Drainage Services Department

AECOM

Agreement No. DP 04/2012
Post-Construction Ecological Monitoring
of Drainage Improvement Works in Southern Lantau
Implemented under 4128CD in Contract DC/2006/11

Monthly EM&A Report – December 2015

January 2016

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Pursuant to Condition 4.4 of Environmental Permit No. EP-237/2005/B (amended by EP-237/2005/C), this monthly EM&A Report for post-construction ecological monitoring and ecological water monitoring during December 2015 has been certified by the Environmental Team Leader (ETL) and verified by the Independent Environmental Checker (IEC)

Certified by:

Signature: _____ Date: 26 January 2016.

Ms. Sharne McMillan
Environmental Team Leader (ETL)
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Verified by:

Signature: _____ Date: 26-1-2015

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Table of Contents

Page

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

This is the twentieth bi-monthly post-construction ecological monitoring and audit exercise for "Drainage Improvement in Southern Lantau" conducted by AECOM. This report concludes the post-construction phase ecological monitoring and audit requirement for the activities undertaken during the period of 1 December 2015 to 31 December 2015.

Ecological monitoring and ecological water quality monitoring were performed on 9 December 2015 and 11 December 2015, respectively. Results obtained are presented in this report.

The Environmental Team (ET) will continue to implement the environmental monitoring & audit (EM&A) programme in accordance with the EM&A Manual and Environmental Permit requirement. The report is available for public inspection and will be uploaded to the dedicated project website (http://www.envproject.com/sldiwema.htm).

1. INTRODUCTION

1.1. Background

1.1.1. The Drainage Services Department (DSD) has implemented Contract No. DC/2006/11 "Drainage Improvement in Southern Lantau and Construction of Mui Wo Village Sewerage Phase 1". The monitoring requirements of the drainage improvement works are subject to the conditions specified in Environmental Permit (EP) No. EP-237/2005/B issued by the Environmental Protection Department (25 January 2006). In response to the latest approval to Variation of an Environmental Permit (VEP) application (VEP-465/2015) regarding Drainage Improvement in Southern Lantau (17 February 2015), the former EP-237/2005/B has been amended to EP-237/2005/C; however, this has not changed the original monitoring requirements. In compliance with the EP, an Environmental Monitoring and Audit (EM&A) programme was established during the construction and post-construction phases of the project. The operation of the project is subject to the conditions in EP No. EP-434/2012. In response to the latest approval to VEP application (VEP-464/2015), the former EP-434/2012 has been amended to EP-434/2012/A.

1.1.2. The Post-Construction Ecological Monitoring and Audit of Drainage Improvement Works in Southern Lantau under Agreement No. DP 04/2012, commenced in January 2012. AECOM Asia Co. Ltd. was appointed by DSD as the Environmental Team (ET) to conduct the above captioned monitoring project from October 2012 onwards. This is the twentieth bi-monthly post-construction ecological monitoring and audit report under that appointment.

1.2. Project Description

1.2.1. Under Contract No. DC/2006/11, the improvement works were undertaken at Pak Ngan Heung River (PNH), Luk Tei Tong River (LTT) and Tai Tei Tong River (TTT) in Southern Lantau, west of Mui Wo. The works for which the post-construction ecological monitoring required by EP No. EP-237/2005/B (amended to EP-237/2005/C) included:

- the drainage channel and a three-cell box culvert at PNH;
- the drainage channel at LTT; and
- the bypass channel at LTT.

1.2.2. No ecological monitoring and ecological water monitoring was required following the drainage improvement works at TTT and village sewerage works in Mui Wo.

1.2.3. Both PNH and LTT are part of the Mui Wo River (also named as Silver River) in Lantau Island. These two tributaries of Mui Wo River, together with Tai Tei Tong River, then joined and connected to Silver Mine Bay next to Mui Wo.

1.3. Report Objectives

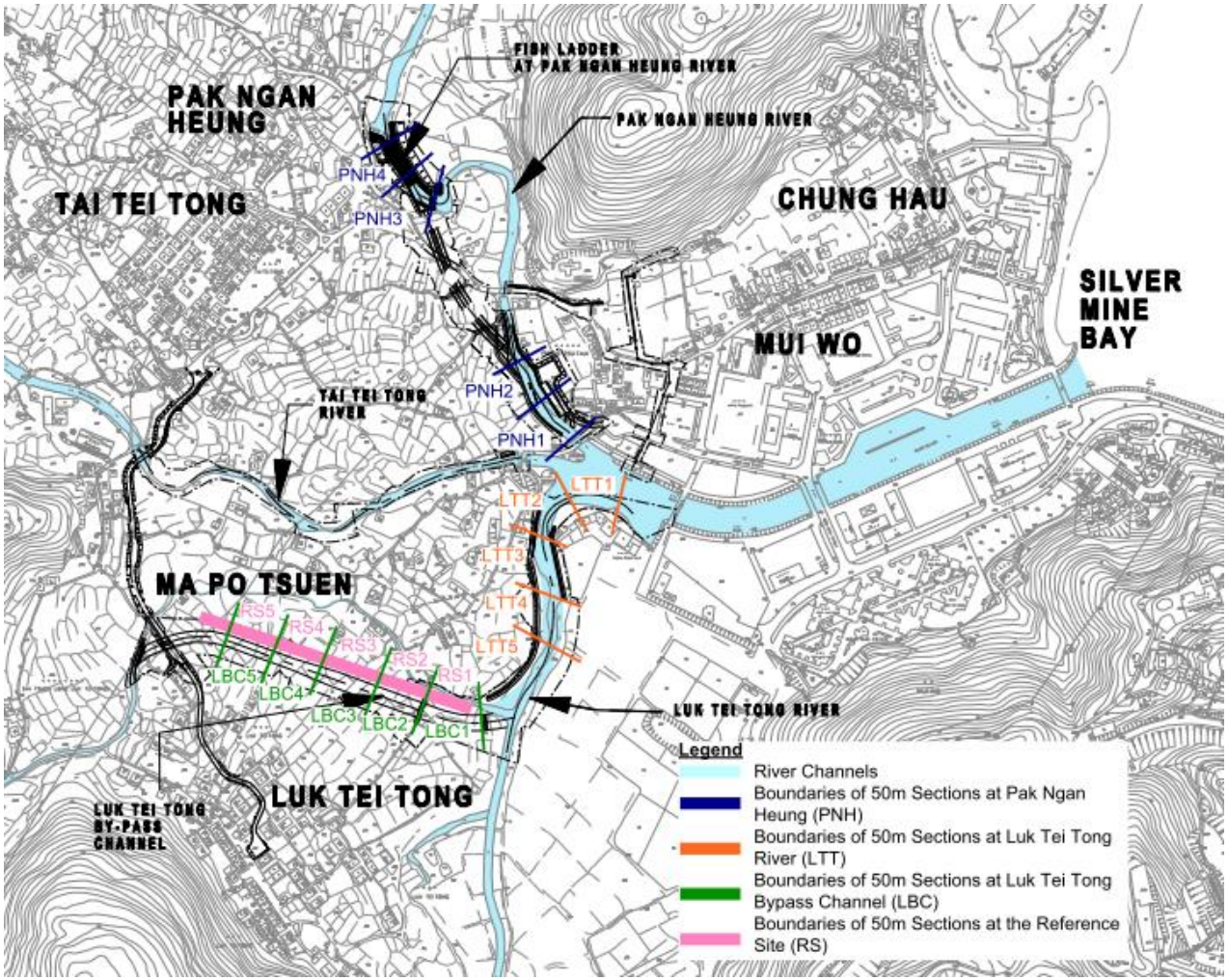
1.3.1. This report presents the findings of the ecological monitoring and the ecological water monitoring conducted in December 2015.

2. ECOLOGICAL MONITORING PARAMETERS

2.1. Ecological Surveys

2.1.1. Details of the monitoring parameters and survey methodology are described below. According to the Final EM&A Manual, a specific ecological monitoring programme of the improved section of PNH, LTT, LTT Bypass Channel (LBC) and its Reference Site (RS) is recommended.

Figure 1 Ecological Monitoring Locations at Pak Ngan Heung River, Luk Tei Tong River, Luk Tei Tong Bypass Channel and the Reference Site



Pak Ngan Heung River and Luk Tei Tong River

2.1.2. The ecological survey for these two rivers was divided into nine 50 m sections and comprised the following:

- Two sections for downstream of PNH (PNH1 and 2), two sections for upstream of PNH (PNH3 and 4);
- Five sections for LTT (LTT1 to 5).

2.1.3. The location plan is shown in **Figure 1** for reference.

2.1.4. The monitoring parameters and survey methodology for each section are described below:

(a) Bird species in each 50 m section were surveyed quantitatively using transect count method. Birds within the river channel and on the riverbank were identified to species and their abundance was recorded. Birds that flew over/across the river channel without landing were not considered to be utilising the area and thus excluded from the records. This does not apply to species that rarely land and are associated with specific habitats (e.g. Barn Swallow).

(b) Surveys on aquatic macroinvertebrate focused on determination of the diversity and abundance. Sampling methods included active searching, direct observation, hand netting and kick sampling. In each section, the macroinvertebrate species composition was identified and their relative abundance was recorded.

(c) Surveys on fish focused on determination of the diversity and abundance of fish communities. Sampling methods included active searching, direct observation, and hand netting, and were determined in accordance with site conditions. In each section, the fish species composition was identified and their relative abundance was recorded.

(d) Adult odonate community in each 50 m section were surveyed quantitatively by transect count method. Adult odonates within the river channel and on the riverbank were identified to species and their abundance was recorded. Species requiring close examination were netted.

(e) Aquatic, emergent and riparian vegetation community was recorded by walk-through survey. Plant species composition and their relative abundance were recorded.

Luk Tei Tong Bypass Channel

2.1.5. The ecological survey for the Luk Tei Tong Bypass Channel (LBC) and its Reference Sites (RS) were carried out in every 50 m section and comprised the following:

- Five sections for LBC (LBC1 to 5);
- Five sections for RS (RS1 to 5).

2.1.6. The location plan is shown in **Figure 1** for reference.

2.1.7. The monitoring parameters and survey methodology are described below:

(a) Bird species in each 50 m section were surveyed quantitatively using transect count method. Birds within the river channel and on the riverbank were identified to species and their abundance was recorded. Birds that flew over/across the river channel without landing were not considered to be utilising the area and thus excluded from the records. This does not apply to species that rarely land and are associated with specific habitats (e.g. Barn Swallow).

(b) Where/when water was present, surveys of aquatic macroinvertebrate focused on determination of their diversity and abundance of stream aquatic communities. Sampling

methods included active searching, direct observation, hand netting and kick sampling. In each section, macroinvertebrate species composition was identified and their relative abundance was recorded.

(c) Where/when water was present, surveys of fish focused on determination of their diversity and abundance. Sampling methods included active searching, direct observation, and hand netting, were determined in accordance with site conditions. In each section, fish species composition was identified and their relative abundance was recorded.

(d) Adult odonate community in each 50 m section were surveyed quantitatively by transect count method. Adult dragonflies within the river channel and on the riverbank were identified to species and their abundance was recorded. Species requiring close examination were netted.

(e) Line-intercept method was adopted to determine the relative plant cover of aquatic, emergent and riparian vegetation. One line transect of 10 m was set perpendicular to the stream channel at each section, and five 1 m x 1 m quadrats were placed along the transect. Relative coverage and plant species intercepting the transect line was recorded. Percentage cover of each species within the quadrat was recorded to the nearest 10% (except "1" = present but insignificant cover, normally 1 to 2 individuals, and 5% = up to 5%). The conditions of vegetation were described.

(f) Herpetofauna community within LBC and RS were surveyed by active searching in potential habitats. Reptiles were identified and their abundance was recorded. Amphibians were identified by their calls and the number of calling males in each section was recorded.

2.1.8. For all surveys, identification of plant species and distribution status in Hong Kong were made with reference to Corlett *et al.* (2000), Hu *et al*. (2003), Hong Kong Herbarium (2012), and Hong Kong Herbarium and South China Botanical Gardens (2007; 2008; 2009; 2011).

2.1.9. In terms of assessing geographical distribution, published references specializing in the distribution of specific faunal groups in Hong Kong have been utilized. For general status, these have included Fellowes *et al*. (2002) and the Hong Kong Biodiversity Database (AFCD, 2015), and for specific faunal groups, these have included: Avifauna – Carey *et al.* (2001), Viney *et al.* (2005); Dragonflies – Tam *et al.* (2011); Butterflies – Lo (2005); and Chan *et al*. (2011); Amphibians – Chan *et al.* (2005); Reptiles – Chan *et al.* (2006), Chan *et al*. (2009), and Karsen *et al.* (1998); Terrestrial Mammals – Shek (2006); Freshwater Fish – Lee *et al.* (2004); and Freshwater Community – Dudgeon (2003). The status and rarity of vascular plants has been based on Hu *et al*. (2003) and Corlett *et al*. (2000).

2.2. Ecological Water Quality Monitoring

2.2.1. Ecological water quality monitoring along PNH, LTT, LBC, and RS was carried out. Ten locations were selected and comprised the following:

- Three locations for existing PNH (WE1 to 3);
- Three locations for existing LTT (WE4 to 6);
- Two locations for RS (WE7 to 8);
- Two locations for existing LBC (WE9 to 10).

2.2.2. The location plan for ecological water quality monitoring is shown in **Figure 2**.

2.2.3. Water Quality Monitoring along PNH, LTT, LBC and RS included the monitoring parameters shown below:

- Biochemical Oxygen Demand (BOD_5)
- Dissolved Oxygen (DO)

- Nitrate
- Ammonia
- Reactive Phosphorus
- Total Suspended Solids (SS)
- Temperature
- Water Depth* and Water Flow Rate
- Conductivity
- pH
- Salinity
- Sediment Characteristics

Note:

*As referred to in the Final EM&A Manual, Water Depth is required only for LBC.

2.2.4. The DO, water depth and water flow rate, conductivity, pH, temperature, salinity and sediment characteristics were measured in-situ while the other water samples were analyzed in a HOKLAS accredited laboratory and the analyses followed the standard methods according to APHA Standard Methods for the Examination of Water and Wastewater, 20th Edition, or equivalent. The limit of reporting for the laboratory analysis is summarized in **Table 2.1**.

Table 2.1 Limit of Reporting for Water Quality Parameters

Parameters	Limit of Reporting (mg/L)
Total Suspended Solids	2
Biochemical Oxygen Demand (BOD_5)	2
Nitrate	0.01
Ammonia	0.01
Reactive Phosphorus	0.01

2.2.5. The instrument for in-situ measurement of pH, temperature, DO, salinity and conductivity is a portable and weather proof Multifunctional Meter complete with cable and uses a DC power source. Calibration certificates are attached in **Appendix 1**. The instruments are capable of measuring:

- pH in the range of 0 to 14
- Temperature of -5 to +65^{0}C
- DO in the range of 0 to 20 mg/L and 0 to 200% saturation
- Salinity in the range of 0-80ppt
- Conductivity in the range of 0 to 4999 µS/cm

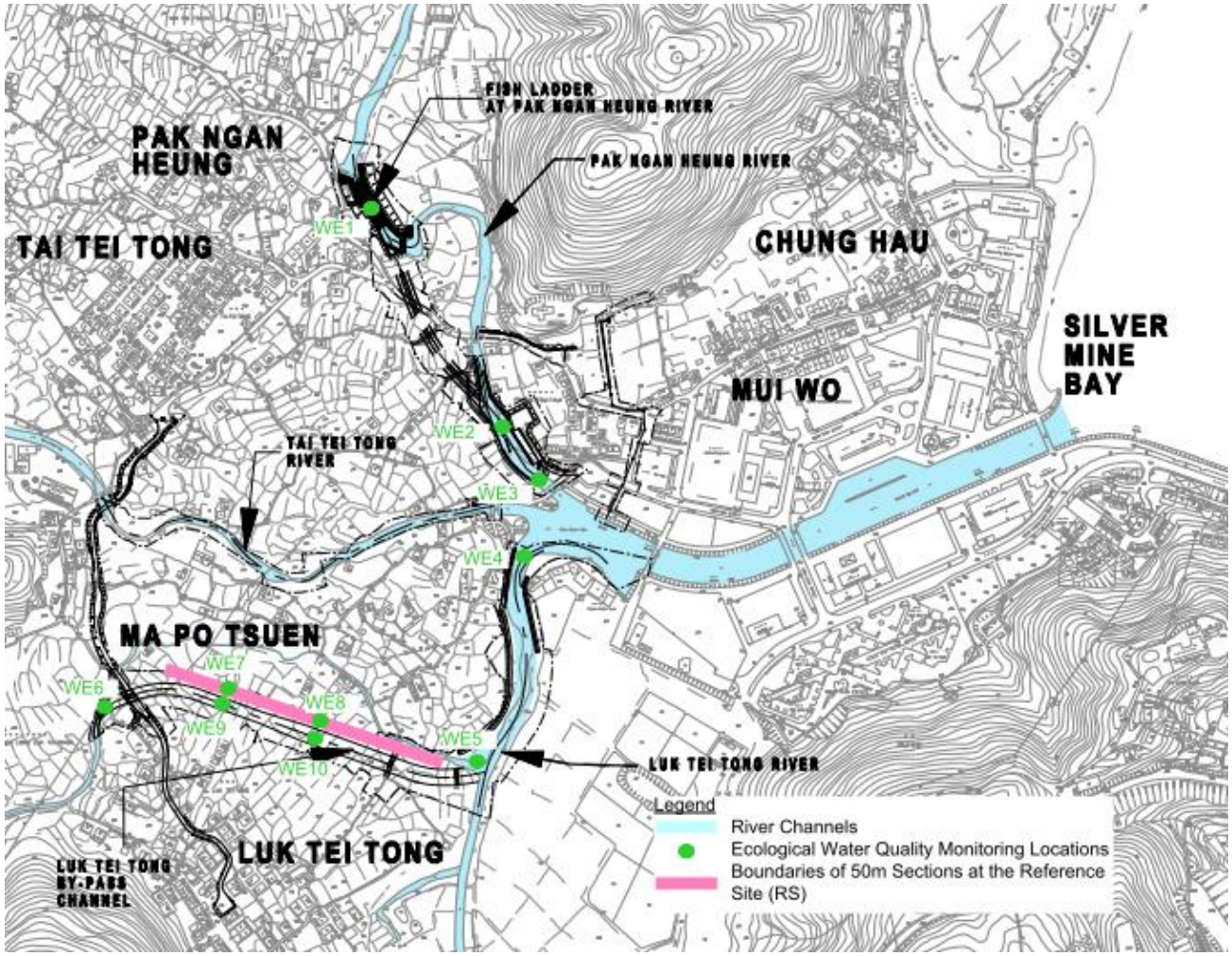
2.2.6. According to the requirement of the Final EM&A Manual, two consecutive measurements for parameters of DO concentration, and DO saturation are required to be taken at each monitoring location. When the difference in value between the first and second reading of DO is more than 25%, the reading was discarded and a further reading taken.

2.3. Limitations

2.3.1. No water was present at LBC2 to LBC5 at the time of ecological survey (11 December 2015), therefore aquatic fauna surveys were not undertaken in these locations.

2.3.2. No water was present at WE7 to WE10 at the time of water quality monitoring (9 December 2015), therefore water quality monitoring was not undertaken at these locations.

Figure 2 Ecological Water Quality Monitoring Locations at Pak Ngan Heung River, Luk Tei Tong River, Luk Tei Tong Bypass Channel and the Reference Site



3. MONITORING RESULTS

3.1. Ecological Survey Findings

Pak Ngan Heung River (PNH)

3.1.1. The lower stream of PNH (PNH1 and PNH2) is subject to tidal influence from Silver Mine Bay. Vertical concrete retaining wall formed the banks of the river channel. The two sections were located at the mouth of the PNH. PNH1 and PNH2 were adjacent to each other. The bridge formed the southern boundary of PNH1 whereas the box-culvert formed the northern boundary of PNH2. Small boulders and sandy substrate formed the main component of the streambed.

3.1.2. Rock-filled gabion formed the eastern bank and the gabion and a vertical concrete retaining wall formed the western bank of the upper stream (PNH3 and PNH4). PNH3 and PNH4 are adjacent to each other. PNH4 comprised a man-made cascade, including a fish ladder, while PNH3 comprised a pool below the cascade and was bounded by a bridge at its downstream end. Small boulders and sandy substrate were the main component in the middle streambed which allowed water flow and pool formation, whereas big boulders were scattered on both sides of the streambed and had an absence of water. The width of the fish ladder at PNH4 is approximately 7 m.

3.1.3. The cascade/fish ladder at PHN4 was designed to allow open water flow and should be free of vegetation in order to allow fish movement.

Vegetation

3.1.4. At PNH1, no plant species were recorded within the river channel. The vegetation recorded on the vertical wall included *Wedelia trilobata* and Opposite-leaved Fig (*Ficus hispida*) at PNH1. At PNH2, three seedlings of *Kandelia obovata* were recorded. No significant changes to the plant species were observed compared with last monitoring in October 2015. During the monitoring, the water level at lower PNH was approximately 40 cm during ebbing tide.

3.1.5. At PNH3 and PNH4, a total of 18 plant species were recorded. Exotic Mile-a-minute (*Mikania micrantha*) was still the dominant species on the banks of the PNH3 pool, the gabion of the PNH4 and the two edges of the cascade/fish ladder. Mile-a-minute was overgrown at the edges of the PNH4 cascade/fish ladder and partially blocked the water flow (refer to **Appendix 5**). In addition, herb species such as *Bidens alba*, Diffuse Day-Flower (*Commelina diffusa*), Ciliate Microstegium (*Microstegium ciliatum*) and *Wedelia trilobata* were also commonly recorded along the gabion of the PNH3, along the sides of PNH3 pool and PNH4 cascade.

3.1.6. The list of plant species is presented in **Appendix 2a**.

Terrestrial Fauna

3.1.7. Six avifauna species were recorded at PNH, all of which are common or abundant in Hong Kong except uncommon Green Sandpiper (*Tringa ochropus*) (AFCD, 2015) (**Table 3.1**). Three avifauna species of conservation importance, Grey Heron (*Ardea cinerea*), Little Egret (*Egretta garzetta*) and Greater Coucal (*Centropus sinensis*), were recorded at PNH1, PNH2 and PNH4, respectively.

3.1.8. Three avifauna species recorded at lower PNH (PNH1 and PNH2). All avifauna recorded were waterbird species (e.g. Grey Heron and Green Sandpiper). There was no evidence of breeding or nesting activities during the monitoring period. One individual of Grey Heron and Little Egret were recorded foraging at PNH1 and PNH2, respectively. These species are both listed as “Potential Regional Concern” by Fellowes *et al*. (2002).

3.1.9. Three avifauna species were recorded at upper PHN (PNH3 and PNH4). All recorded avifauna were generalists (e.g. Common Tailorbird *Orthotomus sutorius*). One individual of Greater Coucal was recorded roosting at PHN4. This species is listed as “”Class II” Protection Status in China and “Vulnerable” in China Red Data Book.

3.1.10. One odonate species, Common Blue Jewel (*Rhinocypha perforata perforate*) was recorded at upper PNH in low abundance (**Table 3.2**). This species is abundant in Hong Kong (AFCD, 2015). No odonate species of conservation importance were recorded during the monitoring.

3.1.11. No herpetofauna were recorded at PNH during the monitoring.

Aquatic Macroinvertebrate and Fish

3.1.12. A total of nine species were recorded within the PNH river, including two fish species, one crustacean species and six aquatic macroinvertebrate species such as worms, snails and insects (**Table 3.3**). One-third of the recorded species are commonly found in freshwater and estuarine habitats of Hong Kong (Chan *et al*., 2003; Williams, 2003; AFCD, 2015). One fish species of conservation importance, Dark-margined Flagtail (*Kuhlia marginata*), was recorded at the pool of PNH3 in low abundance during the monitoring. This species is listed as "Reginal Concern" by Fellowes *et al*. (2002).

Table 3.1 Number of Avifauna Recorded at Pak Ngan Heung River (PNH)

Common Name [1]	Scientific Name	Distribution in Hong Kong [2]	Principal Status [3]	Level of Concern [4]	Protection Status in China [5]	China Red Data Book [6]	IUCN Red List [7]	PNH1	PNH2	PNH3	PNH4
Grey Heron [8]	*Ardea cinerea*	Common	W	PRC	-	-	-	1			
Little Egret [8]	*Egretta garzetta*	Common	P	PRC (RC)	-	-	-		1		
Green Sandpiper [8]	*Tringa ochropus*	Uncommon	W	-	-	-	-	1			
Spotted Dove	*Streptopelia chinensis*	Abundant	R	-	-	-	-				1
Greater Coucal	*Centropus sinensis*	Common	R	-	Class II	Vulnerable	-				1
Common Tailorbird	*Orthotomus sutorius*	Common	R	-	-	-	-			1	

Note:
(1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
(2) AFCD (2015). Hong Kong Biodiversity Database.
(3) R=resident; W=winter visitor; P=present all year, exact composition unknown;
(4) Fellowes *et al*. (2002): RC=Regional Concern; PRC=Potential Regional Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in nesting and/or roosting sites rather than in general occurrence.
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.
(8) Wetland-dependent species (including wetland-dependent species and waterbirds).

Species of conservation importance is noted in bold type face.

Table 3.2 Number of Odonate Recorded at Pak Ngan Heung River (PNH)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Level of Concern (2)	Protection Status in China (3)	China Red Data Book (4)	IUCN Red List (5)	PNH1	PNH2	PNH3	PNH4
Common Blue Jewel	*Rhinocypha perforata perforata*	Abundant	-	-	-	-				2

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Fellowes *et al*. (2002).
(3) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(4) Zheng and Wang (1998).
(5) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Table 3.3 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Pak Ngan Heung River (PNH)

Fauna Group	Common name	Scientific Name	Distribution in Hong Kong (1)(2)(3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	PNH1	PNH2	PNH3	PNH4
Fish	**Dark-margined Flagtail**	***Kuhlia marginata***	-	RC	-	-	-			+	
Fish	Nile Tilapia	*Oreochromis niloticus*	Common	-	-	-	-			+++	
Crustacean (Crabs)	-	*Gaetice depressus*	-	-	-	-	-	++	+		
Worms	Flatworm	Planaria	-	-	-	-	-				+
Snails	-	*Nerita chamaeleon*	Common	-	-	-	-	+++	+++		
Snails	-	*Cerithidea diadjariensis*	Very common	-	-	-	-	+++	+++		
Insects	Caddisflies	Trichoptera	-	-	-	-	-				+
Insects	Non-Biting Midges	Chironomidae	-	-	-	-	-	+	+	+	+
Insects	Mayfly	Baetidae	-	-	-	-	-				+

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Williams, G. (2003). Hong Kong Field Guides – Rocky Shores.
(3) Chan *et al.* (2003). Hong Kong Field Guides – Sandy Shores.
(4) Fellowes *et al.* (2002): RC=Regional Concern
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Relative abundance: + = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.
Species of conservation importance is noted in bold type face.

Luk Tei Tong River (LTT)

3.1.13. The LTT is subject to tidal influence from Silver Mine Bay and is estuarine in nature. It is a north-south running river. A vertical concrete retaining wall formed the riverbank of the LTT1 whereas rock-filled gabion formed the riverbank of LTT2 to LTT5. LTT1 was located at the confluence with Pak Ngan Heung River, Tai Tei Tong River and Luk Tei Tong River. Since it is subject to tidal flow, water flowed from south to north during the survey when the tide was going out. LTT1 and LTT2 had sandy substrate whilst LTT3 to LTT5 had muddy substrate. Clusters of boulders were present at both sides of the river channel. The width of the river channel was approximately 8-10 m.

3.1.14. No evidence of maintenance works (including those relevant to Conditions 2.1 to 2.4 of EP No. EP-434/2012 (amended to EP-434/2012/A) was observed during the monitoring period.

Vegetation

3.1.15. A total of 16 plant species were recorded in LTT. Seven out of the 16 recorded species were exotic. Majority of the recorded species were herbs or climbers that scattered along the gabion such as *Bidens alba*, Burma-reed (*Neyraudia reynaudiana*), Many-flowered Silvergrass (*Miscanthus floridulus*), Chinese Silvergrass (*Miscanthus sinensis*) and *Wedelia trilobata*. In addition to the mangrove stand supporting Spiny Bears Breech (*Acanthus ilicifolius*) and *Kandelia obovata* that have colonized the inside of the river channel at LTT2 and LTT3, several seedlings of *Kandelia obovata* were observed to have regenerated naturally at LTT1, LTT2, LTT3 and LTT5.

3.1.16. The list of plant species is presented in **Appendix 2a**.

Terrestrial Fauna

3.1.17. A total of six avifauna species were recorded at LTT, all of them are common in Hong Kong (AFCD, 2015) (**Table 3.4**). Waterbird species (e.g. Grey Heron) and generalists (e.g. Common Tailorbird) were recorded at LTT. One individual of Grey Heron was recorded foraging at LTT1 and LTT5 respectively, while one individual of Little Egret was recorded foraging at LTT1 during the monitoring (refer to **Appendix 6**).

3.1.18. Two odonate species, including Common Red Skimmer (*Orthetrum pruinosum neglectum*) and Wandering Glider (*Pantala flavescens*) were recorded at LTT5 and LTT3, respectively (**Table 3.5**). These species are abundant in Hong Kong (AFCD, 2015). No odonate species of conservation importance were recorded during the monitoring.

3.1.19. No herpetofauna species were recorded at LTT during the monitoring.

Aquatic Macroinvertebrate and Fish

3.1.20. A total of 15 aquatic species, including two fish species, five crustacean species and eight species of other aquatic macroinvertebrates such as snails, insects, bivalves and amphipods were recorded from LTT (**Table 3.6**). Most of the recorded species are either common or very common in river mouth or estuarine habitats in Hong Kong (Chan *et al*., 2003; Williams, 2003; AFCD, 2015). No fish or aquatic macroinvertebrates species of conservation importance were recorded during the monitoring.

Table 3.4 Number of Avifauna Recorded at Luk Tei Tong River (LTT)

Common Name (1)	Scientific Name	Distribution in Hong Kong (2)	Principal Status (3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	LTT1	LTT2	LTT3	LTT4	LTT5
Grey Heron (8)	***Ardea cinerea***	Common	W	PRC	-	-	-	1				1
Little Egret (8)	***Egretta garzetta***	Common	P	PRC (RC)	-	-	-	1				
Black Drongo	*Dicrurus macrocercus*	Common	M,Su	-	-	-	-		2			
Common Tailorbird	*Orthotomus sutorius*	Common	R	-	-	-	-		1			
Black-collared Starling	*Gracupica nigricollis*	Common	R	-	-	-	-		2			3
White Wagtail	*Motacilla alba*	Common	W,R	-	-	-	-	2				

Note:
(1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
(2) AFCD (2015). Hong Kong Biodiversity Database.
(3) R=resident; M=migrant; Su=summer visitor; W=winter visitor; P=present all year, exact composition unknown.
(4) Fellowes *et al.* (2002): PRC=Potential Regional Concern; RC=Regional Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in nesting and/or roosting sites rather than in general occurrence.
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.
(8) Wetland-dependent species (including wetland-dependent species and waterbirds).

Species of conservation importance is noted in bold type face.

Table 3.5 Number of Odonate Recorded at Luk Tei Tong River (LTT)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Level of Concern (2)	Protection Status in China (3)	China Red Data Book (4)	IUCN Red List (5)	LTT1	LTT2	LTT3	LTT4	LTT5
Common Red Skimmer	*Orthetrum pruinosum neglectum*	Abundant	-	-	-	-					1
Wandering Glider	*Pantala flavescens*	Abundant	-	-	-	-			3		

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Fellowes *et al*. (2002).
(3) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(4) Zheng and Wang (1998).
(5) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Table 3.6 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Luk Tei Tong River (LTT)

Fauna Groups	Common Name	Scientific Name	Distribution in Hong Kong (1)(2)(3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	LTT1	LTT2	LTT3	LTT4	LTT5
Fish	Common Silver-biddy	*Gerres oyena*	Recorded from estuaries throughout Hong Kong	-	-	-	-					++
Fish	Mangrove Snapper	*Lutjanus argentimaculatus*	Common	-	-	-	-	+				
Crustacean (Crabs)	-	*Eriocheir japonica*	-	-	-	-	-	+				
Crustacean (Crabs)	-	*Gaetice depressus*	-	-	-	-	-					+
Crustacean (Crabs)	-	*Sesarma (Perisesarma) bidens*	Very common	-	-	-	-		+	+		+
Crustacean (Crabs)	-	*Uca lactea*	Common	-	-	-	-			+		
Crustacean (Barnacles)	-	*Balanus amphitrite*	Very common	-	-	-	-	++	+			
Snails	-	*Nerita chamaeleon*	Common	-	-	-	-	+++	++			
Snails	-	*Neritina (Dostia) violacea*	Common	-	-	-	-		+			
Snails	-	*Cerithidea cingulata*	Very common	-	-	-	-	+		++	+	
Snails	-	*Cerithidea diadjariensis*	Very common	-	-	-	-	+++	++			
Bivalves	Rock oyster	*Saccostrea cucullata*	Very common	-	-	-	-	+++		+		
Amphipod	-	Amphipoda	-	-	-	-	-	+	+	+		
Insects	Sea Slater	*Ligia exotica*	Common	-	-	-	-				+	
Insects	Non-Biting Midges	Chironomidae	-	-	-	-	-	+			+	

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Williams, G. (2003). Hong Kong Field Guides – Rocky Shores.
(3) Chan *et al*. (2003). Hong Kong Field Guides – Sandy Shores.
(4) Fellowes *et al*. (2002).
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Relative abundance: + = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.

Luk Tei Tong Bypass Channel (LBC) and Reference Site (RS)

3.1.21. The LBC links to the end of LTT5 and runs east to west but the connection with LTT5 is blocked by a layer of gabion wall approximately 1 m in height, which allows water flow between LBC and LTT when water level is higher than the height of the gabion. It is located in the Luk Tei Tong Marsh to the west of the original LTT. Gabion walls formed both sides of the channel bank. A small pool of approximately 60 m^2 in size was located at the western end of LBC1. The pool was separated from the LTT by a weir constructed from a single layer of rock-filled gabion. The substrate comprised soil, which was translocated from the marsh area prior to construction of the bypass. The width of the bypass channel was approximately 15 m.

3.1.22. The RS was located parallel to the northern side of the LBC. Next to the RS was village housing. The site was vegetated and did not have any free-standing water at the time of survey.

Vegetation

3.1.23. The majority of vegetation had been removed since the last monitoring period (October 2015) from LBC1 to LBC5 (refer to **Appendix 5**). Since the majority of vegetation was removed, the vegetation coverage in LBC dropped from 100% to 7% compared to the last monitoring in October. A total of 26 plant species were recorded in LBC, of which 5 species were recorded in the quadrats sampled. The list of plant species is presented in **Appendix 2b**. Among all the recorded species, about 38% were exotic species (**Table 3.7**). Similar to the last monitoring survey in October, half of the LBC1 section included a patch of open water. Other sections were dry.

3.1.24. The habitat at LBC1 is different from the remaining LBC sections in terms of vegetation type. It adjoined LTT5 and had a pool of open water at the eastern tip. LBC1 may be subject to tidal influence during high tide because it is located immediately next to LTT. Although vegetation removal had been carried out in LBC1, re-establishment of the sedge Ferrugineous-scale Fimbristylis (*Fimbristylis sieboldii*) and Native Leather Fern (*Acrostichum aureum*) was observed at LBC1. Four saplings of *Kandelia obovata* were recorded at the open water at LBC1.

3.1.25. Re-establishment of exotic species *Wedelia trilobata* was observed from LBC2 to LBC5. Other herbaceous species encountered along the transects from LBC2 to LBC5 included *Bidens alba*, Ciliate Sasagrass (*Microstegium ciliatum*) and Wild Kudzu Vine (*Pueraria phaseoloides*). Tree seedlings (e.g. Taiwan Acacia, *Acacia confusa* and Chinese Tallow Tree, *Sapium sebiferum*) were occasionally recorded at the drier section near the bridge at LBC1, and near the gabion at LBC2 and LBC4. Wetland species Taro (*Colocasia esculenta*) was only recorded at LBC4 compared to the last monitoring.

3.1.26. A total of 51 plant species were recorded in the RS, of which 13 species were found in the quadrats (**Table 3.7**). Among all the recorded species, about 41% were exotic species. The list of plant species is presented in **Appendix 2b**. All sections were dry and were located next to the village housing. The exotic *Wedelia trilobata* and was the dominant species. The exotic Hilo Grass (*Paspalum conjugatum*), native Wild Kudzu Vine and Rose Mallow (*Urena lobata*) were also commonly recorded along the RS sections. The majority of vegetation recorded at RS are typical in disturbed land. Records of wetland species such as Taro and Ginger Lily were occasional.

Table 3.7 Vegetation Coverage at Luk Tei Tong Bypass Channel (LBC) and Reference Site (RS)

	LBC	RS
No. of species recorded in quadrats	5	13
Total No. of species	26	51
Total No. of exotic species	10	21

Average vegetation coverage	7%	78%
Bare ground coverage	93%	22%

Note:
(1) The transect was not laid along any open water, thus open water coverage was not provided in this table.

Terrestrial Fauna

3.1.27. Three species of avifauna were recorded at the LBC (**Table 3.8**) and five species of avifauna were recorded at the RS (**Table 3.9**). All recorded species are common or abundant in Hong Kong (AFCD, 2015). The recorded avifaunal species in LBC and RS were generalists Crested Myna (*Acridotheres cristatellus*) and Red-whiskered Bulbul (*Pycnonotus jocosus*). No species of conservation importance were recorded at LBC or RS.

3.1.28. One individual of Wandering Glider was recorded at LBC1 while no odonates were recorded at RS during the monitoring (**Table 3.10**). No odonate species of conservation importance were recorded during the monitoring.

3.1.29. One individual of Chinese Skink (*Eumeces chinensis chinensis*), which is widely distributed in Hong Kong (AFCD, 2015), was recorded at LBC1 (**Table 3.11**). No herpetofauna were recorded RS during the monitoring. No herpetofauna species of conservation importance were recorded during the monitoring.

Aquatic Macroinvertebrate and Fish

3.1.30. A total of seven aquatic species, including three fish species, one crustacean species and three aquatic macroinvertebrates species were recorded at LBC1 (**Table 3.12**). Most of the recorded species were very common or common in Hong Kong (Chan *et al*., 2003; Williams, 2003; AFCD, 2015). No fish and aquatic macroinvertebrate species of conservation importance were recorded during the monitoring.

3.1.31. No aquatic fauna was recorded at the RS or the remaining sections of the LBC2 to LBC5 as they were dry during the monitoring.

Table 3.8 Number of Avifauna Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name (1)	Scientific Name	Distribution in Hong Kong (2)	Principal Status (3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	LBC1	LBC2	LBC3	LBC4	LBC5
Red-whiskered Bulbul	*Pycnonotus jocosus*	Abundant	R	-	-	-	-				2	
Crested Myna	*Acridotheres cristatellus*	Common	R	-	-	-	-				2	
White Wagtail	*Motacilla alba*	Common	W,R	-	-	-	-	1				

Note:
(1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
(2) AFCD (2015). Hong Kong Biodiversity Database.
(3) R=resident; W=winter visitor.
(4) Fellowes *et al.* (2002).
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Table 3.9 Number of Avifauna Recorded at Reference Site (RS)

Common Name (1)	Scientific Name	Distribution in Hong Kong (2)	Principal Status (3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	RS1	RS2	RS3	RS4	RS5
Black Drongo	*Dicrurus macrocercus*	Common	M,Su	-	-	-	-	1				
Large-billed Crow	*Corvus macrorhynchos*	Common	R	-	-	-	-	1				
Red-whiskered Bulbul	*Pycnonotus jocosus*	Abundant	R	-	-	-	-			4		
Japanese White-eye	*Zosterops japonicus*	Abundant	R,?W	-	-	-	-					2
Black Drongo	*Dicrurus macrocercus*	Common	M,Su	-	-	-	-	1				

Note:
(1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
(2) AFCD (2015). Hong Kong Biodiversity Database.
(3) R=resident; M=migrant; Su=summer visitor; ?W=the extent of immigration in winter is unclear.
(4) Fellowes *et al.* (2002).
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Table 3.10 Number of Odonate Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Level of Concern (2)	Protection Status in China (3)	China Red Data Book (4)	IUCN Red List (5)	LBC1	LBC2	LBC3	LBC4	LBC5
Wandering Glider	*Pantala flavescens*	Abundant	-	-	-	-	1				

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Fellowes *et al*. (2002).
(3) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(4) Zheng and Wang (1998).
(5) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Table 3.11 Number of Herpetofauna Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Level of Concern (2)	Protection Status in China (3)	China Red Data Book (4)	IUCN Red List (5)	LBC1	LBC2	LBC3	LBC4	LBC5
Chinese Skink	*Eumeces chinensis chinensis*	Widely distributed	-	-	-	-	1				

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Fellowes *et al*. (2002).
(3) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(4) Zheng and Wang (1998).
(5) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Table 3.12 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Luk Tei Tong Bypass Channel (LBC)

Fauna Groups	Common Name	Scientific Name	Distribution in Hong Kong (1)(2)(3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	LBC1	LBC2	LBC3	LBC4	LBC5
Fish	Jarbua Terapon, Crescent-banded Grunter	*Terapon jarbua*	Common	-	-	-	-	+				
Fish	Nile Tilapia	*Oreochromis niloticus*	Common	-	-	-	-	++				
Fish	Bald Glassy	*Ambassis gymnocephalus*	Common	-	-	-	-	+++				
Crustacean (Crabs)	-	Crab larvae	-	-	-	-	-	+				
Snails	-	Thiaridae	-	-	-	-	-	+++				
Snails	-	*Cerithidea cingulata*	Very common	-	-	-	-	++				
Insects	-	Rhagovelia sp.	-	-	-	-	-	+				

Note:
(1) AFCD (2015). Hong Kong Biodiversity Database.
(2) Williams, G. (2003). Hong Kong Field Guides – Rocky Shores.
(3) Chan *et al*. (2003). Hong Kong Field Guides – Sandy Shores.
(4) Fellowes *et al.* (2002).
(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(6) Zheng and Wang (1998).
(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3.

Relative abundance: + = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.

3.2. Ecological Water Quality Monitoring (EWQM)

3.2.1. The post-construction phase EWQM was conducted on 9 December 2015. The monitoring results are presented in **Appendix 3** and summarised in **Table 3.13**, which includes reference to the key Water Quality Objectives (WQOs). Baseline surveys were conducted in 2007 prior to the start of the drainage improvement works. The baseline survey results are presented in **Table 3.14**.

3.2.2. The water quality monitoring results are discussed in **Section 5**.

Table 3.13 Summarized Ecological Water Quality Monitoring Results (December 2015)

Parameters	Key Water Quality Objectives[(1)]	WE1	WE2	WE3	WE4	WE5	WE6
Suspended Solids (mg/L)	<20	13.0	<2.0	6.0	2.0	7.0	8.0
Nitrogen (Ammonia) (mg/L)	-	0.09	0.12	0.09	0.12	3.18	0.12
Nitrogen (Nitrate) (mg/L)	-	0.37	0.43	0.56	0.46	0.48	0.35
Reactive Phosphorous (mg/L)	-	0.07	0.03	0.03	0.02	0.27	0.06
5-day Biochemical Oxygen Demand (BOD5) (mg/L)	<5	5.0	<2.0	2.0	4.0	4.0	6.0
Dissolved Oxygen (mg/L)	>4	7.45	8.24	7.61	7.74	6.79	7.19
Temperature (°C)	-	17.3	18.5	17.9	17.8	18.7	17.4
pH	6.5 – 8 5	7.2	6.3	6.5	6.4	6.7	6.9
Salinity (ppt)	-	0.07	0.07	0.13	0.84	1.12	0.04
Conductivity (µs/cm)	-	120.6	782.0	749.0	923.0	2194.0	100.5
Water Flow (m/s)	-	0.12	0.09	0.09	0.16	0.01	0.02
Water Depth (cm)	-	16.0	15.0	12.0	22.0	15.0	32.0

Note:
(1) The available key Water Quality Objectives (WQOs) for River Monitoring Stations at Mui Wo River on Lantau Island (EPD, 2015).

Table 3.14 Baseline of Ecological Water Quality Monitoring Results (September 2007)

Parameters	WE1	WE2	WE3	WE4	WE5	WE6
Suspended Solids (mg/L)	1.0	2.0	3.0	3.0	<1.0	<1.0
Nitrogen (Ammonia) (mg/L)	0.07	0.12	0.11	0.23	0.03	0.02
Nitrogen (Nitrate) (mg/L)	0.12	0.13	0.13	0.31	0.04	0.05
Reactive Phosphorous (mg/L)	0.04	0.06	0.06	0.09	0.06	0.05
5-day Biochemical Oxygen Demand (BOD_5) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Oxygen (mg/L)	6.58	6.82	6.37	7.61	6.87	5.70
pH	6.4	7.1	7.0	6.8	6.6	6.1
Salinity (ppt)	<0.1	0.1	0.3	7.6	0.1	<0.1

4. ECOLOGICAL MONITORING SCHEDULE

4.1. The next ecological surveys and ecological water quality monitoring are tentatively scheduled for mid-February 2016.

5. DISCUSSION AND RECOMMENDATIONS

5.1. The aim of the monitoring programme is to provide data on the re-establishment of aquatic/riparian communities in the PNH and LTT, and allow an assessment of the relative success of the mitigation measures to be made. In addition, monitoring of the LBC will assess whether the proposed channel design has provided suitable compensation for the impacts to the Luk Tei Tong Marsh.

5.2. Key observations made during the December 2015 monitoring period in relation to the implemented mitigation measures are presented in **Table 5.1**. Where applicable, recommendations for improving the functionality of the mitigation measures have been made for DSD's consideration.

5.3. Vegetation clearance had been carried out from LBC1 to LBC5 (refer to **Appendix 5**), therefore the vegetation coverage of LBC dropped from 100% in October 2015 to 7% in December monitoring. Re-establishment of exotic *Wedelia trilobata* was observed from LBC2 to LBC5. Marsh species Taro was only recorded at LBC4 when compared to last monitoring. The limited occurrence of these species suggested that the water levels/availability within the channel might not be adequate to sustain a marsh habitat.

5.4. LBC1 differed from LBC2 to LBC5 in terms of vegetation composition. Re-establishment of native species Ferrugineous-scale Fimbristylis and Leather Fern were observed at LBC1. Four saplings of *Kandelia obovata* were also recorded at LBC1. It was the best representation of re-established marsh habitat in LBC while LBC2 to LBC5 supported only limited marsh species and was dominated by flora and perennial species which typically occur in dry land habitats such as *Wedelia trilobata* and limited marsh species. Any vegetation clearance at LBC1 results in the removal of the established marsh habitat, therefore it is recommended that future vegetation clearance work should avoid at LBC1 to protect and maintain this habitat.

5.5. Tree seedlings (such as Taiwan Acacia and Chinese Tallow Tree) were recorded near the bridge at LBC1 and near the gabion at LBC2 and LBC4. Such tree species may hinder the re-establishment of marsh habitat.

5.6. Significant coverage of exotic Mile-a-minute (*Mikania micrantha*) is observed at the banks of the PNH3 pool, the gabion of the PNH4 and the two edges of the cascade/fish ladder (refer to **Appendix 5**). Mile-a-minute continued to overgrow at the edges of the PNH4 cascade/fish ladder and partially blocked the water flow. The presence of vegetation growing on the fish

ladder can hinder the use and movement by fish or freshwater community along PNH3 and PNH4, therefore regular weed removal is recommended to keep the fish ladder free from vegetation.

5.7. Dark-margined Flagtail, which was recorded in the 2003-2004 EIA surveys, was recorded during the monitoring at PNH3. This species is recognised as a species of conservation importance and is known locally from only two other river/stream sites besides Pak Ngan Heung River (DS, 2005).

5.8. As any vegetation clearance of the cascade/fish ladder upstream of PNH3 has the potential to result in water quality impacts downstream (e.g. leakage of diesel from trimming machine), hand removal of vegetation is recommended at areas adjacent to the fish ladder and pools. In addition, the removed plants should be disposed properly (i.e. no trimmed/removed vegetation should be allowed to be washed downstream).

5.9. Mangrove stands of Spiny Bears Breech and *Kandelia obovata* were observed inside the river channel at LTT2 and LTT3. Several *Kandelia obovata* seedlings were also observed at LTT1, LTT2, LTT3, and LTT5 and LBC1, indicating a natural re-colonization of mangrove at those sites.

5.10. Whilst there are some differences in the suspended solid and nitrogen level between the original 2007 water quality baseline surveys and the December 2015 water quality monitoring surveys, findings from water monitoring could be attributed to an array of factors including seasonal variations, climatic conditions and/or the influence of tidal status at the time of survey. Taking this into account, the key Water Quality Objectives (WQOs) for River Monitoring Stations at Mui Wo River (EPD, 2015) have been included to provide a comparison with standard water quality goals applicable to the area (refer to **Table 3.13**).

5.11. The Environmental Protection Department (EPD) analyses and presents data from its annual water monitoring programme to express the level of compliance with the statutory WQOs including pH, Suspended Solids (SS), 5-day Biochemical Oxygen Demand (BOD_5), and Dissolved Oxygen (DO). These WQOs specify the long-term water quality goals that the Government is to achieve and maintain for individual rivers in Hong Kong, including the Mui Wo River. As part of the programme five locations are sampled from the Mui Wo River, three of which are associated with the monitoring area for the drainage improvement works (MW1, MW2 and MW4). The objectives related to these sampling locations, have been used in this report. Water quality of the subject watercourses has met the WQOs during the survey.

5.12. No observable evidence of environmental changes such as odour, or discharge within the surveyed areas were recorded. When compared with the EPD key water quality objectives for river monitoring (2014), the parameters (SS and DO) complied with the statutory WQOs. BOD_5 at WE1 and WE6 exceeded the statutory WQOs slightly, while pH value at WE2 and WE4 were below the statutory WQOs slightly. When compared to the last monitoring period, nitrogen (ammonia) concentration slightly increased at all monitoring stations, except significantly increase at WE5. Suspended Solids concentration at WE1, WE3, WE5 and WE6 significantly increased while that at WE2 and WE4 showed minimal changes. Nitrogen (nitrate) concentration at all monitoring stations increased slightly. Conductivity at WE5 showed a significant increase while only minimal changes were at the other monitoring sites. Likewise, the dissolved oxygen level, salinity level, reactive phosphorus, pH value, flow rate and BOD_5 concentration at sites also demonstrated slight fluctuations.

5.13. Despite the fluctuations in water quality, no deteriorating trend has been detected over the monitoring period. The water quality monitoring will continue and findings will be presented in subsequent reports as additional information becomes available.

Table 5.1 Key Observations/Comments and Recommendations Arising from the December 2015 Monitoring Period

Location	Mitigation Measure	Observations/Comments	Recommendations
PNH and LTT	Construction of a small fish ladder at the upstream	Mile-a-minute (*Mikania micrantha*) is the dominant species at upper PNH and partially blocks the water flow at	On-going, regular weed management is recommended, as required,

Location	Mitigation Measure	Observations/Comments	Recommendations
	end of the PNH	the fish ladder (refer to **Appendix 5**).	to maintain the open nature of the fish ladder. Hand removal of vegetation is recommended at areas adjacent to the fish ladder and pools. In addition, the removed plants should be disposed properly (i.e. no trimmed/removed vegetation should be allowed to be washed downstream). Continued retention of native species, particularly at the edges of the river channel, during any future maintenance activities is recommended to maintain the existing habitat and minimize the re-colonization of exotic species. Some pits have been incorporated into the gabion banks, but do not appear to have been planted up. Planting of riparian vegetation, preferably with native species suggested in the EIA report Section 7.8.17 and Table 2.6 (e.g. *Albizia lebbeck*, *Sterculia lanceolata, Cinnamomum camphora, Polyspora axillaris*, and *Rhaphiolepis indica*) is recommended.
		The fish ladder does not meet the lip of the weir at the up-stream end of PNH4 due to a drop of approximately 30 cm. This could limit the overall function of the fish ladder for fish passage/movement up and downstream.	As per the current design of the fish ladder, the gap from the top of the fish ladder and the bottom of the weir is 30 - 40 cm presenting an obstacle to fish passage. Some improvement may be achieved by stacking additional boulders resembling that in PNH4 to form pools at the top of the fish ladder, which could facilitate fish movement.
	Re-establishment of aquatic / riparian communities	One fish species of conservation importance Dark-margined Flagtail (*Kuhlia marginata*), which was recorded in the 2003-2004 EIA surveys, were recorded at PNH3 during current monitoring in December 2015.	The presence of species of conservation importance in both PNH and LTT including relative abundance will continue to be monitored.
LBC	Provision of suitable habitat compensation	Vegetation clearance had been carried out at LBC. Re-establishment of marsh vegetation	Future vegetation clearance should be avoided at LBC1 to protect and maintain the

Location	Mitigation Measure	Observations/Comments	Recommendations
		was observed at LBC1 including native species Ferrugineous-scale Fimbristylis and Leather Fern. Four saplings of *Kandelia obovata* were recorded at LBC1. Vegetation clearance had been carried out at LBC (refer to **Appendix 5)**; however, re-establishment of some vegetation was observed. Limited marsh species were recorded from LBC2 to LBC5. The presence of regenerated tree seedlings at LBC1, LBC2 and LBC4 may hinder the re-establishment of a marsh habitat.	marsh habitat The establishment and the coverage of Leather Fern and *Kandelia obovata* species will continue to be monitored. The regeneration of marsh species in the LBC is to be monitored. Removal of tree seedlings (e.g. Taiwan Acacia and Chinese Tallow Tree) is suggested at LBC1, LBC2 and LBC4. Continued retention of native species from LBC2 to LBC5 during any future maintenance activities are recommended to maintain the existing habitat and minimize the re-colonization of exotic species.
		The limited occurrence of typical marsh plant species (although this was also limiting in the RS) suggests that the water levels/availability within the channel may not be adequate to sustain a marsh habitat.	On-going monitoring of water levels and species composition within the channel are required. Further assessment should take into account the timing of the surveys (wet/dry season).

6. REFERENCES

AFCD (2015). Hong Kong Biodiversity Database. Available at http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/resultlist.asp?lang=en Accessed on 22 December 2015.

Carey, G. J., Chalmers, M. L., Diskin, D. A., Kennerley, P. R., Leader, P. J., Leven, M. R., Lewthwaite, R. W., Melville, D. S., Turnbull, M. and Young, L. (2001). The Avifauna of Hong Kong. Hong Kong Bird Watching Society, Hong Kong.

Chan, A., Cheung, J., Sze, P., Wong, A., Wong, E. and Yau, E. (2011). A Review of the Local Restrictedness of Hong Kong Butterflies. Hong Kong Biodiversity Newsletter 21: 1-6. Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region.

Chan, K. K. B. and Caley, K. J. (2003). Hong Kong Field Guides – Sandy Shores. The Department of Ecology and Biodiversity, The University of Hong Kong.

Chan, S. K. F., Cheung, K. S., Ho, C. Y., Lam, F. N., Tang, W. S., Lau, M. W. N. and Bogadek, A. (2005). A Field Guide to the Amphibians of Hong Kong. Agriculture, Fisheries and Conservation Department, Friends of the Country Parks and Cosmos Books Ltd.

Chan, S. K. F, Cheung, K. S., Ho, C. Y., Lam, F. N, Tang, W. S. and Tse, M. L. (2006). A Field Guide to the Venomous Land Snakes of Hong Kong. Agriculture, Fisheries and Conservation Department, Friends of the Country Parks and Cosmos Books Ltd.

Chan, S. K. F., Chan, A. S. W., Cheung, K. S., Ho, C. Y. Ng, C. K. Y. and Tang, W. S. (2009). The Skinks of Hong Kong. Hong Kong Biodiversity Newsletter: Issue 17.

Corlett, R., Xing, W. F., Ng, C. S., Chau, K. C. L. and Wong, M. Y. L. (2000). Hong Kong Vascular Plants: Distribution and Status. Memoirs of the Hong Kong Natural History Society, 23, 1-157.

Drainage Services Department. 2005. Agreement No. CE 49/2002(DS) – Drainage Improvements in Southern Lantau: Final Environmental Assessment Report. Prepared by Maunsell Consultants Asia Ltd. The Government of the Hong Kong Special Administrative Region.

Dudgeon (2003). Hong Kong Field Guides – Hillstreams. The Department of Ecology and Biodiversity, The University of Hong Kong.

Environmental Protection Department (2005). Wetland Restoration in Country Parks. Advisory Council on the Environment Nature Conservation Subcomittee. Committee Paper NCSC 2/05.

Environmental Protection Department (2015). River Water Quality in Hong Kong in 2014. The Government of the Hong Kong Special Administrative Region.

Fellowes, J. R., Lau, M. W., Dudgeon, D., Reels, G. T., Ades, G. W. and Carey, G. J. (2002). Wild Animals to Watch: Terrestrial and Freshwater Fauna of Conservation Concern in Hong Kong. Memoirs of the Hong Kong Natural History Society, 25, 123-159.

Hong Kong Herbarium and South China Botanical Garden (2007). Flora of Hong Kong. Volume 1. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium and South China Botanical Garden (2008). Flora of Hong Kong. Volume 2. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium and South China Botanical Garden (2009). Flora of Hong Kong. Volume 3. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium and South China Botanical Garden (2011). Flora of Hong Kong. Volume 4. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium (2012). Check List of Hong Kong Plants 2012. Agriculture, Fisheries and Conservation Department, HKSAR Government.

Hu, Q. M., Wu, T. L., Xia, N. H., Xing, F. W., Lai, P. C. C. and Yip, K. W. (2003). Rare and Precious Plants of Hong Kong. Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Government.

IUCN (2015). IUCN Red List of Threatened Species. Version 2015-3. Available at www.iucnredlist.org. Accessed on 22 December 2015.

Lee, V. L. F., Lam, S. K. S., Ng, F. K. Y., Chan, T. K. T. and Young, M. L. C. (2004). Field Guide to the Freshwater Fish of Hong Kong. Agriculture, Fisheries and Conservation Department, Friends of the Country Parks and Cosmos Books Ltd. Hong Kong.

Lo, P. Y. F. (2005). Hong Kong Butterflies, 2nd edition. Agriculture, Fisheries and Conservation Department.

Karsen, S. J., Lau, M. W. N. and Bogadek, A. (1998). Hong Kong Amphibians and Reptiles. Urban Council, Hong Kong.

Shek, C. T. (2006). A Field Guide to the Terrestrial Mammals of Hong Kong. Agriculture, Fisheries and Conservation Department, Hong Kong.

Tam, T. W., Leung, K. K., Kwan, B. S. P., Wu, K. K. Y., Tang, S. S. H., So, I. W. Y., Cheng, J. C. Y., Yuen, E. F. M., Tsang, Y. M. and Hui, W. L. (2011). The Hong Kong Dragonflies. AFCD, Friends of Country Park and Cosmos Books Ltd. Hong Kong.

Tam, N. F. Y. and Wong, Y. S. (2000). Hong Kong Mangroves. Agriculture, Fisheries and Conservation Department. City University of Hong Kong Press.

Viney, C., Phillips, K. and Ying, L. C. (2005). The birds of Hong Kong. Information Service Department.

Wang, L. M., Mu, M. R., Li, X. F., Lin, P. and Wang, W. Q. (2010). Differentiation between true mangroves and mangrove associates based on leaf traits and salt contents. Journal of Plant Ecology, pp.1-10.

Williams, G. A. (2003). Hong Kong Field Guides: Rocky Shore. The Department of Ecology and Biodiversity, The Hong Kong University of Hong Kong, Hong Kong.

Zheng, G. M. and Wang, Q. S. (1998). China Red Data Book of Endangered Animals: Aves. Science Press, Beijing.

Appendix 1. Calibration Certificate of the Instrument (Multifunctional Meter)

ALS Technichem (HK) Pty Ltd
11/F, Chung Shun Knitting Centre
1-3 Wing Yip Street
Kwai Chung, N.T., Hong Kong
T: +852 2610 1044
F: +852 2610 2021
www.alsglobal.com

REPORT OF EQUIPMENT PERFORMANCE CHECK/CALIBRATION

CONTACT:	MR MIKE SHEK	**WORK ORDER:**	HK1541933
CLIENT:	AECOM ASIA COMPANY LIMITED	**SUB-BATCH:**	0
ADDRESS:	1501-10, 15/F, TOWER 1, GRAND CENTRAL PLAZA, 138 SHATIN RURAL COMMITTEE ROAD, SHATIN, NEW TERRITORIES, HONG KONG	**LABORATORY:**	HONG KONG
		DATE RECEIVED:	03/11/2015
		DATE OF ISSUE:	05/11/2015

COMMENTS

The performance of the equipment stated in this report is checked with independent reference material and results compared against a calibrated secondary source.
The "Tolerance Limit" quoted is the acceptance criteria applicable for similar equipment used by the ALS Hong Kong laboratory or quoted from relevant international standards.
The "Next Calibration Date" is recommended according to best practice principals as practised by the ALS Hong Kong laboratory or quoted from relevant international standards.

Scope of Test:	Conductivity, Temperature ,Dissolved Oxygen, Salinity, pH and Turbidity
Description:	Multifunctional Meter
Brand Name:	YSI
Model No.:	Sonde 6820 V2
Serial No.:	12D100972
Equipment No.:	W.026.36
Date of Calibration:	03 November, 2015

NOTES

This is the Final Report and supersedes any preliminary report with this batch number.
Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release.

Mr Fung Lim Chee, Richard
General Manager -
Greater China & Hong Kong

REPORT OF EQUIPMENT PERFORMANCE CHECK/CALIBRATION

Work Order: HK1541933
Sub-batch: 0
Date of Issue: 05/11/2015
Client: AECOM ASIA COMPANY LIMITED

Description: Multifunctional Meter
Brand Name: YSI
Model No.: Sonde 6820 V2
Serial No.: 12D100972
Equipment No.: W.026.36
Date of Calibration: 03 November, 2015 Date of next Calibration: 03 February, 2016

Parameters:

Conductivity **Method Ref: APHA (21th edition), 2510B**

Expected Reading (uS/cm)	Displayed Reading (uS/cm)	Tolerance (%)
146.9	145.2	-1.2
6667	6690	+0.3
12890	12850	-0.3
58670	58700	+0.1
	Tolerance Limit (%)	±10.0

Dissolved Oxygen **Method Ref: APHA (21st edition), 4500O: G**

Expected Reading (mg/L)	Displayed Reading (mg/L)	Tolerance (mg/L)
3.50	3.51	+0.01
5.75	5.72	-0.03
7.70	7.67	-0.03
	Tolerance Limit (mg/L)	±0.20

Temperature **Method Ref: Section 6 of International Accreditation New Zealand Technical Guide No. 3 Second edition March 2008: Working Thermometer Calibration Procedure.**

Reading of Ref. thermometer (°C)	Displayed Reading (°C)	Tolerance (°C)
10.5	10.51	+0.0
22.0	22.05	+0.1
37.0	36.89	-0.1
	Tolerance Limit (°C)	±2.0

Remark: "Displayed Reading" presents the figures shown on item under calibration / checking regardless of equipment precision or significant figures.

Mr Fung Lim Chee, Richard
General Manager -
Greater China & Hong Kong

REPORT OF EQUIPMENT PERFORMANCE CHECK/CALIBRATION

Work Order: HK1541933
Sub-batch: 0
Date of Issue: 05/11/2015
Client: AECOM ASIA COMPANY LIMITED

Description: Multifunctional Meter
Brand Name: YSI
Model No.: Sonde 6820 V2
Serial No.: 12D100972
Equipment No.: W.026.36
Date of Calibration: 03 November, 2015 Date of next Calibration: 03 February, 2016

Parameters:

Salinity

Method Ref: APHA (21st edition), 2520B

Expected Reading (g/L)	Displayed Reading (g/L)	Tolerance (%)
0	0.0	--
10	10.04	+0.4
20	20.06	+0.3
30	30.04	+0.1
	Tolerance Limit (%)	±10.0

Turbidity

Method Ref: APHA (21st edition), 2130B

Expected Reading (NTU)	Displayed Reading (NTU)	Tolerance (%)
0	0.0	--
4	4.1	+2.5
10	10.2	+2.0
20	20.2	+1.0
50	50.5	+1.0
100	99.3	-0.7
	Tolerance Limit (%)	±10.0

pH Value

Method Ref: APHA (21st edition), 4500H:B

Expected Reading (pH Unit)	Displayed Reading (pH Unit)	Tolerance (pH unit)
4.0	4.01	+0.01
7.0	7.03	+0.03
10.0	9.98	-0.02
	Tolerance Limit (pH Unit)	±0.20

Remark: "Displayed Reading" presents the figures shown on item under calibration / checking regardless of equipment precision or significant figures.

Mr Fung Lim Chee, Richard
General Manager -
Greater China & Hong Kong

Appendix 2a: Plant Species Recorded in Pak Ngan Heung River and Luk Tei Tong River in December 2015

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	PNH1	PNH2	PNH3	PNH4	LTT1	LTT2	LTT3	LTT4	LTT5
Acanthus ilicifolius	shrub	native	common						+	+		
Alocasia odora	perennial herb	native	very common			+	+					
Bidens alba	herb	exotic	very common			++	++		+	+		+
Canavalia maritima	climber	native	common							+		
Coix lacryma-jobi	herb	native	common				+					
Colocasia esculenta	herb	native	-				+					
Commelina diffusa	herb	native	common			++	++					
Cyperus spp.	herb	-	-					+				
Ficus hispida	tree	native	very common	+		+	+					
Ficus variegata	shrub	native	common			+						
Hedychium coronarium	shrub	exotic	-			+	+					
Ipomoea cairica	climber	exotic	very common			+					+	+
Kandelia obovata	shrub or small tree	native	common		+			+	++	+		+
Lantana camara	shrub	exotic	very common							+		
Macaranga tanarius	tree	native	common			+						
Microstegium ciliatum	perennial procumbent herb	native	very common			++	++					
Mikania micrantha	climber	exotic	very common			+++	+++		+	+		+
Mimosa pudica	herb	exotic	very common						+		+	
Miscanthus floridulus	perennial herb	native	common							+		+
Miscanthus sinensis	perennial herb	native	very common			+	+	+		+	+	+
Neyraudia reynaudiana	herb	native	very common							+	+	
Panicum maximum	herb	exotic	very common			+	+			+		
Pueraria phaseoloides	climber	native	very common				+			+	+	
Rhus hypoleuca	shrub	native	common			+						
Saccharum arundinaceum	perennial herb	native	common			+				+	+	
Wedelia trilobata	perennial herb	exotic	common	+		+	++			+	+	+

Note:
Code for Abundance: +++=abundant; ++=occasional; +=scarce

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in December 2015

LTT Bypass Channel (LBC)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	LBC1	LBC2	LBC3	LBC4	LBC5	Average
Species recorded in the quadrats along the transects				**Average Percentage Cover**					
Apluda mutica	herb	native	very common	0.00	0.00	0.00	0.00	0.01	0.00
Fimbristylis sieboldii	herb	native	common	0.15	0.00	0.00	0.00	0.00	0.03
Paspalum conjugatum	perennial herb	exotic	common	0.00	0.02	0.00	0.00	0.00	0.00
Ruellia coerulea	herb	exotic	-	0.04	0.00	0.00	0.00	0.00	0.01
Wedelia trilobata	perennial herb	exotic	common	0.00	0.03	0.06	0.03	0.01	0.03
Acacia confusa	tree	exotic	-	+	+				
Acrostichum aureum	herb	native	restricted	+					
Aeschynomene americana L.	herb	exotic	-	+		+			
Alocasia odora	perennial herb	native	very common				+		
Apluda mutica	herb	native	very common		+	+		+	
Bidens alba	herb	exotic	very common		+	+	+	+	
Celtis sinensis	tree	native	common				+	+	
Colocasia esculenta	herb	native	-				+		
Commelina diffusa	herb	native	common	+					
Cynodon dactylon	perennial herb	native	very common			+	+		
Cyperus flabelliformis	herb	-	-	+					
Fimbristylis sieboldii	herb	native	common	+					
Ipomoea cairica	climber	exotic	very common	+	+	+	+	+	
Kandelia obovata	shrub or small tree	native	common	+					
Lantana camara	shrub	exotic	very common	+					
Microstegium ciliatum	perennial procumbent herb	native	very common		+	+	+	+	
Mimosa pudica	herb	exotic	very common		+	+			
Panicum maximum	herb	exotic	very common			+			
Panicum repens	perennial herb	native	very common		+	+		+	
Paspalum conjugatum	perennial herb	exotic	common	+	+	+		+	
Phragmites vallatorius	herb	native	very common	+	+				
Pueraria phaseoloides	climber	native	very common		+	+	+	+	
Pycreus polystachyus	herb	native	common	+					
Ruellia coerulea	herb	exotic	-	+					
Sapium sebiferum	tree	native	common		+		+		
Wedelia trilobata	perennial herb	exotic	common	+	+	+	+	+	

Note:
Code: +=occurrence of the species

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in December 2015

Reference Site (RS)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	RS1	RS2	RS3	RS4	RS5	Average
Species recorded in the quadrats along the transects				**Average Percentage Cover**					
Hedychium coronarium	shrub	exotic	-	0.00	0.00	0.13	0.00	0.00	0.03
Lantana camara	shrub	exotic	very common	0.00	0.00	0.02	0.00	0.00	0.00
Lophatherum gracile	herb	native	common	0.00	0.00	0.00	0.04	0.00	0.01
Microstegium ciliatum	perennial procumbent herb	native	very common	0.00	0.00	0.02	0.00	0.00	0.00
Mimosa pudica	herb	exotic	very common	0.02	0.00	0.00	0.00	0.08	0.02
Miscanthus floridulus	perennial herb	native	common	0.01	0.00	0.00	0.00	0.00	0.00
Paspalum conjugatum	perennial herb	exotic	common	0.08	0.00	0.10	0.10	0.00	0.06
Pueraria phaseoloides	climber	native	very common	0.03	0.02	0.00	0.00	0.00	0.01
Saccharum arundinaceum	herb	native	-	0.00	0.00	0.00	0.02	0.00	0.00
Sapium sebiferum	tree	native	common	0.00	0.02	0.00	0.00	0.00	0.00
Sida rhombifolia	herb	native	common	0.02	0.03	0.04	0.00	0.02	0.02
Urena lobata	shrub	native	common	0.04	0.13	0.10	0.02	0.00	0.06
Wedelia trilobata	perennial herb	exotic	common	0.62	0.57	0.47	0.65	0.49	0.56
Other species recorded during the walk-through survey				**Occurrence of the Species**					
Acacia confusa	tree	exotic	-	+	+				
Aeschynomene americana L.	herb	exotic	-	+	+	+	+	+	
Allamanda cathartica	climbing shrub	exotic	-		+				
Alocasia odora	perennial herb	native	very common	+	+	+			
Apluda mutica	herb	native	very common		+	+			
Bambusa ventricosa	bamboo	exotic	-					+	
Bauhinia blakeana	tree	native	common		+				
Bidens alba	herb	exotic	very common	+	+	+	+	+	
Breynia fruticosa	shrub	native	very common				+		
Bridelia tomentosa	tree	native	very common				+		
Canna indica	herb	exotic	-			+	+		
Celosia argentea	herb	native	very common		+	+	+	+	
Celtis sinensis	tree	native	common	+			+		
Colocasia esculenta	herb	native	-				+		
Conyza canadensis	herb	exotic	very common		+		+		
Crotalaria pallida	herb	exotic	common	+	+				
Cynodon dactylon	perennial herb	native	very common	+		+	+		
Dactyloctenium aegyptium	herb	native	common			+	+	+	
Desmodium heterocarpon	herb	native	very common			+		+	
Diospyros kaki	shrub	native	-		+				
Duranta erecta	shrub	exotic	common				+		
Eucalyptus robusta	tree	exotic	-	+					
Ficus hispida	tree	native	very common	+	+	+	+		

Note:
Code: + = the occurrence of the species

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in December 2015

Reference Site (RS)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	RS1	RS2	RS3	RS4	RS5
Other species recorded during the walk-through survey (Continue)				**Occurrence of the Species**				
Ficus variegata	shrub	native	common			+		
Hedychium coronarium	shrub	exotic	-			+	+	
Hymenocallis littoralis	herb	exotic	-			+		
Ipomoea cairica	climber	exotic	very common		+	+	+	
Ipomoea pes-caprae	perennial herb	native	common	+	+			+
Lantana camara	shrub	exotic	very common	+	+	+	+	+
Ligustrum sinense	tree	native	common				+	+
Livistona chinensis	tree	exotic	cultivated				+	
Lophatherum gracile	herb	native	common		+	+	+	
Mallotus paniculatus	tree	native	very common					+
Microstegium ciliatum	perennial procumbent herb	native	very common	+	+	+	+	+
Mikania micrantha	climber	exotic	very common					+
Mimosa diplotricha [(1)]	herb	exotic	rare					+
Mimosa pudica	herb	exotic	very common	+	+	+		+
Miscanthus floridulus	perennial herb	native	common	+		+		+
Miscanthus sinensis	perennial herb	native	very common		+	+		+
Panicum maximum	herb	exotic	very common	+	+	+	+	+
Panicum repens	perennial herb	native	very common			+		+
Paspalum conjugatum	perennial herb	exotic	common	+	+	+	+	+
Paspalum orbiculare	herb	native	-					+
Pueraria phaseoloides	climber	native	very common	+	+	+	+	+
Saccharum arundinaceum	herb	native	-		+	+		+
Sageretia thea	shrub	native	very common					+
Sapium sebiferum	tree	native	common	+	+	+		
Sida rhombifolia	herb	native	common	+	+	+	+	+
Urena lobata	shrub	native	common	+	+	+	+	+
Wedelia trilobata	perennial herb	exotic	common	+	+	+	+	+
Artemisia indica	herb	native	-					+

Note:
Code: +=occurrence of the species
(1) This species is listed as "rare" by Corlett *et al* . (2000); but it is an exotic species in Hong Kong.

Appendix 3: Ecological Water Quality Monitoring Raw Data (Decemer 2015)

Date of Monitoring: 9 December 2015 **Weather : Cloudy and Rainy**

Monitoring Location[(1)]	Suspended Solids (mg/L)	Nitrogen (Ammonia) (mg/L)	Nitrogen (Nitrate) (mg/L)	Reactive Phosphorous (mg/L)	5-day Biochemical Oxygen Demand (BOD^5) (mg/L)	Dissolved Oxygen (mg/L)	
						M1	M2
WE1	13.0	0.09	0.37	0.07	5.0	7.49	7.41
WE2	<2.0	0.12	0.43	0.03	<2.0	8.38	8.09
WE3	6.0	0.09	0.56	0.03	2.0	7.69	7.53
WE4	2.0	0.12	0.46	0.02	4.0	7.68	7.79
WE5	7.0	3.18	0.48	0.27	4.0	6.77	6.80
WE6	8.0	0.12	0.35	0.06	6.0	7.21	7.16
WE7	No water - Not sampled						
WE8	No water - Not sampled						
WE9	No water - Not sampled						
WE10	No water - Not sampled						

Monitoring Location[(1)]	Temperature (°C)		pH	Salinity (ppt)		Conductivity (µs/cm)		Water Flow (m/s)		Water Depth (cm)
	M1	M2		M1	M2	M1	M2	M1	M2	
WE1	17.3	17.3	7.2	0.06	0.08	118.6	122.5	0.115	0.118	16.0
WE2	18.5	18.4	6.3	0.08	0.06	783.0	781.0	0.088	0.091	15.0
WE3	17.9	17.9	6.5	0.12	0.14	752.0	746.0	0.092	0.096	12.0
WE4	17.8	17.8	6.4	0.82	0.85	921.0	925.0	0.157	0.162	22.0
WE5	18.7	18.7	6.7	1.11	1.12	2202.0	2186.0	0.012	0.016	15.0
WE6	17.4	17.4	6.9	0.04	0.03	102.2	98.8	0.015	0.016	32.0
WE7	No water - Not sampled									
WE8	No water - Not sampled									
WE9	No water - Not sampled									
WE10	No water - Not sampled									

Note:

* Where more than one measurement was taken, the data is represented by Measurement M1 and M2.

(1) As no water was present at WE7 to WE10 at the time of survey, no water quality monitoring was undertaken at these water quality monitoring stations.

PNH1 and PNH2

PNH3 and PNH4

LTT1

LTT2

LTT3 and LTT4

LTT5

LBC1

LBC2 and LBC3

AECOM	Post-Construction Ecological Monitoring of Drainage Improvement Works in Southern Lantau	SCALE	N.T.S.	DATE	Dec-15
	Representative Photographs Taken during the Ecological Monitoring	CHECK	McmillanSE	DRAWN	TSOIWYC
		JOB NO.	60278381	DRAWING NO.	Appendix 4

LBC4 and LBC5

RS1

RS2

RS3 and RS4

RS5

AECOM	Post-Construction Ecological Monitoring of Drainage Improvement Works in Southern Lantau	SCALE	N.T.S.	DATE	Dec-15
	Representative Photographs Taken during the Ecological Monitoring	CHECK	McmillanSE	DRAWN	TSOIWYC
		JOB NO.	60278381	DRAWING NO.	Appendix 4

Mile-a-minute partially blocks the water flow at the fish ladder

Vegetation clearance had been carried out along LBC

AECOM	Post-Construction Ecological Monitoring of Drainage Improvement Works in Southern Lantau	SCALE	N.T.S.	DATE	Jan-16
	Representative Photographs of Site Observations Taken during the Ecological Monitoring	CHECK	McmillanSE	DRAWN	TSOIWYC
		JOB NO.	60278381	DRAWING NO.	Appendix 5

Foraging Grey Heron (*Ardea cinerea*) at LTT1

Foraging Little Egret (*Egretta garzetta*) at LTT1

AECOM	Post-Construction Ecological Monitoring of Drainage Improvement Works in Southern Lantau	SCALE	N.T.S.	DATE	Jan-16
	Representative Photographs of Species of Conservation Importance Taken during the Ecological Monitoring	CHECK	McmillanSE	DRAWN	TSOIWYC
		JOB NO.	60278381	DRAWING NO.	Appendix 6