Dipsastraea veroni</i>	Common
<i>Duncanopsammia peltata</i>	Common
<i>Favites chinensis</i>	Dominant
<i>Goniopora columna</i>	Abundant
<i>Goniopora lobata</i>	Common

<i>Leptastrea purpurea</i>	Abundant
<i>Lithophyllon undulatum</i>	Common
<i>Oulastrea crispata</i>	Abundant
<i>Pavona decussata</i>	Abundant
<i>Platygyra acuta</i>	Dominant
<i>Platygyra carnosus</i>	Common
<i>Porites aranetai</i>	Uncommon
<i>Porites lobata</i>	Common
<i>Porites lutea</i>	Abundant
<i>Psammocora profundacella</i>	Abundant
<i>Stylocoeniella guentheri</i>	Common

Rapid Ecological Assessment Survey

2.2.5 The REA survey was performed on 22nd February 2022 right after the spot check survey. One 100 m transects were laid parallel to the coastline along spot check site SC1 (**Figure 3**). The GPS coordinates, maximum depth, bottom substrate and bottom visibility were shown in Table 2.7

Table 2.7 GPS of Transect Starting and Ending, Maximum Depth, Bottom Substrate and Bottom Visibility of the Four REA Transects

Transect	Location (GPS) (Starting Point)	Location (GPS) (End Point)	Max. Depth (m)	Bottom Substrate	Visibility (m)
1	E 114°17'06.37" N 22°31'24.27"	E 114°17'04.41" N 22°31'21.69"	3	Natural Boulders, Rocks and Sand	1.5

2.2.6 A 100 m transect was laid down along the coastline which covered part of spot check site SC1 (**Figure 2**). The average depth for the transect was about 3.5 m and visibility around 1.5 m

2.2.7 The substrate along the transect line is mainly composed of natural boulders, rock and sand (**Table 6**). Common marine life such as common sponges, bryozoans, rock oyster *Saccostrea cucullata*, common green mussel *Perna viridis*, *Diadema* sea urchin and tubeworm *Sabelastarte japonica* were found on survey area.

Table 2.8 Ecological Attributes on SC1 REA Transect 1

Ecological Attributes	Rank
Hard Coral	4
Dead Coral	0
Octocoral (Soft corals black and gorgonians)	0
Anemone Beds	0
Dead Standing Corals	0
Other Benthos (sponges, zoanthids, ascidinas and bryozoans)	0.5
Macro-algae	0

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

Table 2.9 Substratum Attributes on SC1 REA Transect 1

Hard Substrata	Rank
Bedrock/continuous pavement	0
Boulder Blocks (diam.>50cm)	3
Boulder Blocks (diam.<50cm)	2
Rubble	0
Other	0
Soft Substrata	Rank
Sand	2
Mud/Silt	0
Mud	0

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

Table 2.10 Ranks of Taxon Abundance along the SC1 REA Transect 1

Benthic Taxa	Rank
<i>Cyphastrea serailia</i>	3
<i>Dipsastraea favus</i>	2
<i>Dipsastraea rotumana</i>	3
<i>Duncanopsammia peltata</i>	2
<i>Favites chinensis</i>	3
<i>Goniopora columna</i>	4
<i>Goniopora lobata</i>	3
<i>Leptastrea purpurea</i>	4
<i>Oulastrea crispata</i>	4
<i>Pavona decussata</i>	3
<i>Porites aranetai</i>	2
<i>Porites lobata</i>	5
<i>Porites lutea</i>	5
<i>Psammocora profundacella</i>	4
Sponges	3
Bryozoan	3
<i>Saccostrea cucullata</i>	3
<i>Perna viridis</i>	3
Common Black Sea Cucumber	2

* Rank of Abundance: 0 = Absent; 1 = Rare; 2 = Uncommon; 3 = Common; 4= Abundant; 5 = Dominant.

3.11 This site supported high percentage (>50%) of hard coral. A total of 14 coral species (**Table 2.12**) were recorded during the REA survey. They were of large to medium size (about 15 to 85 cm in diameter) and in high coverage. All the coral colonies were in good condition.

2.3 Conclusion

2.3.1 The suggested new recipient site is also located inside the Marine Park and this site is dominated by different species of *Porites* with high percentage of coral coverage (>50%). A total of 14 coral species were recorded during the REA survey. Both *Porites lutea* and *Cyphastrea serailia* were recorded in the suggested recipient site.

2.3.2 Since the same species of coral were also recorded at the suggested new recipient site, the suggested new recipient site will be a suitable site to adopt the 4 coral colonies recorded at the existing pier.

Figure 1 Spot Check Route of the New Recipient Site



Figure 2 REA Transect at the New Recipient Site



Photo A

	
<p>Suggested New Recipient Site</p>	
	
<p>The New Recipient Site is Dominated by <i>Porites</i> sp.</p>	
	
<p><i>Porites lobata</i></p>	<p><i>Porites aranetai</i></p>
	
<p><i>Goniopora lobata</i></p>	<p><i>Cyphastrea serailia</i></p>

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