

**Independent Environmental Checker for
Contract No. YL/2009/01 – Hang Hau Tsuen Channel at
Lau Fau Shan**

Post-Construction Mangrove Monitoring

**5th Quarterly Mangrove Monitoring Report
(June 2014)**

Prepared for:
Civil Engineering and Development Department

Prepared by:
ENVIRON Hong Kong Limited

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(June 2014)**

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Contents

	Page
1.0 INTRODUCTION	1
1.1 Project Background	1
2.0 MANGROVE MONITORING MEHTHODOLOGY	2
2.1 Monitoring Equipment.....	2
2.2 Quadrate	2
2.3 Measurement.....	2
2.4 Photo Record.....	3
3.0 MONITORING RESULTS.....	4
3.1 Visual Inspection	4
3.2 Measurement of selected plant individual.....	4
3.3 Photographic record	10
4.0 CONCLUSION.....	10

List of Tables

Table 1 Mangrove plant growth and health monitoring for each planted species.....	5
Table 2 Record sheet for mangrove plant density and survival rate monitoring	6
Table 3 Mean height of <i>Acanthus ilicifolius</i> and <i>Kandelia obovata</i>	8
Table 4 Mean diameter of <i>Acanthus ilicifolius</i> and <i>Kandelia obovata</i>	8

List of Figures

Figure 1 Mean height (cm) of *Acanthus ilicifolius* and *Kandelia obovata* monitored at Hang Hau Tsuen Channel from Jun 2013 to Jun 2014

Figure 2 Mean diameter (mm) of *Acanthus ilicifolius* and *Kandelia obovata* monitored at Hang Hau Tsuen Channel from Jun 2013 to Jun 2014

List of Annexes

Annex A Location of the mangrove zone and quadrate within Hang Hau Tsuen Channel

Annex B Overall view of mangrove compensation area

1.0 INTRODUCTION

1.1 Project Background

- 1.1.1 Hang Hau Tsuen is situated at the southern part of Lau Fau Shan bordering the Hang Hau Tsuen stream. A channel improvement project under an Environmental Permit (EP no: EP-343/2009) has been carried out to alleviate flooding occurred in the catchment by converting the existing Hang Hau Tsuen stream between Deep Bay and Deep Bay Road to an engineered channel that will meet the required flood protection standards. Habitat restoration will be performed after finished the construction work in the channel. In accordance with Clause 2.16 of the EP and Section 6.4 of the Environmental Monitoring and Audit (EM&A) Manual (the EM&A Manual) under the EP, to mitigate the loss of 0.07 ha of mangrove patches, a total of 0.07 ha (1:1 ratio) area at tidal zone on northern side of the constructed channel will be planted with varies mangrove species. Monitoring was required to assess the growing condition of planted mangrove plants during the Operation Phase of the Project in accordance with Section 6.4 of the EM&A Manual.
- 1.1.2 The proposal and schedules for Operational Phase monitoring of compensatory mangrove planting had been submitted to AFCD on 14 May 2012. Comments on the proposal had been received from AFCD on 5 June 2012, and the revised proposal and schedules had been submitted to AFCD on 14 November 2012. No comment has been received from AFCD on 19 November 2012.
- 1.1.3 China-Hong Kong Ecology Consultants Co. (CHEC) has been appointed by ENVIRON Hong Kong Limited as ecologist to undertake the post-construction mangrove monitoring starting from June 2013 for 2 years.
- 1.1.4 Monitoring will be conducted once every quarter for two years after completion of the mangrove planting in accordance with Section 6.4 of the EM&A Manual.
- 1.1.5 This is the fifth quarterly monitoring report presents the findings of the initial monitoring survey that was undertaken on 20 June 2014.

2.0 MANGROVE MONITORING MEHTHODOLOGY

2.1 Monitoring Equipment

2.1.1 Monitoring was involved physical measurement and photo record. Thus, tape/metallic ruler, vernier caliper and camera were used for the monitoring.

2.2 Quadrate

2.2.1 Locations of five quadrates of 5m x 5m in size were chosen at representative plantation area. The locations of quadrates were selected based on tidal level, species and ground characteristics as well as accessibility by foot. The location for each quadrate was marked by setting up bamboo or similar material at each corner of quadrates. The species and number of mangrove individual were counted within each quadrate. The location of mangrove zone and quadrates within the channel was shown in **Annex A**.

2.3 Measurement

- 2.3.1 In order to collect data consistent and comparable in temporal scale, for each planted plant species, 5 selected plants in each quadrate was marked by color rope or ribbon. Color rope or ribbon was tied on tree branch for marking only. No damage or any adverse effect was anticipated on the growth of mangrove trees. There was a maximum of 25 plants for each species will be selected for measurements if the species presented in all 5 quadrates. Every planted species was selected for monitoring. It is expected that at least two mangrove species was planted in the planting area. Maximum height of the selected individual plant was measured to a nearest centimeter based on growing form of plant.
- 2.3.2 Stem diameter for 5 selected plants of each species in each quadrate was measured by vernier caliper. A mark such as rope/ribbon was made on stem where diameter measurement will be carried out. Same orientation for the vernier caliper will be maintained for each measurement. Measurement will be taken to the nearest millimeter.
- 2.3.3 The overall health condition was assessed for each species within quadrate. The assessment in some inaccessible location was aided by binocular. The following was the health scheme for the assessment. The rate of survival of the mangroves after planting was estimated by visual observation.

2.3.4 Health scheme:

Good: Low mortality rate. Green foliage color. Dense foliage. No damage from floating rubbish or high water flow.

Fair: Low to medium mortality rate. Less dense foliage. Some yellowish foliage color recorded. Some leave or branches were damaged by floating rubbish, water flow or insect.

Poor: High mortality rate. Highly sparse crown and most foliage were drying up. The plant may be seriously damaged.

2.4 Photo Record

- 2.4.1 Photos of overall view for mangrove compensation area and each quadrat was taken. For consistence, same photo location and angle for each measurement will try to be maintained but it may need adjustment due to site and plant change. Other site conditions and observations should also be recorded.

3.0 MONITORING RESULTS

3.1 Visual Inspection

- 3.1.1 The species and the total number of mangrove tree were counted within each quadrat. Two native species (*Acanthus ilicifolius*, *Kandelia obovata*) were planted on the compensatory mangrove planting area.
- 3.1.2 The overall health condition of each species within each quadrat was assessed and shown in **Table 1**. The total number, density and survival rate of mangrove tree within each quadrat were shown in **Table 2**.
- 3.1.3 Generally, the overall health condition of *Acanthus ilicifolius* and *Kandelia obovata* was Fair as green foliage color was observed during the monitoring survey. However, the health condition of *Acanthus ilicifolius* and *Kandelia obovata* in Quadrat 1 was assessed as “Poor to Fair” due to the mangrove tree on eastern side of Quadrat 1 was dead since the inspection on December 2013. As that side of Quadrat 1 was nearest to the outlet of sewage, it was believed that eastern side of Quadrat 1 was immersed by sewage and lead to the death of mangrove tree on that area. However, the affected area was small compare to the whole compensatory site, thus the influence to the mangrove by the sewage is anticipated to be minor, but continuous monitoring of the health condition is still recommended.
- 3.1.4 *Derris trifoliata* was observed within the monitoring site. Some of the mangroves within the monitoring site were covered by *Derris trifoliata*, in which the health of mangrove tree would be affected. It was recommended to remove *Derris trifoliata* within the monitoring site.
- 3.1.5 Contractor scheduled to remove the observed *Derris trifoliata* in July 2014. The follow-up action would be reported in the next quarterly mangrove monitoring report.

3.2 Measurement of selected plant individual

- 3.2.1 Maximum height and stem diameter of maximum 5 selected individual of each species in each quadrat was measured during the monitoring survey. Result of the measurement was shown in **Table 1**.
- 3.2.2 Height reduction was observed at an individual of *Acanthus ilicifolius* (Quadrat 5, Individual 1). Height reduction was due to the death of the highest stem of this individual. Another healthy stem of this individual was chosen for measurement. Thus, the measurement was reduced compared with previous record.
- 3.2.3 Mean height & diameter of *Acanthus ilicifolius* and *Kandelia obovata* was calculated and shown in **Table 3 & 4**. The change of measurement parameters since June 2013 was shown in **Figures 1 & 2**.

3.2.4 By compare the measurement record for both last and current inspection, most mangrove trees were recorded in positive growth and increment in height or diameter was observed. Except for the quadrate 1, there was no significant change in survival rate in the monitoring quadrate. The comparison for the measurement was shown on **Table 1 to 4**.

Table 1 Mangrove plant growth and health monitoring for each planted species

Date: 20 Jun 2013

Temperature: 31°C

Tidal condition: Low

Quadrat 1	Individual 1		Individual 2		Individual 3		Individual 4		Individual 5		Overall health condition	Change of overall health condition
	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)		
<i>Acanthus ilicifolius</i>	Dead	Dead	Dead	Dead	90	9.2	70	10.2	Dead	Dead	Poor to Fair	Unchange
<i>Kandelia obovata</i>	Dead	Dead	55	14	Dead	Dead	Dead	Dead	50	15.1	Poor to Fair	Unchange

Quadrat 2	Individual 1		Individual 2		Individual 3		Individual 4		Individual 5		Overall health condition	Change of overall health condition
	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)		
<i>Acanthus ilicifolius</i>	72	9	110	9.22	94	10.3	138	10.92	110	9.66	Fair	Unchange
<i>Kandelia obovata</i>	61	14.7	73	15.95	58	17.14	84	22	59	13.6	Fair	Unchange

Quadrat 3	Individual 1		Individual 2		Individual 3		Individual 4		Individual 5		Overall health condition	Change of overall health condition
	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)		
<i>Acanthus ilicifolius</i>	112	14.24	110	12.82	135	13.1	102	12.45	92	10.1	Fair	Unchange
<i>Kandelia obovata</i>	60	14.1	104	21.1	59	20	46	16.39	66	14.9	Fair	Unchange

Quadrat 4	Individual 1		Individual 2		Individual 3		Individual 4		Individual 5		Overall health condition	Change of overall health condition
	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)		
<i>Acanthus ilicifolius</i>	5	6.59	111	13	9.5	6.28	85	10.48	93	11.2	Fair	Unchange

Quadrat 5	Individual 1		Individual 2		Individual 3		Individual 4		Individual 5		Overall health condition	Change of overall health condition
	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)	H (cm)	Dia (mm)		
<i>Acanthus ilicifolius</i>	73	12.26	84	11.58	65	9.88	26	8.5	112	13.2	Fair	Unchange
<i>Kandelia obovata</i>	77	17.62	112	18.61	44	11.73	111	14.4	54	15.3	Fair	Unchange

Table 2 Record sheet for mangrove plant density and survival rate monitoring

Date	Parameter	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Overall Survival rate in five Quadrates (%)	
4th Jun 2013	Initial total number of mangrove tree	18	24	31	20	18	N.A	
	Initial density of mangrove tree (No. of mangrove tree / m ²)	0.72	0.96	1.24	0.8	0.72	N.A	
12th Sep 2013	Initial total number of mangrove tree	23	26	27	31	20	N.A	
	Initial density of mangrove tree (No. of mangrove tree / m ²)	0.92	1.04	1.08	1.24	0.8	N.A	
	Survival rate (%)	<i>Acanthus ilicifolius</i>	86%	100%	89%	84%	100%	91.8%
		<i>Kandelia obovata</i>	88%	89%	94%	N.A	93%	91%
03rd Dec 2013	Initial total number of mangrove tree	23	26	27	31	20	N.A	
	Initial density of mangrove tree (No. of mangrove tree / m ²)	0.92	1.04	1.08	1.24	0.8	N.A	
	Survival rate (%)	<i>Acanthus ilicifolius</i>	57%	94%	89%	84%	100%	85%
		<i>Kandelia obovata</i>	63%	78%	94%	N.A	93%	82%

Date	Parameter	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Overall Survival rate in five Quadrates (%)	
04th Mar 2014	Initial total number of mangrove tree	23	26	27	31	20	N.A	
	Initial density of mangrove tree (No. of mangrove tree / m ²)	0.92	1.04	1.08	1.24	0.8	N.A	
	Survival rate (%)	<i>Acanthus ilicifolius</i>	94%	89%	84%	100%		85%
		<i>Kandelia obovata</i>	60%	78%	94%	N.A	93%	82%
20th Jun 2014	Initial total number of mangrove tree	23	26	27	31	20	N.A	
	Initial density of mangrove tree (No. of mangrove tree / m ²)	0.92	1.04	1.08	1.24	0.8	N.A	
	Survival rate (%)	<i>Acanthus ilicifolius</i>	94%	89%	89%	84%	100%	85%
		<i>Kandelia obovata</i>	59%	78%	94%	N.A	93%	82%
Change of survival rate compared with last month (Unchange/better/poor)	<i>Acanthus ilicifolius</i>	Unchange	Unchange	Unchange	Unchange	Unchange	Unchange	
	<i>Kandelia obovata</i>	Poor	Unchange	Unchange	Unchange	Unchange	Unchange	

Table 3 Mean height of *Acanthus ilicifolius* and *Kandelia obovata*

Month	Mean Height (cm)				Change of mean height (Positive growth, negative)
	Jun 2013	Sep 2013	Dec 2013	Jun 2014	
<i>Acanthus ilicifolius</i>	92.81	93.2	94.85	85.54	Negative growth
<i>Kandelia obovata</i>	75.05	73.05	65	66.525	Positive growth

Table 4 Mean diameter of *Acanthus ilicifolius* and *Kandelia obovata*

Month	Mean Diameter (mm)				Change of mean height (Positive growth, negative)
	Jun 2013	Sep 2013	Dec 2013	Jun 2014	
<i>Acanthus ilicifolius</i>	11.05	10.94	10.83	10.5312	Negative growth
<i>Kandelia obovata</i>	14.26	14.96	15.39	16.0145	Positive growth

3.3 Photographic record

- 3.3.1 The overall view of the mangrove compensation area and each quadrat was presented by a number of photos taken at specific location along the channel. The photos will be useful to illustrate and compare the mangrove plant condition with future record. The overall view of the mangrove compensation area and each quadrat for both last and current inspection was presented in **Annex B, Photo 1-8** and **Photo 9-18** respectively.
- 3.3.2 By compare the photographic record for both last and current inspection, there was no significant change for the condition of mangrove trees in the monitoring site. The comparison for the photographic record was shown on **Photo 9-18**.

4.0 CONCLUSION

- 4.1.1 The post-construction mangrove monitoring survey was carried out on 20 June 2014. The species and the total number of mangrove tree were counted within each quadrat. The overall health condition of each species within each quadrat was assessed and shown in **Table 1**. The total number, density and survival rate of mangrove tree within each quadrat were shown in **Table 2**.
- 4.1.2 Generally, the overall health condition of *Acanthus ilicifolius* and *Kandelia obovata* was Fair. However, the health condition of *Acanthus ilicifolius* and *Kandelia obovata* in Quadrat 1 was assessed as “Poor to Fair” due to the sudden dead of mangrove tree at eastern side, it was believed that eastern side of Quadrat 1 was immersed by sewage and lead to sudden dead of mangrove tree. However, the affected area was small compare to the whole compensatory site, thus the influence to the mangrove by the sewage is anticipated to be minor, but continuous monitoring of the health condition is recommended.
- 4.1.3 Maximum height and stem diameter of maximum 5 selected individual of each species in each quadrat was measured, the result of the measurement was shown in **Table 1**. Mean height & diameter of *Acanthus ilicifolius* and *Kandelia obovata* was calculated and shown in **Table 3 & 4**. The change of measurement parameters since June 2013 was shown in **Figures 1 & 2**. Generally, most mangrove trees were recorded in positive growth and increment in height or diameter was observed. However, height and diameter reduction was observed at some individual of *Acanthus ilicifolius* (Quadrat 4, Individual 1,3 and Quadrat 5, Individual 4) due to the death of the highest stem of these individual. Another healthy stem of this individual was chosen for measurement. Thus, the mean height and diameter of *Acanthus ilicifolius* was reduced compared with previous record.
- 4.1.4 *Derris trifoliata* was observed within the monitoring site. Some of the mangroves within the monitoring site were covered by *Derris trifoliata*, in which the health of

mangrove tree would be affected. It was recommended to remove *Derris trifoliata* within the monitoring site.

- 4.1.5 Contractor scheduled to remove the observed *Derris trifoliata* in July 2014. The follow-up action would be reported in the next quarterly mangrove monitoring report.
- 4.1.6 The overall view of the mangrove compensation area and each quadrat was presented in **Photos 1-4** and **Photo 5-9** respectively

Figures

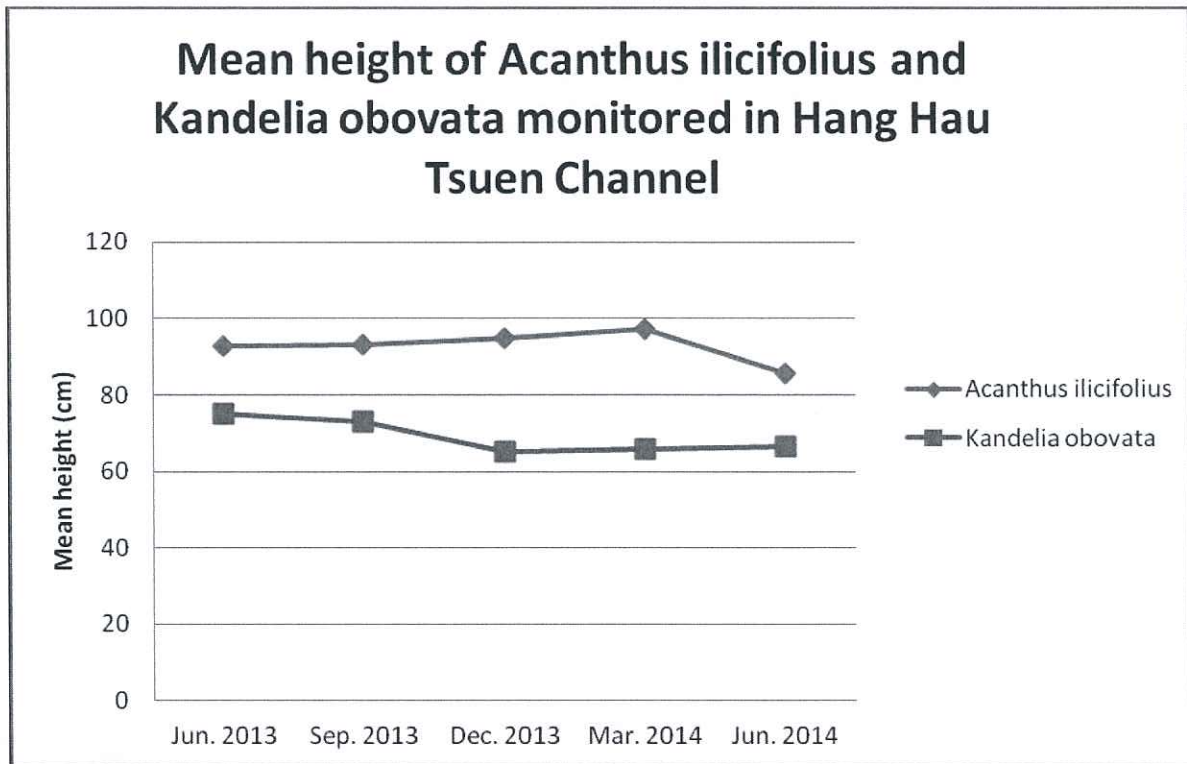


Figure 1 - Mean height (cm) of *Acanthus ilicifolius* and *Kandelia obovata* monitored at Hang Hau Tsuen Channel from Jun 2013 to Jun 2014

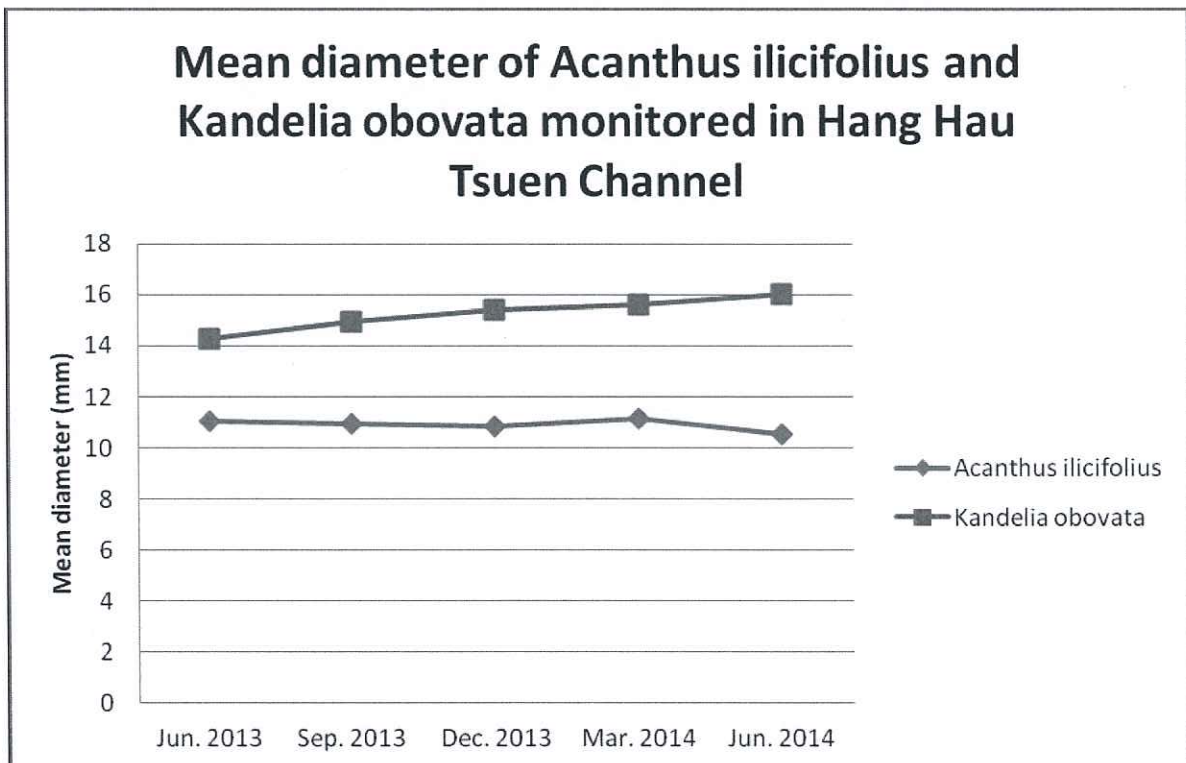
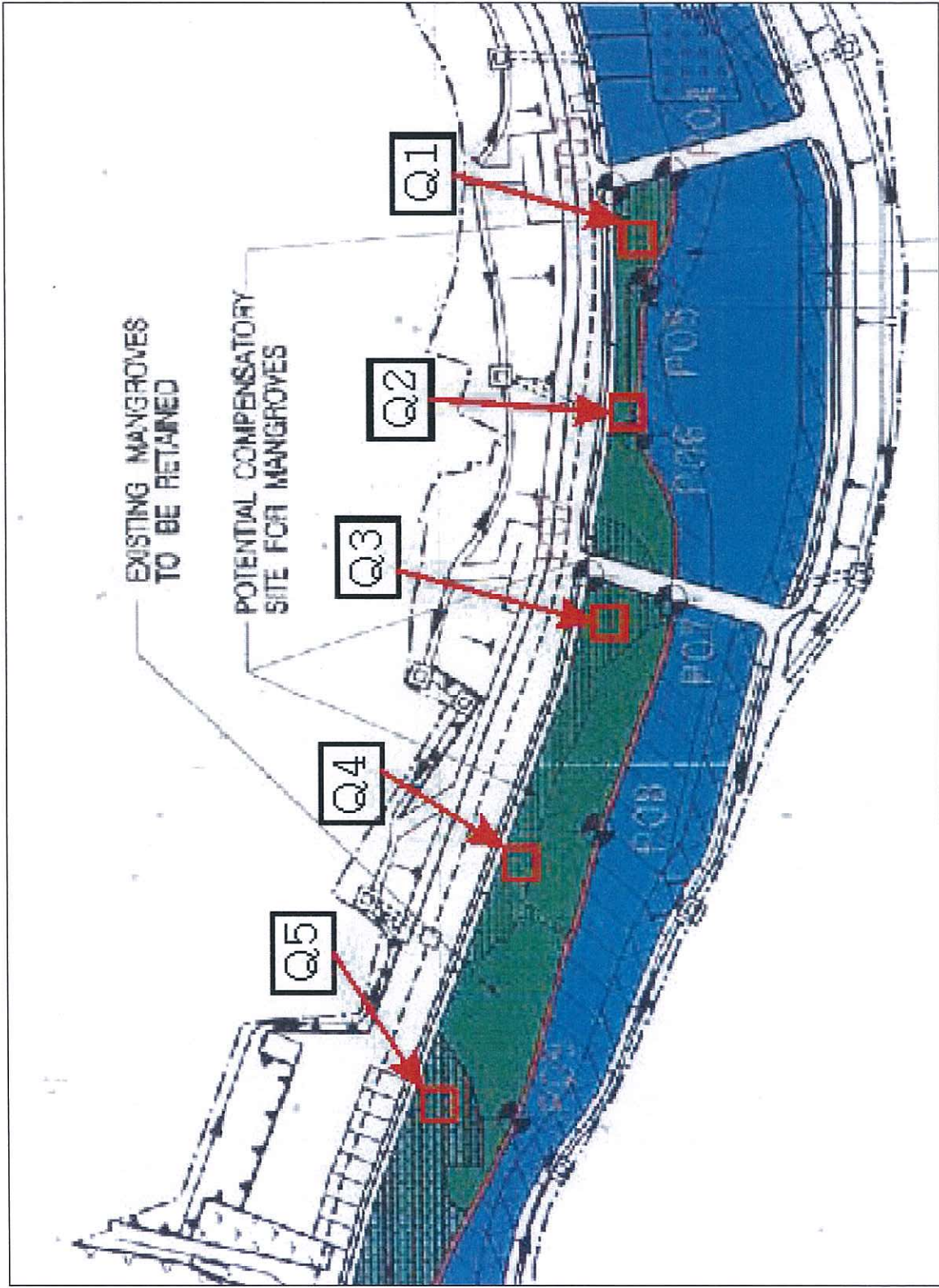


Figure 2 - Mean diameter (mm) of *Acanthus ilicifolius* and *Kandelia obovata* monitored at Hang Hau Tsuen Channel from Jun 2013 to Jun 2014

Annexes



Annex A: Location of mangrove zone and quadrates within Hang Hau Tsuen Channel



1. Last inspection



2. Current inspection



3. Last inspection



4. Current inspection



5. Last inspection



6. Current inspection



7. Last inspection



8. Current inspection

Post-construction mangrove monitoring - Jun 2014

Overall view of mangrove compensation area for both last and current inspection

Photo 1 - 8

Date 20th Jun 2014

Quadrante 1



9. Last inspection



10. Current inspection : Rubbish from upstream was cleared up in this quadrante

Quadrante 2



11. Last inspection



12. Current inspection: No significant change

Quadrante 3



13. Last inspection



14. Current inspection: No significant change

Post-construction mangrove monitoring - Jun 2014

Overall view of Quadrante 1 – 3 for both last and current inspection

Photo 9 - 14

Date 20th Jun 2014

Quadrat 4



15. Last inspection



16. Current inspection: No significant change

Quadrat 5



17. Last inspection



18. Current inspection: No significant change

Post-construction mangrove monitoring - Jun 2014

Photo 15-18

Overall view of Quadrat 4-5 for both last and current inspection

Date 20^h Jun 2014