

Issue No. : Issue 1
Issue Date : December 2015
Project No. : 1266

**AGREEMENT NO. CE 65/2013 (EP)
POST-CONSTRUCTION ECOLOGICAL
MONITORING OF RIVER IMPROVEMENT
WORKS IN UPPER LAM TSUEN RIVER
SHE SHAN RIVER AND UPPER TAI PO
RIVER – INVESTIGATION**

**MONTHLY POST-CONSTRUCTION
ECOLOGICAL MONITORING REPORT
No. 18**

Prepared By:

ALLIED ENVIRONMENTAL CONSULTANTS LTD.

For:

Drainage Services Department

Allied Environmental Consultants Limited
Acousticians & Environmental Engineers

19/F., Kwan Chart Tower, 6 Tonnochy Road, Wan Chai, Hong Kong
Tel: (852) 2815 7028 Fax: (852) 2815 5399 Email: info@aechk.com



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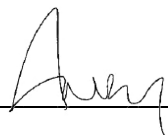
Drainage Services Department

Author:



Joanne Ng
BSc MSc
AHKIEIA

Checked:



Andy Lai
Bsc(Hons) AMHKIOA, MSEE, CEEQUAL,
BEAM Pro

Approved:



Grace Kwok
BEng(Hons) MHKIEIA MHKIOA
MISWA MIAIA MRAPA LEED AP
BEAM Pro CAP

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**Agreement No. CE65/2013(EP)
Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation**

**Post-Construction Ecological Monitoring Report (No. 18)
Upper Lam Tsuen River**

June 2015



Prepared by: Mike pang

July 16, 2015

Validated by: Mark Shea

July 17, 2015

Ecology Team: China-Hong Kong Ecology Consultants

Post-Construction Ecological Monitoring Report (No. 18)

Upper Lam Tsuen River

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Introduction

- 1.1 Agreement No. CE65/2013(EP) Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River – Investigation required a post-construction ecological monitoring programme when the project completed. The collected data are mainly used to assess ecological recovery process and effectiveness of ecological migration proposed and enforced during the construction period.
- 1.2 The scope of the ecological monitoring was detailed in EM & A Manual of the project. In brief, the survey aimed to collect data on abiotic factors such as water quality, substratum characteristics, water flow as well as flora and fauna.
- 1.3 China Hong Kong Ecology Consultants Ltd. was committed by Allied Environmental Consultants Ltd (AEC) to undertake the ecological monitoring tasks for the project for December 2014.
- 1.4 This is the number 18 post-construction ecological monitoring report for the project conducted **on 26th of June 2015**. It contains the following subsections:
 - Summary of major points
 - Monitoring Methods and Results
 - Summary and Comments

2 Summary of Major Points

- Field ecological monitoring was undertaken **on 26th of June 2015**.
- Fauna and flora along the drainage project sections is in a process of re-establishing or restoration; Plants on river bed was experiencing seasonal changes in abundance and phenological appearance ;
- The species richness of odonata was higher than last month due to seasonality;
- Bird diversity and abundance were in natural fluctuation ; and
- Abundance of a target river fauna (i.e., Hong Kong Newt *Paramesotriton hongkongensis* adult and juvenile were recorded in low abundance along the Lam Tsuen River
- Heavy rain events caused a significant decrease in fish abundance and vegetation coverage along the river.

3 Monitoring Methodology

3.1 Riparian Vegetation

Riparian vegetation, including aquatic and emergent, was sampled using line transects along the affected river channel and riparian habitat. Species, relative abundance and average heights were recorded. Vegetation surveys were conducted at four selected belt transects with two located at the lower portion (T3 and T4) of the river channel and another two at the upper section (T1 and T2) of the river respectively (**Figure 1**). The belt transects was run across the river channel in order to collect quantitative data of the vegetation, e.g., species inventory, height, percentage cover. Qualitative data of plants was collected by recording plant species, relative abundance along line transect.

Nomenclature and protection status of the species followed those documented in Lai *et al* (2004) and Hong Kong Herbarium (2015).

3.2 Avifauna

Avifauna survey was conducted during post construction monitoring period. Special attention was given to the river channel and corridor area which birds used as feeding and foraging habitat. Avifauna surveys were undertaken in the early morning plus species recorded in the rest of the day when conducting other taxonomic groups (benthic, fish, insect) monitoring. Numerical abundance was recorded at fixed count points within a radius of 30-50m according to landscape feature and visual penetration extent. The duration of the point count of birds was standardized for 10 minutes at each location in order to collect comparable data. Transect count along accessible section of river channel were used in order to collect qualitative data. Binoculars and digital camera were the main items of equipment used. Nomenclature and protection status of the species follows the AFCD website (www.hkbiodiversity.net) and Carey *et al* (2001).

The point count was conducted at four locations with two located at the lower portion (T3 and T4) of the river channel and the other two located at the upper section (T1 and T2) of the river. The point count and survey transect locations for the bird survey and sampling sites for surveys of other faunal groups and flora were presented in **Figure 1**.

3.3 Adult Odonata Survey

Adult Odonata survey was conducted along transects (**Figure 1**). Binoculars, digital camera and hand net were utilized to aid identification. Numerical abundance, species identity and other notable behaviour were recorded. Nomenclature and protection status of the species followed those documented in the AFCD website (www.hkbiodiversity.net), Wilson *et al* (2004) and Tam *et al* (2011). Adult Odonata survey was conducted along line transects in parallel with river channel within the works area where access was permitted.

3.4 Aquatic Macro-invertebrates

Macro-invertebrates in the river channel were surveyed. Sampling was conducted at five sampling locations including two sites located at the lower portion (T3 and T4) of the river channel and another two sites at the upper section (T1 and T2) of the river, as well as the reference site. Those sampling sites covered major type of river habitats, e.g. river pool and riffle (**Figure 1**). Five replicates were taken at each sampling point and pool together for further sample sorting and identification. Kick sampling and hand netting were the survey methodologies for river organisms. Dissection microscope and digital camera were used to aid identification and enumeration. Numerical abundance and species identity were recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net) and other literatures such as Dudgeon (1994).

3.5 Fish and Newt

Fish community and *Paramesotriton hongkongensis* at the specified river channel was monitored by live trapping, hand netting and direct observation methods.

Sampling was conducted at five sampling locations including two sites located at the lower portion (T3 and T4) of the river channel and another two sites at the upper section (T1 and T2) of the river, as well as reference site. Those sampling sites covered major type of river habitats, e.g. river pool and riffle (**Figure 1**). The number of the observed fish and newt was estimated and recorded. Nomenclature and protection status of the species followed those documented in the AFCD website (www.hkbiodiversity.net) and Lee *et al* (2004).

3.6 Abiotic Data Collection

3.6.1 Water Quality Monitoring

Dissolved oxygen level, pH value, conductivity, salinity, BOD and nutrient level (nitrate and ammonium) were measured and analyzed by conventional methods in situ or in laboratory. The instruments for measuring dissolved oxygen level, pH value, conductivity, salinity were model: DO-5510, AZ8685, AZ8361 and AZ8374 respectively. All the instruments were calibrated every monitoring month according to the operation manuals in order to obtain the precise result. BOD test took 5 days to complete within darkness incubator with stable temperature at 20°C and was performed using model: DO-5510 for measuring dissolved oxygen. Nutrient levels including nitrate and ammonia were performed in laboratory by applying the In-house method SOP056 (FIA) and SOP057 (FIA) respectively.

3.6.2 Sediment Characteristics

Sediment/substrate characteristics were recorded of sediment cover in percentage e.g. mud, sand, rock, boulder and cemented bottom in the river bed at sampling sites.

3.6.3 Water Flow

Water flow rates in river channel were measured by recording the time taken for a floating object (e.g. floating ball) to cover a measured distance.

The sampling locations for surveys were presented in **Figure 1**.

4 Monitoring Results

4.1 Vegetation

Vegetation has generally covered the gabion and partially covered the riverbed along Lam Tsuen River. Lower density of vegetation was observed during current wet season since heavy rain events occurred which could wash away plants (Photos 1-3). In total, 63 flora species were recorded within the survey transects along the river course. Among those recorded flora, exotic species *Brachiaria mutica* was the dominated species recorded along the river (Photo

4). The recorded floras were generally in good health, and the height of the dominated riparian grass and herb species were in a range from 0.3m to 2m as observed along survey transect. Dominant flora species were shown in the **Table 4.1** marked with relative abundance sign “+++”. Results of vegetation survey and belt transect survey were presented in **Table 4.1** and **Table 4.2**. **Figure 1** shows the transect line for the flora surveys.

4.2 Fauna

4.2.1 Avifauna

An avifauna survey was undertaken along survey transects and at four selected point count locations. In total, 25 species of birds were recorded during the bird survey and 7 of the total were wetland dependent species including *Egretta garzetta*, *Ardea alba*, *Motacilla alba*, *Alcedo atthis*, *Amaurornis phoenicurus*, *Ardeola bacchus* and *Motacilla cinerea*, they were commonly observed foraging in the river channel. The dominant species was *Pycnonotus jocosus*, it is a very common species in Hong Kong. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Some of the recorded wetland dependent birds are classified as Regional Concern by Fellowes *et al* (2002), they were *Egretta garzetta*, *Ardea alba* and *Ardeola bacchus*, which usually observed foraging in the river. *Centropus sinensis* was frequently observed in the surveyed river (Photo 5), which is listed in China Red Data Book Status as Vulnerable. Transect and Point Count locations were shown on **Figure 1**. Result of bird survey was presented in the **Table 4.3**.

4.2.2 Adult Odonata Survey

Odonata survey was performed, and a list of recorded odonata species at Upper Lam Tsuen River is shown in **Table 4.4**. In total, 13 odonata species were recorded during the survey and all of recorded species were common species (Photos 6-7). The result obtained this month is similar to previous surveys conducted in approximate period of last year. Species richness slightly increased by 1 species in this month compared with last month. Most of the odonata species in Hong Kong prefer emerging in spring due to the increased mean ambient temperature, their emerging period will last for few months until late autumn (Wilson *et al*, 2004 & Tam *et al*, 2011). Sampling location was shown in **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

Upper Lam Tsuen River was flowing with constant water during survey (Photo 8). The river benthic fauna collected was mainly comprised of insects, molluscs and crustaceans. Details of recorded of river benthic fauna refers to **Table 4.5**. Sampling location was shown on **Figure 1**

4.2.4 Hong Kong Newt

Surveys of Hong Kong Newt were conducted at Upper Lam Tsuen River. Adult *Paramesotriton hongkongensis* was observed at the Lam Tsuen River where the habitat consisted of riparian vegetation during the survey (Photo 9). During the current wet season, lower abundance of Hong Kong Newt was

observed, but they still can be found near the potential habitats like riparian vegetation. Riparian vegetation grown along the channel especially along water margin could provide shelter and breeding habitat for Hong Kong Newt. The lower abundance of newt in current season was recorded because newt normally breeds from September to March and much of the rest of the year is spent on land (Dudgeon, 2003). Hong Kong Newt is listed in Wild Animals Protection Ordinance (Cap. 170) and classified as “Near Threatened” under IUCN Red List Status and as “Potential Global Concern” by Fellowes *et al* (2002). Record of Hong Kong Newts can be referred to **Table 4.6**.

4.2.5 River Fish Fauna

Fish surveys were performed at Upper Lam Tsuen River during field monitoring (Photos 8-10). In total, 18 species of freshwater fish, including species recorded from reference site, were recorded. *Acrossocheilus parallens* and *Rhinogobius* spp were the dominated species in the river. *Acrossocheilus parallens* is a rare freshwater fish that only recorded in few of reservoir catchments and streams in Hong Kong (Lee *et al*, 2004) and listed as Global Concern by Fellowes (2002). It was observed a dominant species along the surveyed river with pool. Except *Acrossocheilus parallens*, *Parazacco spilurus* is classified as Vulnerable in China Red Data Book and observed along the river with low abundance. Fish counting at 2 x 2 meter area were performed and abundance of fish individuals was low as strong flooding occurred frequently in June that could disperse fish out of the river. Details of recorded of fish fauna refers to **Table 4.6**. Sampling location was shown on **Figure 1**.

4.3 **Abiotic Data**

Data on water quality and major river hydrological feature (water flow and substratum) of the river were collected and are presented in the **Table 4.7**.

Generally, the water was clean and nutrient levels were generally low. Results of water test were presented in the **Table 4.7**.

The river substratum was comprised of over 75-93% stones or rocks in most of the river sections with moderate water flow (up to 0.2m/second at pool and 0.5m/second at riffle).

5 **Summary and Commentary**

Post construction ecological monitoring was carried out in June 2015 and relevant biotic and abiotic data was collected according to project specification and EM & A Manual. Benthic fauna was temporally de-faunated in river sections due to river bed engineering works during construction period between 2008 and early 2013 and is under recovery process after that period. . Mature and juvenile individuals of amphibian *Paramesotriton hongkongensis* were recorded low in abundance at river channel where the river margin covered with riparian vegetation. *Acrossocheilus parallens*, a rare freshwater fish species in Hong Kong, was observed a dominant species at a few locations in the river channel with pool. Except *Acrossocheilus parallens*, *Parazacco spilurus* recorded in the river is also considered with conservation interest and observed along the river with low abundance. Increased species

richness of odonate and low abundance of fishes were observed in this month due to seasonality.

Aquatic and riparian vegetation along river channel was re-established. Vegetation has generally covered the gabion and partially covered the river bed along Upper Lam Tsuen River. As frequent flooding occurred in June which could wash out the vegetation on the river bed, vegetation coverage on the river bed decreased sharply along the river.

The water quality of the surveyed river was not polluted although the river receives low concentration of nutrients from the nearby agriculture lands and resident houses.

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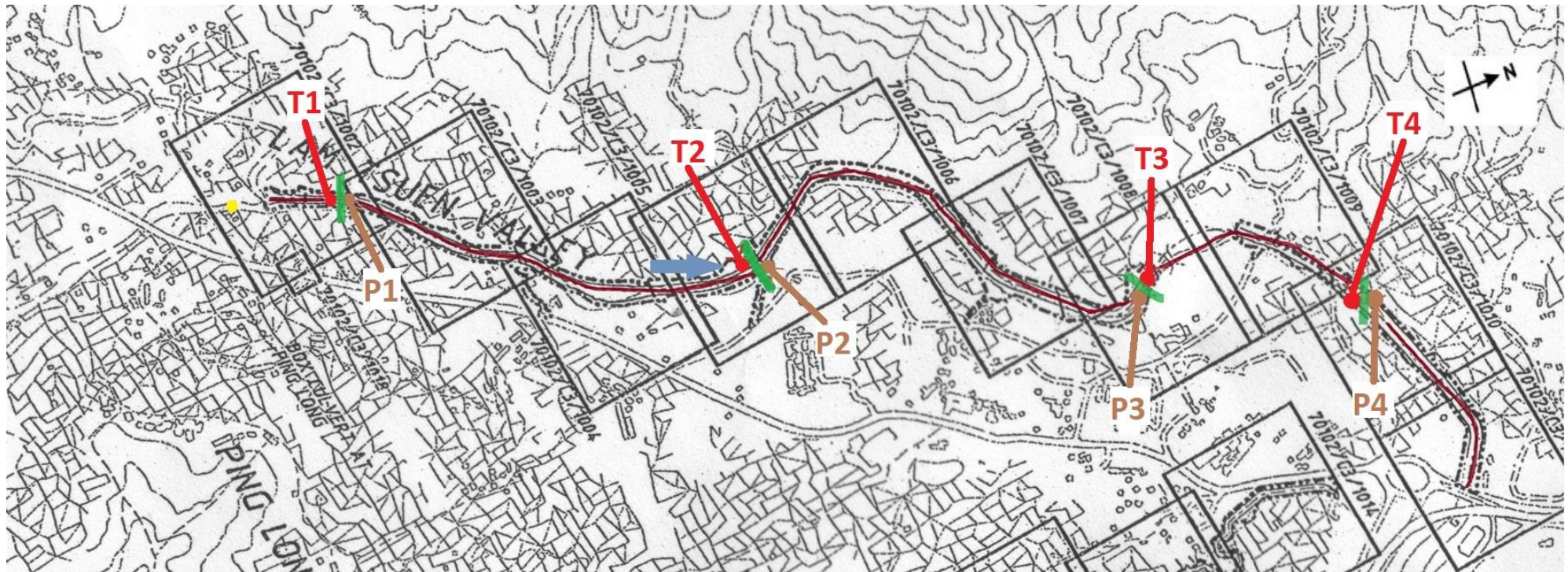
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FIGURES



Legend

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> — Belt transect -Vegetation -Sediment characteristics | <ul style="list-style-type: none"> ● Sampling station -Fish -Aquatic macroinvertebrate -Water quality and flow rate | <ul style="list-style-type: none"> ● Point count location -Avifauna |
| <ul style="list-style-type: none"> ● Reference sample | | <ul style="list-style-type: none"> — Line transect -Avifauna -Adult Odonate -Vegetation |

Figure1. Sampling Location of Ecological Survey and Monitoring at Upper Lam Tsuen River, Tai Po.

PHOTOS

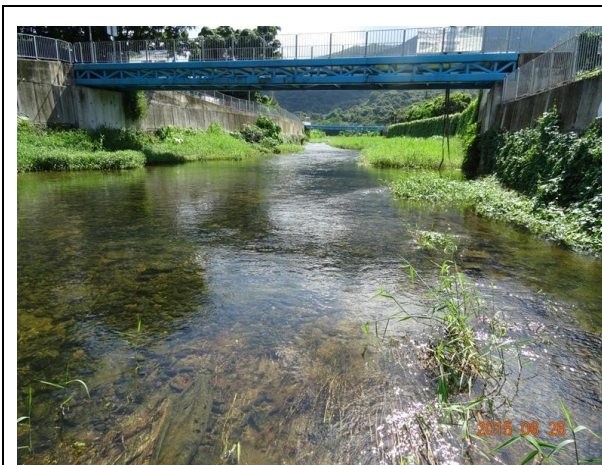


Photo 1: General view of the river (Lower section)



Photo 2: General view of the river (Middle section)



Photo 3: General view of the river (Upper section)



Photo 4: *Brachiaria mutica* dominated at river bed (Middle section)



Photo 5: Avifauna - *Centropus sinensis*



Photo 6: Odonata - *Ceriagrion auranticum ryukyuanum*



Photo 7: Dragonfly - *Rhinocypha perforata perforata*



Photo 8: Kicking sampling



Photo 9 : Adult and juvenile of Hong Kong Newt



Photo 10: Aquatic samples shown fish and invertebrates collected in Lam Tsuen River.

TABLE

Table 4.2. Flora species recorded from belt transect survey at the Upper Lam Tsuen River (T1- Upper stream sampling site T4 - Lower stream sampling site)

Family	Species	Stream Transsect Chinese name	Impact monitoring Jul-10				Impact monitoring Jul-10				Impact monitoring Jan-11				Impact monitoring Jul-11				Impact monitoring Jan-12				Impact monitoring Jul-12																			
			T1		T2		T3		T4		T1		T2		T3		T4		T1		T2		T3		T4		T1		T2		T3		T4									
			Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%										
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹											0.8	5																												
Fabaceae	<i>Pueraria lobata</i>	野葛		0.5	5																																					
Poaceae	<i>Pennisetum purpureum</i>	象草											1.2	10																												
Araceae	<i>Alocasia odora</i>	海芋				1	10																																			
Caesalpiniaceae	<i>Cassia alata</i>	翅英決明																																								
Magnoliaceae	<i>Michelia alba</i>	白蘭																																								
Poaceae	<i>Brachiaria mutica</i>	巴拉草	0.8	20	0.9	30	1	60	1.5	30	0.8	5																														
Moraceae	<i>Ficus hispida</i>	對葉榕				4	5																																			
Asteraceae	<i>Mikania micrantha</i>	微甘菊			0.5	20	0.3	5			0.4	10	0.5	5	0.3	5	0.4	8	0.4	5	0.5	3			0.4	2	0.4	5	0.5	3												
Musaceae	<i>Musa paradisiaca</i>	大蕉																																								
Ulmaceae	<i>Celtis sinensis</i>	朴樹																																								
Araceae	<i>Pistia stratiotes L.</i>	大漂																																								
Urticaceae	<i>Boehmeria nivea</i>	苧麻																																								
Asteraceae	<i>Bidens alba</i>	白花鬼針草	0.4	20																																						
Poaceae	<i>Cox lacryma-jobi</i>	薏苡																																								
Solanaceae	<i>Solanum nigrum</i>	龍葵																																								
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草																																								
Poaceae	<i>Miscanthus floridulus</i>	五節草																																								
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐																																								
Asteraceae	<i>Wedelia chinensis</i>	娜銀菊																																								
Commelinaceae	<i>Commelina diffusa</i>	節節草				0.5	20																																			
Asteraceae	<i>Erechites hieracifolia</i>	革命菜																																								
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨																																								
Convolvulaceae	<i>Pharbitis nil</i>	牽牛																																								
Verbenaceae	<i>Lantana camara</i>	馬纓丹																																								
Mimosaceae	<i>Leucaena leucocephala</i>	銀合歡																																								
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜																																								
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香																																								
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草																																								
Amaranthaceae	<i>Celosia argentea</i>	青葙																																								
Bare Ground				60		45		20		30		75		65		45		54		73		85		65		88		73		82		28		88		75		82		58		92

P1 - Point count location 1; P4 - Point count location 4

Table 4.2. Flora species recorded from belt transect survey at the Upper Lam Tsuen River (T1- Upper stream sampling site T4 - Lower stream sampling site)

Family	Species	Stream Transsect Chinese name	Post construction monitoring								Post construction monitoring								Post construction monitoring								Post construction monitoring								Post construction monitoring															
			Mar-14				Apr-14				May-14				Jun-14				Jul-14				Aug-14																											
			T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4																				
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹					0.3	2					0.3	2					0.3	2					0.5	4					0.7	5																		
Fabaceae	<i>Pueraria lobata</i>	野葛				0.3	10								0.3	5	0.3	5									0.3	5	0.3	5			0.3	5	0.3	5														
Poaceae	<i>Pennisetum purpureum</i>	象草				1.5	5																																											
Araceae	<i>Alocasia odora</i>	海芋																																																
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Magnoliaceae	<i>Michelia alba</i>	白蘭																																																
Poaceae	<i>Brachiaria mutica</i>	巴拉草	1	13		1	13						0.5	5	0.6	10			0.6	10	0.5	5	0.6	6			0.6	6	0.6	10	0.8	10			0.8	6	0.6	10	0.8	12			0.8	8						
Moraceae	<i>Ficus hispida</i>	對葉榕																																																
Asteraceae	<i>Mikania micrantha</i>	微甘菊	0.5	10	0.5	5	0.5	10	0.4	10				0.3	5	0.3	15	0.3	5		0.3	5	0.3	15	0.3	5		0.3	6	0.3	15	0.3	8		0.3	6	0.3	15	0.3	8										
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Araceae	<i>Pistia stratiotes L.</i>	大漂																																																
Urticaceae	<i>Boehmeria nivea</i>	芋麻																																																
Asteraceae	<i>Bidens alba</i>	白花鬼針草	0.4	5			0.5	10					0.5	20	0.5	10	0.7	15	0.6	10	0.5	20	0.5	10	0.7	15	0.6	10	0.5	20	0.5	12	0.7	18	0.6	10	0.5	20	0.6	12	0.7	15	0.6	10						
Poaceae	<i>Coix lacryma-jobi</i>	薏苡																																																
Solanaceae	<i>Solanum nigrum</i>	龍葵																																																
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草																																																
Poaceae	<i>Miscanthus floridulus</i>	五節草																																																
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐																																																
Asteraceae	<i>Wedelia chinensis</i>	錦娘菊																																																
Commelinaceae	<i>Commelina diffusa</i>	節節草				0.3	5						0.2	10			0.3	3			0.2	8					0.3	3			0.2	8			0.3	3			0.3	10			0.3	5						
Asteraceae	<i>Erechtites hieracifolia</i>	革命菜																																																
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨																																																
Convolvulaceae	<i>Pharbitis nil</i>	牽牛																																																
Verbenaceae	<i>Lantana camara</i>	馬纓丹																																																
Mimosaceae	<i>Leucaena leucocephala</i>	銀合歡																																																
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜								0.2	5	0.2	50	0.2	5			0.2	2	0.2	2	0.2	1			0.2	2	0.2	2	0.2	1			0.3	1	0.3	1	0.3	1	0.3	1									
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香																																																
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草																																																
Amaranthaceae	<i>Celosia argentea</i>	青葙				1	2																																											
Bare Gound				72		82		73		75		63		70		12		65		65		77		60		73		65		74		60		70		58		71		58		70		55		69		59		68

P1 - Point count location 1; P4 - Point count location 4

Table 4.3 Avifauna recorded along survey transects and at four selected point count locations of Lam Tsuen River.

(T1 - located at upper river channel sampling site to T4 - located at lower river Channel sampling site)

Common Name	Species name	Chinese name	Status	Commonness	Post construction monitoring																																																				
					Sep-14					Oct-14					Nov-14					Dec-14					Jan-15					Feb-14					Mar-14					Apr-14					May-14					Jun-14							
					Abundance					Abundance					Abundance					Abundance					Abundance					Abundance					Abundance					Abundance																	
C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4													
Barn Swallow	<i>Hirundo rustica</i>	家燕	PM	C																																																					
Black Drongo	<i>Dicrurus macrocerus</i>	黑卷尾	SV	C																																																					
Black Kite	<i>Milvus lineatus</i>	黑鷹	R, RC, Cap.586	C																																																					
Black-faced bunting	<i>Emberiza spodocephala</i>	灰頭鶇	WV&PM	C																																																					
Black-necked Staring	<i>Sturnus nigricollis</i>	黑頸鵲	R	C	++		2	2	1	++	2		3		++		2	2		++	2		3	2	++	2		2		++		3	2		++	2		2		++		3	2														
Black-winged Cuckoo-shrike	<i>Coracina melaschistos</i>	暗灰胸鵲	PM	C																																																					
Buzzard (Common Buzzard)	<i>Buteo buteo</i>	普通鵟	WV, Cap.586	C																																																					
Chinese Bulbul	<i>Pycnonotus sinensis</i>	白頭鵲	R	C	+	2	2	1		+	3		2	1	+	2		1		+	2		1		++	2		3	1	+	1		1		++	2		2		++	2		2														
Chinese Pond Heron	<i>Ardeola bacchus</i>	池鷺	R, RC	C	++	3	2	3	1	++	4	1	1	2	++	3		2	1	+	2	1	3		+	2	2		1	+	2	1	2		+	2	1	2	1	+	1		1														
Common Kingfisher	<i>Alcedo atthis</i>	普通翠鳥	R	C	+					+					+	1		1		+	1		1		+	1		1		+	1		1		+	1		1		+	1		1														
Common Koel	<i>Eudynamis scolopacea</i>	雉鴉	R	C	+					+					+					+	1				+	1				+	1				+	1				+	1																
Common Sandpiper	<i>Actitis hypoleucos</i>	磯鶇	WV&PM	C	+					+					+					+					+					+					+					+																	
Common Tailorbird	<i>Orthotomus sutorius</i>	長尾鹪鶯	R	C	++	1	1	2	2	++	1	1	1	1	+	1		1		++	1		1		++	1		1		++	1		1		++	1		1		++	1		1														
Crested bulbul	<i>Pycnonotus jocosus</i>	紅耳鵲	R	C	+++	2	2	3	2	+++	3	3	4	2	+++	2	2	3	+++	+++	4	3	2	+++	+++	3	2	3	+++	+++	2	2	4	+++	+++	2	4	+++	+++	+++	4	3	5	2	+++	5	2	5	2	+++	5	3	5	4			
Crested Goshawk	<i>Accipiter trivirgatus</i>	鳳頭鷹	R, CR, Cap.586	R																																																					
Crested Myna	<i>Acridotheres cristatellus</i>	八哥	R	C	++	4	3	2		++	1		2	3	++	3		4		++	2	3	5		++	3	4	2		++	4	3			++	2	3	2	+++	+++	3	4	2	3	+++	3	4	2	3	+++	3	4	2	3			
Crested Serpent Eagle	<i>Spilornis cheela</i>	蛇鵟	R, VU, LC	R																																																					
Daurian redstart	<i>Phoenicurus auroreus</i>	北紅尾鶇	WV	U						+		1	1		+	1	1			++	1	1	1		+	1				+					+					+																	
Domestic pigeon	<i>Columba sp.</i>	鴿	R	C	+					+					+					+					+					+					+					+																	
Dusky Warbler	<i>Phylloscopus fuscatus</i>	褐柳鶯	WV	U			1					1	1		+		1	1		+	1	1			+	1				+					+					+																	
Eurasian tree sparrow	<i>Passer montanus</i>	麻雀	R	C	+		1			+		3	1		+	2	2			++	3	1	2		+++	3	2	1	++	++	2	1	++	2	++	2	1	++	2	++	2	1	3	++	2	2	1	3	++	3	2	2	2				
Great Coucal	<i>Centropus sinensis</i>	褐翅鵲鴉	R, VU	C	+		1	1		+	1	1			+	1	1			+	1	1			+	1	1			+	1	1			+	1	1			+	1	1															
Great Tit	<i>Parus major commictus</i>	大山雀	R	C																																																					
Green Sandpiper	<i>Tringa ochropus</i>	白腰草鵲	PM&WV	U																																																					
Grey Heron	<i>Ardea cinerea</i>	蒼鷺	WV, PRC	C																																																					
Grey Wagtail	<i>Motacilla cinerea</i>	灰鶇	WV	C	+	2	1	3	1	+	1	2	2	1	+	1	1	1	2	+	1		2	1	+	1	1	1	1	++	1	2	2	2	++	1		1	2	+		1	1	2	++	1	1	2	++	1	1	2	++	1	1	1	1
Japanese White Eye	<i>Zosterops japonica simple</i>	暗綠繡眼鳥	R	C	++	2				++	3		3		++	2		3		++	3	4	5		++	3		3		++	3		4		++	3		4		++	3		3		++	3	3	2	3								
Jungle Crow	<i>Corvus macrorhynchos</i>	大嘴烏鶇	R	C	+					+					+					+					+					+					+					+																	
Large Hawk Cuckoo	<i>Cuculus sparveroides</i>	鷹鵲	SV	U																																																					
Lesser Coucal	<i>Centropus bengalensis</i>	小鶇鵲	R, VU	C																																																					
Little Egret	<i>Egretta garzetta</i>	小白鷺	R, RC	C	++	1	2	4	2	++	2	1	3	1	++	3	2	4	2	++	2	1	3	1	++	1	2	3	2	+	1	1	3	2	+	1	2	3	2	+		2	1		+		2	1		+		1	1				
Great Egret	<i>Ardea alba</i>	大白鷺	R, WV, RC	C																																																					
Little Swift	<i>Apus affinis</i>	小白腰雨燕	R, SpM	C																																																					
Maggie	<i>Pica pica</i>	喜鵲	R	C	+					+		1			+					+					+					+					+					+																	
Maggie Robin	<i>Copsychus saularis</i>	鶇鵲	R	C	++	2	1	2	1	++	1	2	2		++	1	1	2	1	++	1	1	2	2	++	1	1	2	2	++	1	1	2	1	++	1	1	2		++	1	1	2		++	1	1	1	2	++	2						
Mandarin Duck	<i>Aix galericulata</i>	鸕鶇	WV	U																																																					
Masked Laughing Thrush	<i>Garrulus perspicillatus</i>	黑臉鳴鶇	R	C	+		2	4	2	+		2	2		+	3		3		++					++					+					+					+																	
Northern Shoveler	<i>Anas clypeata</i>	綠頭鴨	WV	C																																																					
Olive Backed Pipit	<i>Anthus hodgsoni</i>	樹鶇	WV	C																																																					
Plainive Cuckoo	<i>Cacomantis merulinus</i>	八聲杜鵑	SV	C																																																					
Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>	紅咀藍鶇	R	C																																																					
Red-flanked Bhetal	<i>Turdus cyanurus</i>	紅脇藍尾鶇	PM&WV	C																																																					
Rufous Turtle Dove	<i>Streptopelia orientalis</i>	山斑鳩	R	C																																																					
Rufous-backed Shrike	<i>Lanius schach</i>	棕背伯勞	R	C	+		1	1		+		1	1		+	1		1		+	1		1		+	1		1		+					+					+																	
Rufous-capped Babbler	<i>Stachyridopsis ruficeps</i>	紅頭鵲鶇	R	C																																																					
Scarlet Minivet	<i>Pericrocotus flammeus</i>	赤紅山椒鳥	R	C																																																					

Agreement No. CE65/2013(EP)
Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation
Post-Construction Ecological Monitoring Report (No.18)
She Shan River

June 2015



Prepared by: Mike Pang

July 20, 2015

Validated by: Mark Shea

July 21, 2015

Ecology Team: China Hong Kong Ecology Consultants

Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River – Investigation

Agreement No. CE65/2013(EP) Post-Construction Ecological Monitoring Report (No.18) She Shan River

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FIGURES

Figure 1: Sampling location of ecological survey and monitoring at She Shan River, Tai Po.

PHOTOS

Photo 1: General view of the river habitat (Lower section).

Photo 2: General view of the river habitat (Middle section).

Photo 3: Dead vegetation accumulated at lower section of the river.

Photo 4: Abundant species: *Brachiaria mutica*.

Photo 5: Avifauna - *Motacilla alba*

Photo 6 : Odonata - *Orthetrum pruinosum neglectum*

Photo 7: Odonata - *Nannophya pygmaea*

Photo 8: Odonata : *Crocothemis servilia servilia*

Photo 9: Odonata - *Copera marginipes*

Photo10: Odonata - *Ceriagrion auranticum ryukyuanum*

Photo 11: Kick sampling

Photo 12: Aquatic samples collected from kick sampling

TABLE

Table 4.1: Flora species recorded along the She Shan River including riparian habitat.

Table 4.2: Flora species recorded from belt transect survey at the She Shan River.

Table 4.3: Avifauna recorded along survey transects and at three selected point count locations at She Shan River.

Table 4.4: Odonata species recorded at the She Shan River

Table 4.5: Aquatic Macro invertebrates recorded at She Shan River.

Table 4.6: Fish species and Hong Kong Newt recorded at She Shan River.

Table 4.7: Abiotic data for She Shan River.

1 Introduction

- 1.1 Agreement No. CE65/2013(EP) Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River – Investigation required a post-construction ecological monitoring programme when the project completed. The collected data are mainly used to assess ecological recovery process and effectiveness of ecological migration proposed and enforced during the construction period.
- 1.2 The scope of the ecological monitoring was detailed in EM & A Manual of the project. In brief, the survey aimed to collect data on abiotic factors such as water quality, substratum characteristics, water flow as well as flora and fauna.
- 1.3 China Hong Kong Ecology Consultants Ltd. was committed by Allied Environmental Consultants Ltd (AEC) to undertake the ecological monitoring tasks for the project from December 2014.
- 1.4 This is the number 18 post-construction ecological monitoring report for the project conducted **on 25th of June 2015**. It contains the following subsections:
 - Summary of major points
 - Monitoring Methods and Results
 - Summary and Comments

2 Summary of Major Points

- Field ecological monitoring was undertaken **on 25th of June 2015**;
- Fauna and flora along the drainage project sections is in a process of re-establishing or restoration;
- Heavy rain occurred in June, flooding led to significant change in vegetation coverage and fish abundance.
- Bird diversity and abundance was in natural fluctuation; and
- Odonata abundance was increasing compared to last month.
Paramesotriton hongkongensis abundance was low in the surveyed area.

3 Monitoring Methodology

3.1 Riparian Vegetation

Riparian vegetation, including aquatic and emergent, was sampled using line transects along the affected river channel and riparian habitat. Species, relative abundance and average heights were recorded. Vegetation survey was conducted at three selected belt transects located at the upper (T1), middle (T2) and lower portion (T3) of the river channel (**Figure 1**). The belt transects was run across the river channel in order to collect quantitative data of vegetation, e.g., species inventory, height, percentage cover. Qualitative data of plants was collected by recording plant species along line transect, e.g., species inventory, relative abundance. Nomenclature and protection status of the species has followed those documented in the Lai *et al* (2004) and Hong Kong Herbarium (2015).

3.2 Avifauna

Avifauna survey was conducted during the post construction monitoring period. Special attention was given to those stream channel area which birds used as feeding and foraging habitat. Avifauna surveys were undertaken in the early morning plus species recorded in the rest of the day when conducting other taxonomic groups (benthic, fish, insect) monitoring. Numerical abundance was recorded at fixed count points within a radius of 30 to 50m according to landscape feature and visual penetration extent. The duration of the point count of birds was standardized for 10 minutes at each location in order to collect comparable data. Transect count along accessible section of river channel were used in order to collect qualitative data. Binoculars and digital camera were the main items of equipment used. Nomenclature and protection status of the species has followed in the AFCD website (www.hkbiodiversity.net) and Carey *et al* (2001).

The point count was conducted at four locations located at the lower (T3), middle (T2) and upper portion (T1) of the river channel, as well as the reference site. The point count and survey transect locations for the bird survey and sampling sites for surveys of other faunal groups and flora were presented in **Figure 1**.

3.3 Adult Odonata Survey

Adult Odonata survey was conducted along transects (**Figure 1**). Binoculars, digital camera and hand net were utilized to aid identification. Numerical abundance, species identity and other notable behaviour were recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net), Wilson *et al* (2004) and Tam *et al* (2011). Adult Odonata survey was conducted along line transects in parallel with river channel within the works area where access was permitted.

3.4 Aquatic Macro-invertebrates

Macro-invertebrates in the riverbed were surveyed. Four sampling sites were selected to collect necessary macro-invertebrate fauna for ecological monitoring information, which covered upper (T1), middle (T2) and lower (T3) sections of the river respectively, as well as reference site (**Figure 1**). Five replicates were taken at each sampling point and pool together for further sample process. Kick sampling and hand netting were the survey methodologies for stream organisms. Dissection microscope and digital camera were used to aid identification and enumeration. Numerical abundance, species identity was recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net), and other literatures such as Dudgeon (1994).

3.5 Fish Population and Hong Kong Newt

Fish community at the specified river channel was monitored by live trapping, hand netting and direct observation methods. And the Hong Kong newt was surveyed by direct observation and hand netting as well.

Sampling was conducted at four proposed sampling locations at upper (T1), middle (T2), lower (T3) sections and reference site respectively. Those sampling sites covered major type of stream habitats, e.g. river pool and riffle (**Figure 1**). The number of the observed fish was estimated and recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net) and Lee *et al* (2004).

3.6 Abiotic Data Collection

3.6.1 Water Quality Monitoring

Dissolved oxygen level, pH value, conductivity, salinity, BOD and nutrient level (nitrate and ammonium) were sampled and analyzed by conventional methods in situ or in laboratory. The instruments for measuring dissolved oxygen level, pH value, conductivity, salinity were model: DO-5510, AZ8685, AZ8361 and AZ8374 respectively. All the instruments were calculated every monitoring month according to the operation manuals in order to obtain the precise result. BOD test took 5 days to complete within darkness incubator with stable temperature at 20°C and was performed using model: DO-5510 for measuring dissolved oxygen. Nutrient levels including nitrate and ammonia were performed in laboratory by applying the In-house method SOP056 (FIA) and SOP057 (FIA) respectively.

3.6.2 Sediment Characteristics

Sediment/substrate characteristics were recorded of sediment cover in percentage e.g. mud, sand, rock, boulder and cemented bottom in the stream bed at sampling sites.

3.6.3 Water Flow

Water flow rates in river channel were measured by recording the time taken for a floating object (e.g. floating ball) in a measured distance. The sampling locations for surveys were presented in **Figure 1**.

4 Monitoring Results

4.1 Vegetation

In total, 56 flora species was recorded within the survey transects along the river course. The recorded floras were generally common wetland species. The height of the dominated riparian grass and herb species were in a range from 0.3m to 1.6m as observed along survey transect. Dominant flora species were shown in the **Table 4.1** marked with relative abundance sign “+++”. Vegetation has generally covered the riverbed and riparian habitat in upper sections and partially covered of the riverbed in middle to lower section. The vegetation coverage along the river changed significantly during current wet season (Photos 1-3). Heavy rain was frequently recorded in June that led to occur flooding. As river bed in She Shan river was mainly concrete, most of the plants were easily washed out to lower river section. Aquatic plants *Brachiaria mutica* was the most abundant plants found along the river channel (Photo 4). Results of vegetation survey and belt transect survey were presented

in **Table 4.1** and **Table 4.2**. **Figure 1** shows the transect line for the flora surveys.

4.2 Fauna

4.2.1 Avifauna

An avifauna survey was undertaken along survey transects and at three selected point count locations. In total, 25 species of birds were recorded during the bird surveys within project area. 6 recorded species were wetland dependant birds and observed foraging in the river channel including *Ardeola bacchus*, *Egretta garzetta*, *Alcedo atthis*, *Motacilla alba*, *Motacilla cinerea* and *Amaurornis phoenicurus*. The dominant species of the river was a common species *Pycnonotus jocosus*. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Some of wetland dependent species including *Ardeola bacchus* and *Egretta garzetta*, are considered as Regional Concern by Fellowes et al (2002), they were always found foraging in the river. Due to seasonality, some of summer visitors were recorded such as *Cuculus sparverioides*. Transect and Point Count locations were shown on **Figure 1**. Result of bird survey was presented in the **Table 4.3**.

4.2.2 Adult Odonata Survey

Odonata survey was performed and a list of recorded odonata species at She Shan River is shown in **Table 4.4**. A little increase in species richness was observed in this month comparing to last month due to current wet season, in which provided the most favorable condition such as increased temperature for most species of odonata in Hong Kong to emerge, their emerging period will last for few months until late autumn (Wilson *et al*, 2003 & Tam *et al* (2011). In total of 13 species were recorded, those recorded species were common species in Hong Kong (Photos 6-9). Mating behavior was observed (Photo 10). Sampling location was shown on **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

Survey of aquatic marco-invertebrates was conducted (Photos 11-12). The river benthic fauna collected was mainly comprised of insects and molluscs. Details of recorded benthic fauna refer to **Table 4.5**. Sampling location was shown on **Figure 1**.

4.2.4 Hong Kong Newt

Survey of Hong Kong Newt was conducted. Low abundance of *Paramesotriton hongkongensis* was only observed at the river channel where the habitat consisted of riparian vegetation in T2 sampling point during the survey. Abundant riparian vegetation regenerated along the channel could provide shelter and breeding habitat for Hong Kong Newt. Hong Kong Newt is listed in Wild Animals Protection Ordinance (Cap. 170) and classified as “Near Threatened” under IUCN Red List Status and as “Potential Global Concern” by Fellowes *et al* (2002). Record of Hong Kong Newts can be referred to **Table 4.6**.

4.2.5 Fish Fauna

Fish surveys were performed at She Shan River (Photos 11-12) and total 13 species of freshwater fish were recorded. Native fish *Zacco platypus* and *Oreochromis niloticus* were abundant species dominating in the river channel. Among the recorded fish, *Parazacco spilurus* is classified as “Vulnerable” in Red China Data Book, it was commonly observed along the river with low abundance. The density of fish recorded was similar to last month because of frequent flooding events which could disperse fish out of the river. Details of recorded of fish fauna refers to **Table 4.6**. Sampling location was shown on **Figure 1**.

4.3 **Abiotic Data**

Data on water quality and major stream hydrological feature (water flow and substratum) of the stream were collected and are presented in the **Table 4.7**.

Generally, the water was clean and nutrient levels were moderate. Relatively higher concentration of ammonia and nitrate were likely from runoff from nearby cultivation lands, but the nutrients level are similar to the baseline level without causing any adverse impacts such as eutrophication. Results of water test are presented in the **Table 4.7**.

The river substratum was comprised of over 30-80% stones or rocks in large proportion of the river sections with slow water flow (up to 0.2m/second at pool and 0.5m/second at riffle).

5 **Summary and Commentary**

Ecological monitoring was carried out in current months and relevant biotic and abiotic data was collected according to project specification and EM & A Manual. Mature amphibian *Paramesotriton hongkongensis* was recorded at river channel with low abundance. Mating behavior of odonata was observed. The rest of fauna was in a natural fluctuation except significant decrease in fish abundance was observed.

Aquatic plants and riparian vegetation were generally established at new drainage channel. Vegetation has completely covered the gabion wall mainly in upper sections River and partially covered the river bed along the river channel. Vegetation coverage of the river bed decreased averagely in entire river due to frequent flooding event in June.

The water quality of the river was generally good along river channel. Water was clean and nutrient levels were low to moderate.

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FIGURE

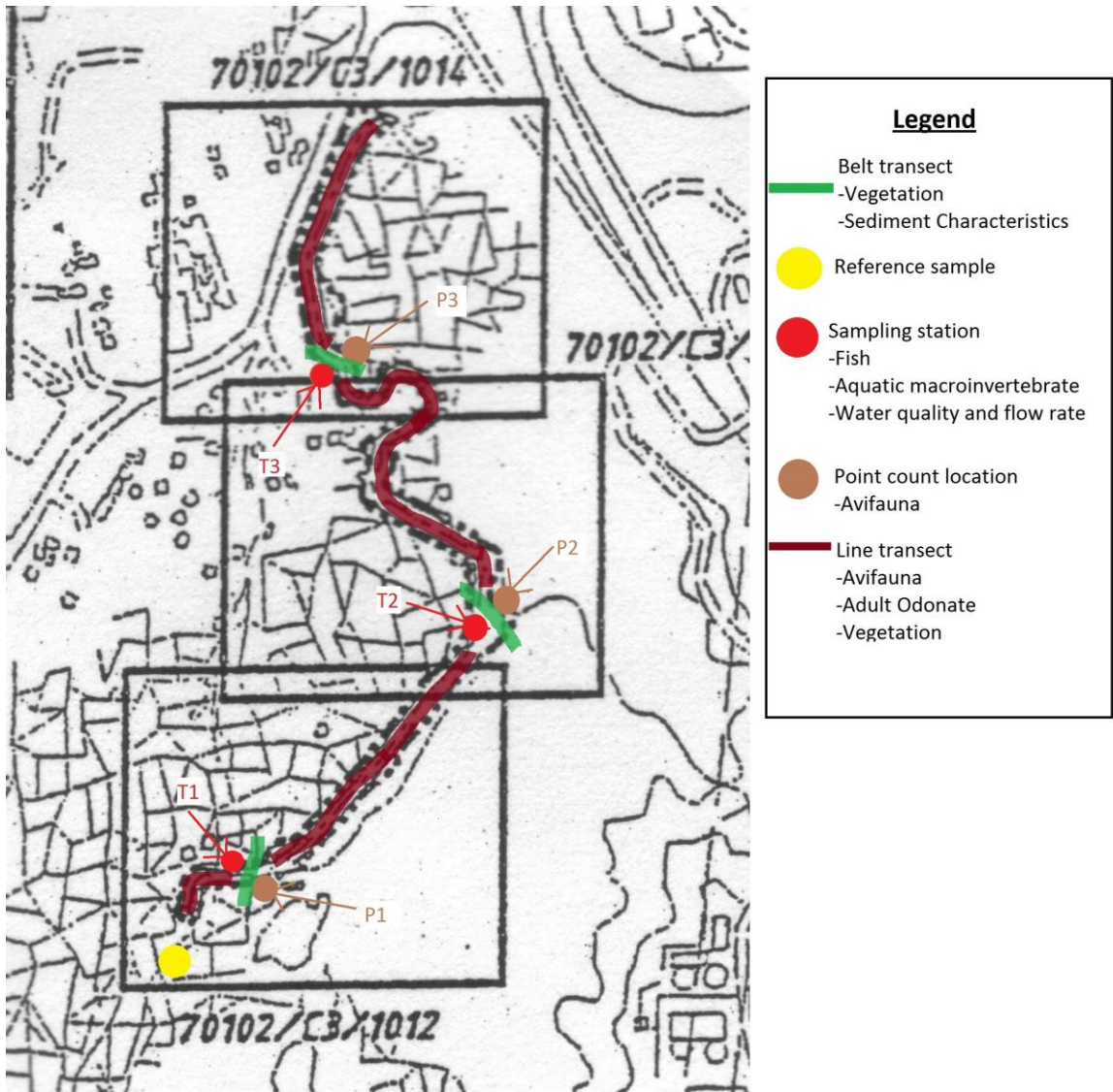


Figure 1. Sampling Location of Ecological Survey and Monitoring at She Shan River, Tai Po.

PHOTOS

<p>Photo 1: General view of the river habitat (Lower section).</p>	<p>Photo 2: General view of the river habitat (Middle section).</p>
<p>Photo 3: Dead vegetation accumulated at lower section of the river.</p>	<p>Photo 4: Abundant species: <i>Brachiaria mutica</i> (Middle section).</p>
<p>Photo 5: Avifauna - <i>Motacilla alba</i></p>	<p>Photo 6 : Odonata - <i>Orthetrum pruinosum neglectum</i></p>



Photo 7: Odonata - *Nannophya pygmaea*



Photo 8: Odonata : *Crocothemis servilia servilia*



Photo 9: Odonata - *Copera marginipes*



Photo10: Odonata - *Ceriagrion auranticum ryukyuanum*



Photo 11: Kick sampling



Photo 12: Aquatic samples collected from kick sampling

TABLE

Table 4.2. Flora species recorded from belt transect survey at the She Shan River
 (T1- Upper stream section, T2 - middle stream section and T3 - Lower stream section)

Family	Species	Chinese name	Baseline monitoring								Post construction monitoring						Post construction monitoring						Post construction monitoring																			
			Jul-08				Aug-08				Oct-14			Nov-14			Dec-14			Dec-14			Dec-14																			
			P1		P3		P1		P3		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3																	
Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%																			
Commelinaceae	<i>Commelina diffusa</i>	箭筈草			0.2	20			10	6			1	10			1	50	0.1	2			1	10			1	50	0.1	2			1	10			1	50	0.1	2		
Poaceae	<i>Panicum repens</i>	枯骨草	0.3	5																																						
Asteraceae	<i>Mikania micrantha</i>	薇甘菊						0.2	7			0.3	5			1	15		0.3	2			0.3	5			1	15			0.3	2			0.3	5			1	15	0.3	2
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜																																								
Moraceae	<i>Ficus microcarpa</i>	細葉榕			0.7	5			0.6	7																																
Moraceae	<i>Ficus hispida</i>	對葉榕			3	10			3	10																																
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	0.5	5			0.5	3																																		
Fabaceae	<i>Pueraria lobata</i>	野葛			0.3	5	0.5	3	0.3	5																																
Araceae	<i>Colocasia esculenta</i>	芋						0.2	5																																	
Urticaceae	<i>Boehmeria nivea</i>	芋麻	1.5	30			2	7																																		
Asteraceae	<i>Bidens alba</i>	白花鬼針草									1	2	0.5	5	0.8	10			1	2	0.5	5	0.8	10			1	2	0.5	5	0.8	10			1	2	0.5	5	0.8	10		
Poaceae	<i>Pennisetum purpureum</i>	象草	3	50	1	60	3	80	2	60																																
Poaceae	<i>Coix lacryma-jobi</i>	薏苡											1.5	1							1.5	1														1.5	1					
Amaranthaceae	<i>Alternanthera philoxeroides</i>	空心蓮子草	0.2	10			0.2	7																																		
Poaceae	<i>Panicum maximum</i>	大黍																																								
Moraceae	<i>Broussonetia papyrifera</i>	構樹																																								
Polygonaceae	<i>Polygonum chinense</i>	火炭母																																								
Onagraceae	<i>Ludwigia hyssopifolia</i>	草龍																																								
Cyperaceae	<i>Cyperus sp.</i>	莎草																																								
Poaceae	<i>Miscanthus floridulus</i>	五節芒																																								
Poaceae	<i>Brachiaria mutica</i>	巴拉草									1.8	65	1.8	20	1.5	5	1.8	70	1.8	25	1.5	8	1.8	70	1.8	25	1.5	8	1.8	70	1.8	25	1.5	8	1.8	70	1.8	25	1.5	8		
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨																																								
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草									2	15	3	5			2	10	3	2			2	10	3	2			2	10	3	2			2	10	3	2				
Araceae	<i>Allocasia macrorrhizos</i>	海芋																																								
Lemnaceae	<i>Lemna minor</i>	浮萍																																								
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼										1	3					1	1																							
Cyperaceae	<i>Cyperus involucratus</i>	風車草										1.7	2					1.7	1																							
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香									1.5	1			2	5	1.5	1			2	5	1.5	1			2	5	1.5	1			2	5	1.5	1			2	5		
Bare Gound											2		0		75		2		1		72		2		1		72		2		1		72		2		1		72			

P1 – Point count location 1; P3 – Point count location 3

Table 4.2. Flora species recorded from belt transect survey at the She Sh
 (T1- Upper stream section, T2 - middle stream section and T3 - Lower st

Family	Species	Chinese name	Post construction monitoring												Post construction monitoring												Post construction monitoring												Post construction monitoring												Post construction monitoring												Post construction monitoring											
			Jan-15				Feb-15				Mar-15				Apr-15				May-15				Jun-15				Jan-15				Feb-15				Mar-15				Apr-15				May-15				Jun-15																											
			T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%	T1	T2	T3	%																																				
Comelinaceae	<i>Commelina diffusa</i>	箭箭草	0.5	10	0.8	70	0.3	40	0.6	10	1	70	0.4	40	0.6	10	1	70	0.5	40	0.6	10	1	70	0.5	40	0.3	5	0.7	50	0.5	25	0.3	5	0.7	50	0.5	25																																				
Poaceae	<i>Panicum repens</i>	枯骨草																																																																								
Asteraceae	<i>Mikania micrantha</i>	薇甘菊	0.4	10	0.5	15			0.4	10	0.5	15			0.4	10	0.5	15			0.4	10	0.5	15			0.3	5	0.5	10			0.3	5	0.5	10																																						
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜																																																																								
Moraceae	<i>Ficus microcarpa</i>	細葉榕																																																																								
Moraceae	<i>Ficus hispida</i>	對葉榕																																																																								
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹																																																																								
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Asteraceae	<i>Bidens alba</i>	白花鬼針草																																																																								
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Poaceae	<i>Coix lacryma-jobi</i>	薏苡																																																																								
Amaranthaceae	<i>Alternanthera philoxeroides</i>	空心蓮子草																																																																								
Poaceae	<i>Panicum maximum</i>	大黍																																																																								
Moraceae	<i>Broussonetia papyrifera</i>	構樹																																																																								
Polygonaceae	<i>Polygonum chinense</i>	火炭母																																																																								
Onagraceae	<i>Ludwigia hyssopifolia</i>	草龍																																																																								
Cyperaceae	<i>Cyperus sp.</i>	莎草																																																																								
Poaceae	<i>Miscanthus floridulus</i>	五節芒																																																																								
Poaceae	<i>Brachiaria mutica</i>	巴拉草	1.5	80	1	5	1	25	1.5	80	1.3	5	1.3	25	1.5	80	1.3	5	1.3	25	1.5	80	1.4	5	1.4	25	1.5	40	1.2	5	1.2	15	1.5	45	1.2	10	1.2	20																																				
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨																																																																								
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草																																																																								
Araceae	<i>Allocasia macrorrhizos</i>	海芋																																																																								
Lemnaceae	<i>Lemna minor</i>	浮萍																																																																								
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼																																																																								
Cyperaceae	<i>Cyperus involucratus</i>	風車草		1.5	5				1.5	5				1.5	5				1.5	5				1.5	5				1.4	5				1.4	5																																							
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香				2	10				2	10				2	10				2	10				2	10				1.6	5				1.6	5																																					
Bare Gound				0		5		25		0		5		25		0		5		25		0		5		25		50		30		55		45		25		50																																				

P1 – Point count location 1; P3 – Point count location 3

Table 4.3 Avifauna recorded along survey transects and at three selected point count locations at She Shan River.

(T1- Upper stream section, T2 - middle stream section and T3 - Lower stream section)

Common Name	Species name	Chinese name	Status	Commonness	Impact monitoring				Impact monitoring				Impact monitoring				Jan-14				Feb-14				Mar-14				Apr-14				May-14				Jun-14				Jul-14				Aug-14			
					Jul-12				Jul-13				Dec-13				Abundance				Abundance				Abundance				Abundance				Abundance				Abundance				Abundance				Abundance			
					C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3
Barn Swallow	<i>Hirundo rustica</i>	家燕	PM	C																																												
Black Drongo	<i>Dicrurus macrocerus</i>	黑卷尾	Sv	C																																												
Black Kite	<i>Milvus lineatus</i>	鷹	R, RC, Cap.586	C																																												
Black-necked Staree	<i>Sturnus nigricollis</i>	黑領椋鳥	R	C																																												
Black-throated Laughingthrush	<i>Garrulax chinensis</i>	黑喉噪鶇	R	C																																												
Buzzard (Common Buzzard)	<i>Buteo buteo</i>	普通鵟	WV, Cap.5	U																																												
Chinese Bulbul	<i>Pycnonotus sinensis</i>	白頭鵲	R	C																																												
Chinese Pond Heron	<i>Ardeola bacchus</i>	池鷺	R,RC	C																																												
Common Kingfisher	<i>Alcedo atthis</i>	普通翠鳥	R	C																																												
Common Koel	<i>Eudynamis scolopacea</i>	噪鵲	R	C																																												
Common Sandpiper	<i>Actitis hypoleucos</i>	磯鷸	WV&PM	C																																												
Common Tailorbird	<i>Oriolotus chinensis</i>	長尾縫葉鶇	R	C																																												
Crested bulbul	<i>Pycnonotus jocosus</i>	紅耳鵲	R	C																																												
Crested Goshawk	<i>Accipiter trivirgatus</i>	鳳頭鷹	R, CR, Cap.5	R																																												
Crested Myna	<i>Acridotheres cristatellus</i>	八哥	R	C																																												
Crested Serpent Eagle	<i>Spilornis cheela</i>	蛇鵰	R, CR, Cap.5	R																																												
Domestic pigeon	<i>Columba sp.</i>	鴿	R	C																																												
Dusky Warbler	<i>Phylloscopus fuscatus</i>	褐柳鶇	WV	U																																												
Eurasian tree sparrow	<i>Passer montanus</i>	麻雀	R	C																																												
Fork-tailed Sunbird	<i>Aethopyga christinae</i>	叉尾太陽鳥	R	C																																												
Great Coucal	<i>Centropus sinensis</i>	褐翅鴉鵂	R, VU	C																																												
Great Egret	<i>Ardea alba</i>	大白鷺	R,RC	U																																												
Great Tit	<i>Parus minor (comissatus)</i>	大山雀	R	C																																												
Green Sandpiper	<i>Tringa ochropus</i>	白腰草鶻	PM&C	U																																												
Grey Heron	<i>Ardea cinerea</i>	蒼鷺	WV, P, Cap.5	C																																												
Grey Wagtail	<i>Motacilla cinerea</i>	灰鶺鴒	WV	C																																												
Japanese White Eye	<i>Zosterops lateralis (sinaley)</i>	暗綠繡眼鳥	R	C																																												
Large Hawk	<i>Buteo swainsonii</i>	鷹	SV	U																																												
Little Egret	<i>Egretta garzetta</i>	小白鷺	R,RC	C																																												
Maggie Robin	<i>Copsychus saularis</i>	鶉鴉	R	C																																												
Night Heron	<i>Nycticorax nycticorax</i>	夜鶺鴒	R, LC	U																																												
Olive Backed Pipit	<i>Anthus hodgsoni</i>	樹鶺鴒	WV	C																																												
Plaintive Cuckoo	<i>Cacomantis merulinus</i>	八聲杜鵑	SV	C																																												
Rufous-backed Shrike	<i>Lanius schach</i>	棕背伯勞	R	C																																												
Rufous-capped Warbler	<i>Stachyridopsis affinis</i>	紅頭穗鶻	R	C																																												
Scarlet Minivet	<i>Pericrocotus sinensis</i>	赤紅山椒鳥	R	C																																												
Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	白喉紅鵲	R	C																																												
Spotted Dove	<i>Streptopelia chinensis</i>	珠頸斑鳩	R	C																																												
Spotted Munia	<i>Lonchura punctulata</i>	斑文鳥	R	U																																												
White Wagtail	<i>Motacilla alba</i>	白鶺鴒	WV	C																																												
White-breasted Waterhen	<i>Amaurornis phoeniceus</i>	白胸苦惡鳥	R	C																																												
Yellow Bellid Prinia	<i>Prinia flaviventris</i>	黃腹鶺鴒	R	C																																												
Number of birds					0	15	22	11	10	10	14	13	30	34	11	26	32	10	34	37	16	38	31	12	22	28	15	26	24	15	18	17	16	24	26	18	24	26	18	28	28							
No. of species					20	9	8	7	22	6	8	9	31	9	14	16	32	11	16	17	33	11	18	18	34	13	19	17	32	9	11	12	27	9	10	10	23	8	11	10	20	12	14	14	20	13	17	15

Note: R – Resident; WV – Winter visitor; PM – Passage migrant; C – Common; SpM – Spring migrant; SV – Summer Visitor; C – transect count; P1 – Point count; +, occurred; ++, common; +++, abundant/dominant species in the study; Commonness and status were decided according to AFCD biodiversity website; All bird species are under protection of Wild Animals Protection Ordinance (Endangered Species of Animals and Plants Ordinance (Cap. 586))
 RC : Regional concern Fellowes *et al* (2002)
 LC : Local Concern Fellowes *et al* (2002)
 PRC: Potential regional concern Fellowes *et al* (2002)
 CR: Rare in China Red Data Book Status
 VU: Vulnerable in China Red Data Book Status

Table 4.4. Odonate species recorded at the She Shan River

Species	Common name	Chinese name	Status	Commonness	Baseline monitoring		Impact monitoring				Impact monitoring						
					Jul-08	Aug-08	Jan-09	Jul-09	Jan-10	Jul-10	Jan-11	Jul-11	Jan-12	Jul-12	Jan-13	Jul-13	Dec-13
<i>Agrionemis pygmalis</i>	Wandering Midget	黃尾小蠅	NP	VC													
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC											+		
<i>Ceragrion auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘背蠅	NP	VC													
<i>Coperia ciliata</i>	Black-knees Featherlegs	白狹扇蠅	NP	VC													
<i>Coperia marginipes</i>	Yellow Featherlegs	黃狹扇蠅	NP	VC											+		
<i>Crocothemis servilia servilia</i>	Crimson Darter	紅蜻	NP	VC	+	+		+		++		+				+	
<i>Diplacodes trivialis</i>	Blue Percher	紋藍小蜻	NP	VC		+											
<i>Ictinogomphus pertinax</i>	Common Flanetail	霸王葉春蜓	NP	C								+				+	+
<i>Ischnura senegalensis</i>	Common Bluetail	褐斑異痣蠅	NP	VC								+				+	
<i>Nannophya pygmaea</i>	Scarlet Dwarf	侏紅小蜻	NP	C													
<i>Neurobasis chinensis chinensis</i>	Chinese Greenwing	華艷色蠅	NP	VC								+					
<i>Neurothemis fulvia</i>	Russet Percher	網脈蜻	NP	VC								+					
<i>Orthetrum chrysis</i>	Red-faced Skimmer	華麗灰蜻	NP	VC	+	+	+	+				+					+
<i>Orthetrum glaucum</i>	Common blue skimmer	黑尾灰蜻	NP	VC			+									+	
<i>Orthetrum luzonicum</i>	Marsh Skimmer	呂宋灰蜻	NP	VC								+					
<i>Orthetrum pruinosum neglectum</i>	Common Red Skimmer	赤褐灰蜻	NP	VC								++				+	
<i>Orthetrum Sabina sabina</i>	Green Skimmer	狹腹灰蜻	NP	C	+	+											
<i>Pantala flavescens</i>	Wandering Glider	黃蜻	NP	VC	+	+			+	+	+	+++	+	+	+	+	+
<i>Prodasineura autumnalis</i>	Black Threadtail	烏齒原蠅	NP	VC								+				+	
<i>Pseudagrion pruinosum fraseri</i>	Ferruginous-faced Sprite	赤斑蠅	NP	C													
<i>Pseudagrion rubriceps rubriceps</i>	Orange-faced Sprite	丹頂斑蠅	NP	UC	+		+	+				+			+		+
<i>Rhinocypha perforata perforata</i>	Common Blue Jewel	三斑鼻蠅	NP	VC													
<i>Rhyothemis variegata arria</i>	Variagated Flutterer	斑麗翅蜻	NP	C												+	
<i>Trithemis aurora</i>	Crimson Dropwing	曉褐蜻	NP	VC								++				+	
<i>Trithemis festiva</i>	Indigo Dropwing	慶褐蜻	NP	VC				+		+		+				+	
<i>Zygonyx iris insignis</i>	Emerald Cascader	彩虹蜻	P,PG	VC													

Note: NP – Not protected in Hong Kong; P – Protected in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” – Common
 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 Commonness and status were decided according to AFCD biodiversity website (www.hkbiodiversity.net)
 LC- Local Concern - Fellowes *et al* (2002)
 PGC - Potential Global Concern - Fellowes *et al* (2002)

Table 4.4. Odonate species recorded at the She Shan River

Species	Common name	Chinese name	Status	Commonness	Post construction monitoring																	
					Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
<i>Agriocnemis pygmaelis</i>	Wandering Midget	黃尾小蠅	NP	VC				+														
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC																		
<i>Ceriatrigon auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘黃蠅	NP	VC				+	++	+			+						+	+	+	+
<i>Coperia ciliata</i>	Black-knees Featherlegs	白依扇蠅	NP	VC				+														
<i>Coperia marginipes</i>	Yellow Featherlegs	黃狹扇蠅	NP	VC				+		+			+	+	+				+	+	+	+
<i>Crocothemis servilia servilia</i>	Crimson Darter	紅蜻	NP	VC	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Diplacodes trivialis</i>	Blue Percher	紋藍小蜻	NP	VC	+	+	+															
<i>Ictinogomphus pertinax</i>	Common Flanetail	霸王葉春蜓	NP	C	+	+	+			+	+	+	+	+							+	+
<i>Ischnura senegalensis</i>	Common Bluetail	褐斑異痣蠅	NP	VC				+	+	+												
<i>Nannophya pygmaea</i>	Scarlet Dwarf	侏紅小蜻	NP	C																		
<i>Neurobasis chinensis chinensis</i>	Chinese Greenwing	華麗色蠅	NP	VC			+							+	+				+	+	+	
<i>Neurothemis fulvia</i>	Russet Percher	網脈蜻	NP	VC						+	+								+	+	+	+
<i>Orthetrum chrysis</i>	Red-faced Skimmer	華麗灰蜻	NP	VC																		
<i>Orthetrum glaucum</i>	Common blue skimmer	黑尾灰蜻	NP	VC					+													
<i>Orthetrum luzonicum</i>	Marsh Skimmer	呂宋灰蜻	NP	VC					+	+												+
<i>Orthetrum pruinosum neglectum</i>	Common Red Skimmer	赤褐灰蜻	NP	VC					++	++	+	+	+	+						+	+	+
<i>Orthetrum Sabina sabina</i>	Green Skimmer	狹腹灰蜻	NP	C					+				+	+								
<i>Pantala flavescens</i>	Wandering Glider	黃蜻	NP	VC	+									+							+	+
<i>Prodasineura autumnalis</i>	Black Threadtail	烏齒原蠅	NP	VC				+	+											+	+	+
<i>Pseudagrion pruinosum fraseri</i>	Ferruginous-faced Sprite	赤斑蠅	NP	C																		
<i>Pseudagrion rubriceps rubriceps</i>	Orange-faced Sprite	丹頂斑蠅	NP	UC				+	+	+	+	+	+	+	+							
<i>Rhinocypha perforata perforata</i>	Common Blue Jewel	三斑鼻蠅	NP	VC									+	+	+					+	+	+
<i>Rhyothemis variegata arria</i>	Variogated Flutterer	斑麗翅蜻	NP	C						+	+	+										+
<i>Trithemis aurora</i>	Crimson Dropwing	曉褐蜻	NP	VC						+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Trithemis festiva</i>	Indigo Dropwing	慶褐蜻	NP	VC			+			+	+	+	+	+	+				+	+	+	+
<i>Zygonyx iris insignis</i>	Emerald Cascader	彩虹蜻	P,PG	VC						+	+	+										

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 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 Commonness and status were decided according to AFCD biodiversity website (www.hkbiodiversity.org)
 LC- Local Concern - Fellowes *et al* (2002)
 PGC - Potential Global Concern - Fellowes *et al* (2002)

Table 4.5 Aquatic Macro invertebrates recorded at She Shan River.

(T1 - Upper stream section, T2 - middle stream section, T3 - Lower stream section)

Species	Chinese name	Sampling location	Baseline monitoring		Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring											
			Status	Common-ness	Jul-08		Jan-09			Jul-09			Jan-10			Jul-10			Jan-11			Jul-11			Jan-12			Jul-12			Jan-13			Dec-13			
					Upper stream	Lower stream	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2
Molluscs																																					
<i>Anodonta woodiana</i>	背角無齒蚌	NP	VC																																		
<i>Biomphalaria sp.</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
<i>Brotia hainanensis</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
<i>Corbicula fluminea</i>	河蚬	NP	VC																																		
<i>Melanooides tuberculata</i>	縮擬黑螺	NP	VC	+	+	+	++																														
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC	+	++	+	+	+	+	+	+	+	+	++	+	+	++	++	+	+++	+++	+++	+	++	++	+++	+	+	+	+	+	+	+	+	+	+	
<i>Radix plicatulus</i>	--	NP	VC	+	+	+	+	+																													
<i>Sinotaia quadrata</i>	田螺	NP	VC	+	+	+	++	+																													
Insects																																					
<i>Baetis sp.</i>		NP	VC	+	+	+	+	+																													
<i>Caenis sp.</i>	--	NP	VC	+	+	+	+	+																													
<i>Chironomus sp.</i>	孿幼虫	NP	VC	+	+	++	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Euphaea sp.</i>		NP	VC																																		
<i>Indobaetis sp.</i>	--	NP	VC	+	+	+	+	+																													
<i>Odonate larvae</i>		NP	VC																																		
<i>Orthetrum spp.</i>	--	NP	VC					+	+																												
<i>Pseudagrion spp.</i>	--	NP	UC																																		
<i>Pseudocloeon sp.</i>	--	NP	VC	+	+	+	+																														
<i>Serratella sp.</i>		NP	VC	+	+	+	+																														

Note: NP – Not protected in H K P - protected species in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” - Common
 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 - Reference point was the sampling location outside the works area used to compare the with the data within works area.

Table 4.5 Aquatic Macro invertebrates recorded at She Shan Rive

(T1- Upper stream section, T2 - middle stream section, T3 - Lower stream section)

Species	Chinese name	Sampling location	Status	Common-ness	Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring							
					Jan-14				Feb-14				Mar-14				Apr-14				May-14				Jun-14				Jul-14				Aug-14				Sep-14				Oct-14			
					Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3
Molluscs																																												
<i>Anodonta woodiana</i>	背角無齒蚌	NP	VC																																									
<i>Biomphalaria sp.</i>	--	NP	VC																																									
<i>Brotia hainanensis</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Corbicula fluminea</i>	河蚬	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Melanooides tuberculata</i>	縮擬黑螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Radix plicatulus</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Sinotaia quadrata</i>	田螺	NP	VC	+	+	+	+	++	+	+	+	+	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+						
Insects																																												
<i>Baetis sp.</i>		NP	VC	+				+	+			+	+	+																														
<i>Caenis sp.</i>	--	NP	VC																																									
<i>Chironomus sp.</i>	孿幼虫	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Euphaea sp.</i>		NP	VC																																									
<i>Indobaetis sp.</i>	--	NP	VC	+				+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Odonate larvae</i>		NP	VC																																									
<i>Orthetrum spp.</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Pseudagrion spp.</i>	--	NP	UC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Pseudocloeon sp.</i>	--	NP	VC																																									
<i>Serratella sp.</i>		NP	VC					+				+	+	+																														

Note: NP – Not protected in H P - protected species in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” - Common
 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 - Reference point was the sampling location outside the works area used to compare the with the data within works area.

Table 4.5 Aquatic Macro invertebrates recorded at She Shan Rive

(T1- Upper stream section, T2 - middle stream section, T3 - Lower stream section)

Species	Chinese name	Sampling location	Status	Common-ness	Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring																										
					Nov-14				Dec-14				Jan-15				Feb-15				Mar-15				Apr-15				May-15				Jun-15																		
					Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3															
Molluscs																																																			
<i>Anodonta woodiana</i>	背角無齒蚌	NP	VC																																																
<i>Biomphalaria sp.</i>	--	NP	VC	+	+					+				+	+						+	+	+			+	+	+																							
<i>Brotia hainanensis</i>	--	NP	VC	+	+	+				+	+	+			+	+	+				+	+	+			+	+	+																							
<i>Corbicula fluminea</i>	河蜆	NP	VC			+				+					+							+					+																								
<i>Melanooides tuberculata</i>	縮擬黑螺	NP	VC	+	+	+	+			+	+	+			+	+	+				+	+	+			+	+	+																							
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC	+	+	+	+			+	+	+			+	+	+				+	+	+			+	+	+																							
<i>Radix plicatulus</i>	--	NP	VC	+	+	+	+			+	+	+			+	+	+				+	+	+			+	+	+																							
<i>Sinotaia quadrata</i>	田螺	NP	VC	+	+	+	+			+	+	+			+	+	+				+	+	+			+	+	+																							
Insects																																																			
<i>Baetis sp.</i>		NP	VC	+	+	+				+												+																													
<i>Caenis sp.</i>	--	NP	VC																																																
<i>Chironomus sp.</i>	孳幼虫	NP	VC	+	+	+	+			+	+	+			+	+	+				+	+	+			+	+	+																							
<i>Euphaea sp.</i>		NP	VC			+				+												+	+				+	+																							
<i>Indobaetis sp.</i>	--	NP	VC	+	+	+				+					+	+											+	+																							
<i>Odonate larvae</i>		NP	VC																								+																								
<i>Orthetrum spp.</i>	--	NP	VC	+	+	+	+			+	+	+			+	+	+										+	+	+																						
<i>Pseudagrion spp.</i>	--	NP	UC	+	+	+	+			+					+	+						+	+				+	+																							
<i>Pseudocloeon sp.</i>	--	NP	VC	+		+				+																	+	+	+	+																					
<i>Serratella sp.</i>		NP	VC												+																																				

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 - Reference point was the sampling location outside the works area used to compare the with the data within works area.

Table 4.6 Fish species and Hong Kong Newt recorded at She Shan River
(T1 - Upper stream section, T2 - middle stream section and T3 - Lower stream section)

Species	Status	Commonness	Impact monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring								
			Dec-13				Jan-14				Feb-14				Mar-14				Apr-14				May-14				Jun-14				Jul-14				Aug-14				Sep-14				
			Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	
<i>Channa maculata</i>	斑鱧	NP	C									+				+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+	
<i>Clarias gariepinus</i>	革胡子鯪	NP	VC									+				+				+				+				+				+				+				+			
<i>Gambusia affinis</i>	食蚊魚	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Misgurnus anguillicaudatus</i>	泥鰍	NP	C	+				+				+				+				+				+				+				+				+				+			
<i>Oreochromis niloticus</i>	尼羅口非鯽	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Parazacco spilurus</i>	黑鰱	NP, V	C	+	+	+	+	+	+	++	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Poecilia reticulata</i>	孔雀花魚	NP	VC																																								
<i>Pterocryptis cochinchinensis</i>	越南鱮	NP	C									+				+				+				+				+				+				+				+			
<i>Puntius semifasciolatus</i>	土庫魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Rhinogobius spp.</i>	鰻虎魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Xiphophorus hellerii</i>	劍尾魚	NP	C	+	+	+	+	+	+	++	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Xiphophorus variatus</i>	雜色劍尾魚	NP	C	+				+				+				+				+				+				+				+				+				+			
<i>Zacco platypus</i>	寬鱮	NP	C	+	+	+	+	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++
2x2m fish number				5	3	4	2	12	16	30	40	30	40	50	60	60	60	70	70	40	40	50	40	20	10	20	10	12	5	8	6	16	8	10	10	12	10	16	12	20	20	30	16
Amphibian																																											
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P, Cap 170, NT, PGC	R					+				+		+		+	+	+						+								+										+	

Note: NP – Not protected in Hong Kong; P – Protected in Hong Kong
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 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 - Reference point was the sampling location outside the works area used to compare
 *Cap 170” - List in Wild Animals Protection Ordinance (Cap.170)
 *NT” - Near Threatened in IUCN Red List Status
 *PGC”-Potential Golar Concern by Fellowes *et al* (2002)
 *V” - Vulnerable - in Red China Data Book

Table 4.6 Fish species and Hong Kong Newt recorded at She Shan River
(T1- Upper stream section, T2 - middle stream section and T3 - Lower stream sect

Species		Status	Commonness	Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring							
				Oct-14				Nov-14				Dec-14				Jan-15				Feb-15				Mar-15				Apr-15				May-15				Jun-15			
				Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3
<i>Channa maculata</i>	斑鱧	NP	C		+	+			+	+				+				+				+				+					+	+				+	+		
<i>Clarias gariepinus</i>	革胡子鯪	NP	VC		+	+	+			+				+	+				+	+				+	+	+						+	+	+			+	+	
<i>Gambusia affinis</i>	食蚊魚	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Misgurnus anguillicaudatus</i>	泥鰌	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Oreochromis niloticus</i>	尼羅口非鯽	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Parazacco spilurus</i>	烏鱧	NP, V	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Poecilia reticulata</i>	孔雀花魚	NP	VC				+					+				+							+																
<i>Pterocryptis cochinchinensis</i>	越南鱮	NP	C			+					+				+							+																	
<i>Puntius semifasciolatus</i>	土庫魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Rhinogobius spp.</i>	鰕虎魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Xiphophorus hellerii</i>	劍尾魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Xiphophorus variatus</i>	雜色劍尾魚	NP	C				+				+				+							+																	
<i>Zacco platypus</i>	寬鱮	NP	C	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	
			2x2m fish number	40	30	40	30	50	50	60	50	60	50	40	50	40	50	40	30	40	40	40	40	50	50	30	35	55	45	20	10	20	10	20	10	20	10		
Amphibian																																							
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P, Cap 170, NT, PGC	R			+				+				+						+						+												+	

Note: NP – Not protected in Hong Kong ; P – Protected in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” - Common
 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 - Reference point was the sampling location outside the works area used to compar
 "Cap 170" - List in Wild Animals Protection Ordinance (Cap.170)
 "NT" - Near Threatened in IUCN Red List Status
 "PGC"-Potential Gonal Concern by Fellowes *et al* (2002)
 "V" - Vulnerable - in Red China Data Book

Table 4.7 Abiotic data for the Upper She Shan River (T1- Upper stream section, T2 - middle stream section and T3 - Lower stream section)

Stream	Baseline monitoring	Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring			Impact monitoring		
	Aug-08	Jan-09			Jul-09			Jan-10			Jul-10			Jan-11			Jul-11			Jan-12			Jul-12			Jul-13		
Replicate		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
DO (mg/L)	8.9	--	9.1	8.3	6	5.8	6.5	--	8.9	--	8.2	8.3	8.3	8	8.5	8.8	8	8.5	9	8.6	8.2	8.8	7.7	7.7	6.3	7.8	7.8	7.7
pH	7.29	--	7.51	7.42	7.22	7.16	7.35	--	7.5	--	7.5	7.5	7.5	6.9	7	7.2	7	7.2	7.5	6.9	6.6	7.1	6.7	6.6	6.6	6.8	7.2	7.6
Nitrate (mg N/L)	0.5	--	1.6	1.5	0.22	0.3	0.4	--	0.75	--	0.1	0.14	0.2	0.1	0.2	0.7	0.1	0.3	0.4	0.2	0.2	0.4	0.84	0.86	1.14	0.6	0.61	0.7
Ammonia (mg N/L)	0.1	--	PO4-P (µg P/L) :<100	PO4-P (µg P/L) :110	0.83	0.97	0.99	--	0.03	--	0.25	0.2	0.12	0.1	0.1	0.12	0.1	0.1	0.15	0.2	0.2	0.3	0.05	0.02	1.08	0.14	0.06	0.05
Salinity (ppt)	<0.1	--	0.1	0.1	0	0	0	--	0	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0	0	0.03	0.04	0.07	0.03	0.03	0.04
Conductivity (µS/cm)	90	--	140	170	116	114	116	--	105	--	410	410	390	110	111	115	120	115	130	122	118	126	121	120	160	94	97	97
BOD (mg/L)	<2	--	<2	4	<2	<2	<2	--	2	--	<2	3.2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Water flow at pool (m/s)	0.1-0.3	--	<0.01-0.1		<0.01	N.A	<0.01-0.1	--	<0.01-0.1	--	0.1	0	0	0.1	0	0	0.2	0.05	0.1	0.2	0.05	0.1	0.2	0.05	0.1	0.2	0.05	0.1
Water flow at riffle (m/s)	0.4-0.5	--	0.2-0.3		<0.01	N.A	0.2-0.3	--	0.01	--	0.1	0	0	0.1	0	0	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1
Sand (%)	55	65	23	65	23	23	65	5	23	--	5	30	5	5	30	2	5	30	2	10	25	5	10	25	5	15	25	5
Stone (%)	25	30	75	30	75	75	30	40	75	--	40	65	80	40	65	2	40	65	2	45	65	5	45	65	5	65	65	15
Mud (%)	30	5	2	5	2	2	5	5	2	--	5	5	5	5	5	1	5	5	1	5	10	10	5	10	10	10	10	10
Concrete (%)	0	0	0	0	0	0	0	50	0	100	50	0	10	50	0	95	50	0	95	40	0	80	40	0	80	10	0	70

**Agreement No. CE65/2013(EP) Post-Construction
Ecological Monitoring of River Improvement Work in
Upper Lam Tsuen River, She Shan River and Upper Tai Po
River – Investigation
Post-Construction Ecological Monitoring Report (No. 18)
Upper Tai Po River**

June 2015



Prepared by : Mike Pang

July 22 , 2015

Validated by: Mark Shea

July 22, 2015

Ecology Team: China Hong Kong Ecology Consultants

**Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation
Agreement No. CE65/2013(EP)**

**Post-Construction Ecological Monitoring Report (No.18)
Upper Tai Po River**

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1 Introduction

- 1.1 The current post-construction ecological monitoring programme is under Agreement No. CE65/2013(EP) Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River. The collected data are mainly used to assess ecological recovery process and effectiveness of ecological migration proposed and enforced during the construction period.
- 1.2 The scope of the ecological monitoring was detailed in EM & A Manual of the project. In brief, the survey aimed to collect data on abiotic factors such as water quality, substratum characteristics, water flow as well as flora and fauna.
- 1.3 China Hong Kong Ecology Consultants Ltd. was committed by Allied Environmental Consultants Ltd (AEC) to undertake the ecological monitoring tasks for the project from December 2014.
- 1.4 This is the number 18 post-construction ecological monitoring report for the project conducted **on 23rd June 2015**. It contains the following subsections:
 - Summary of major points
 - Monitoring Methods and Results
 - Summary and Comments

2 Summary of Major Points

- Fauna and flora along the drainage project sections is in a process of re-establishing or restoration;
- Bird abundance was similar to those recorded during baseline survey.
- The abundance of target river fauna, i.e., fish *Parazacco spilurus* recorded was lower than those recorded during baseline monitoring (before fish capture/relocation took place). The reason for low fish population of *P. spilurus* was due to river bed modification. The rare fish *Pseudobagrus trilineatus* was consistently recorded in the river during recent monitoring. The other target species, Hong Kong Newt *Paramesotriton hongkongensis*, was not found within works area during baseline, impact monitoring and it was recorded in the river during this post construction monitoring. Apart from fauna species, 67 flora species was recorded within the survey transects along the river course. Some common herbs were observed generating on the embankment, which indicating that vegetation was recovering. Flora species of *Tibouchina semidecandra* and *Ipomoea pes-caprae* were planted on the gabion along the river for landscape purpose.
- Heavy rain events was frequently recorded in current wet season, leading to strong flooding which could wash out fish and vegetation out of the river.

3 Monitoring Methodology

3.1 Riparian Vegetation

Riparian vegetation including aquatic and emergent was sampled by line transects along the affected river channel and riparian habitat. Species, relative abundance and average heights were recorded. Vegetation surveys were conducted at three selected belt transects with one located at the upper portion of the river channel (T1) and another one at the middle section of the river, as well as reference site (**Figure 1**). The belt transects was run across the river channel in order to collect quantitative data of the vegetation, e.g., species inventory, height, percentage cover. Qualitative data of plants was collected by recording plant species along line transect, e.g., species inventory, relative abundance. Nomenclature and protection status of the species has followed those documented in Lai *et al* (2004) and Hong Kong Herbarium (2015).

3.2 Avifauna

Avifauna survey was conducted during post construction monitoring period. Special attention was given to the river channel and corridor area which birds used as feeding and foraging habitat. Avifauna survey was undertaken in the early morning plus species recorded in the rest of the day when conducting other taxonomic groups (benthic, fish, insect) monitoring. Numerical abundance was recorded at fixed count points within a radius of 30 to 50m according to landscape feature and visual penetration extent. The duration of the point count of birds was standardized for 10 minutes at each location in order to collect comparable data. Transect count along accessible sections of river channel were used in order to collect qualitative data. Binoculars and digital camera were the main items of equipment used. Nomenclature and protection status of the species has followed in the AFCD website (www.hkbiodiversity.net) and Carey *et al* (2001).

The point count was conducted at three locations with one located at the lower portion (T2) of the river channel and the other located at the upper section (T1) of the river, as well as reference site. The point count locations, survey transect for bird survey and sampling sites for surveys of other faunal groups and flora was given in **Figure 1**.

3.3 Adult Odonata Survey

Adult Odonata surveys were conducted along transects (**Figure 1**). Binoculars, digital camera and hand net were utilized to aid identification. Numerical abundance, species identity and other notable behaviour were recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net), Wilson *et al* (2004) and Tam *et al* (2011). Adult Odonata survey was conducted along line transects in parallel with river channel within the works area where access was permitted.

3.4 Aquatic Macro-invertebrates

Macro-invertebrates in the river channel were surveyed in three sampling sites with two located at upper (T1) and middle proportion (T2) of the river respectively and one reference site. It aims to collect necessary macro-

invertebrate fauna for ecological monitoring programme (**Figure 1**). Five replicates were taken at each sampling point and pool together for further sample sorting and identification. Kick sampling and hand netting were the survey methodologies for river organisms. Dissection microscope and digital camera were used to aid identification and enumeration. Numerical abundance and species identity were recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net) and other literatures such as Dudgeon (1994).

3.5 Fish and Newt

Fish community including target species *Parazacco spilurus* and *Paramesotriton hongkongensis* at the specified river channel was monitored by live trapping, hand netting and direct observation methods.

Sampling was conducted at three sampling locations with one located at upper section (T1) and one located at middle section (T2), as well as reference site. The selected sampling site covered major type of river habitats, e.g. river pool and riffle (**Figure 1**). The number of the observed fish and newt was estimated and recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net) and Lee *et al* (2004).

3.6 Abiotic Data Collection

3.6.1 Water Quality Monitoring

Dissolved oxygen level, pH value, conductivity, salinity, BOD and nutrient level (nitrate and ammonium) were measured and analyzed by conventional methods in situ or in laboratory. The instruments for measuring dissolved oxygen level, pH value, conductivity, salinity were model: DO-5510, AZ8685, AZ8361 and AZ8374 respectively. All the instruments were calibrated every monitoring month according to the operation manuals in order to obtain the precise result. BOD test took 5 days to complete within darkness incubator with stable temperature at 20°C and was performed using model: DO-5510 for measuring dissolved oxygen. Nutrient levels including nitrate and ammonia were performed in laboratory by applying the In-house method SOP056 (FIA) and SOP057 (FIA) respectively.

3.6.2 Sediment Characteristics

Sediment/substrate characteristics were recorded of sediment cover in percentage e.g. mud, sand, rock, boulder and cemented bottom in the river bed at sampling sites.

3.6.3 Water Flow

Water flow rates in river channel were measured by recording the time taken for a floating object (e.g. floating ball) in a measured distance. The sampling sites for surveys were given in **Figure 1**.

4 Monitoring Results

4.1 Vegetation

Major proportion of river bed and bank was concrete and without plant colonizing (Photos 2-3). Vegetation has partially covered the gabion wall along the upper Tai Po River and the river bed (Photo 4) with some common plants including invasive species *Mikania micrantha*, and native species *Commelina diffusa*. In total, 67 flora species was recorded within the survey transects along the river course. Abundant native species *Commelina diffusa* was the dominant species established in the river bed (Photo 5). The recorded floras were generally in good health, and the height of the dominated riparian grass and herb species were in a range from 0.2m to 2m as observed along survey transect. The frequent flooding events occurred during current wet season has washed part of vegetation out of the river. Dominant flora species were shown in the **Table 4.1** marked with relative abundance sign “+++”. Results of vegetation survey and belt transect survey were presented in **Table 4.1** and **Table 4.2**. **Figure 1** shows the transect line for the flora surveys.

4.2 Fauna

4.2.1 Avifauna

An avifauna survey was undertaken along survey transects and at two defined point count locations. In total, 18 species of birds were recorded during bird survey. Among them, 5 species were dependant birds observed feeding in the river channel including *Motacilla alba* (Photo 6), *Motacilla cinerea*, *Egretta garzetta* (Photo 7), *Amaurornis phoenicurus* and *Ardeola bacchus*. The dominant species was a common species in Hong Kong, *Pycnonotus jocosus*. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Some of the wetland dependent species recorded are classified as Regional Concern by Fellowes *et al* (2002) such as *Egretta garzetta* and *Ardeola bacchus*, which were usually observed feeding in the river. Bird abundance was similar to those recorded during baseline survey. Transect and Point Count locations were shown on **Figure 1**. Result of bird survey was presented in the **Table 4.3**.

4.2.2 Adult Odonata Survey

Odonata surveys were performed and a list of recorded odonata species at Upper Tai Po River is shown in **Table 4.4**. Number of odonata species recorded slightly increased by 2 species compared with last surveys and the result was similar to previous surveys conducted in approximate period of last year. In total, 9 species odonata were found, those recorded odonata were common species in Hong Kong (Photos 8-10). Increased abundance of odonata in this month was due to seasonality. The mean ambient temperature is highly related to their emergence for most species in Hong Kong, their abundance will increase following increased temperature from spring, when the peak emergence initiated until later late autumn (Wilson *et al*, 2004 & Tam *et al*, 2011). Mating behavior was observed during survey. Sampling location was shown in **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

Aquatic-net and kick sampling were performed at the river (Photo 9). The river benthic fauna collected was mainly comprised of insects, molluscs and

crustaceans. Details of recorded of river benthic fauna refers to **Table 4.5**. Sampling location was shown on **Figure 1**.

4.2.4 Hong Kong Newt

Surveys of Hong Kong Newt were conducted at Upper Tai Po River. Low abundance of Hong Kong Newt was observed only in reference sit. Hong Kong Newt is listed in Wild Animals Protection Ordinance (Cap. 170) and classified as “Near Threatened” under IUCN Red List Status and as “Potential Global Concern” by Fellowes *et al* (2002). Record of Hong Kong Newts can be referred to **Table 4.6**.

4.2.5 River Fish Fauna

Fish surveys were performed at Upper Tai Po River during surveys (Photo 9). In total, 12 species freshwater fish were recorded within project area. Fish abundance was low along the modified river channel. The *Glyptothorax pallozonum* (Photo 12), *Parazacco spilurus* and *Pseudobagrus trilineatus*, which have conservation interest, were restricted in the upper section of the surveyed river outside the works boundary where the habitat was not affected by construction works, while *Glyptothorax pallozonum* is a rare freshwater fish in Hong Kong, *Parazacco spilurus* is listed in China Red Data Book Status as Vulnerable and *Pseudobagrus trilineatus* is classified as Global Concern by Fellowes *et al* (2002). And the rare fish *Pseudobagrus trilineatus* was recorded consistently during recent monitoring. Very low abundance of fish was recorded because of frequent strong flooding occurred current wet season which could wash the fish out of the river. Details of records of fish fauna refers to **Table 4.6**. Sampling location was shown on **Figure 1**.

4.3 **Abiotic Data**

Data on water quality and major river hydrological feature (water flow and substratum) of the river were collected and are presented in the **Table 4.7**.

Generally, the water was clean and nutrient levels were generally low. Results of water test were presented in the **Table 4.7**.

The river substratums of upper and lower sections were comprised of 40% stone and 60% concrete, 20% stone and 80% concrete respectively. Moderate water flow up to 0.3m/second at pool and 0.6m/second at riffle was measured.

5 **Summary and Commentary**

Post construction ecological monitoring was carried out in current month and relevant biotic and abiotic data was collected according to project specification and EM & A Manual. Juveniles of Hong Kong Newt were recorded from the river channel. The rare fish *Pseudobagrus trilineatus* was consistently recorded in the river during recent monitoring. Abundance of fish decreased sharply due to frequent heavy rain events in current wet season. Bird abundance was similar to those recorded during baseline survey. Species richness of odonata increased this month and mating behavior was observed.

Aquatic and riparian vegetation along river channel was re-established compared to those recorded during baseline surveys. Vegetation has partially covered gabion wall and river bed along to the Upper Tai Po River. Vegetation coverage on the river bed decreased due to frequent heavy rain events in current wet season.

The water quality of the surveyed river was not polluted as indicated by low nutrient concentration level of ammonium and nitrate although the river channel may receive discharge and runoff from the village areas.

6 REFERENCES

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FIGURE

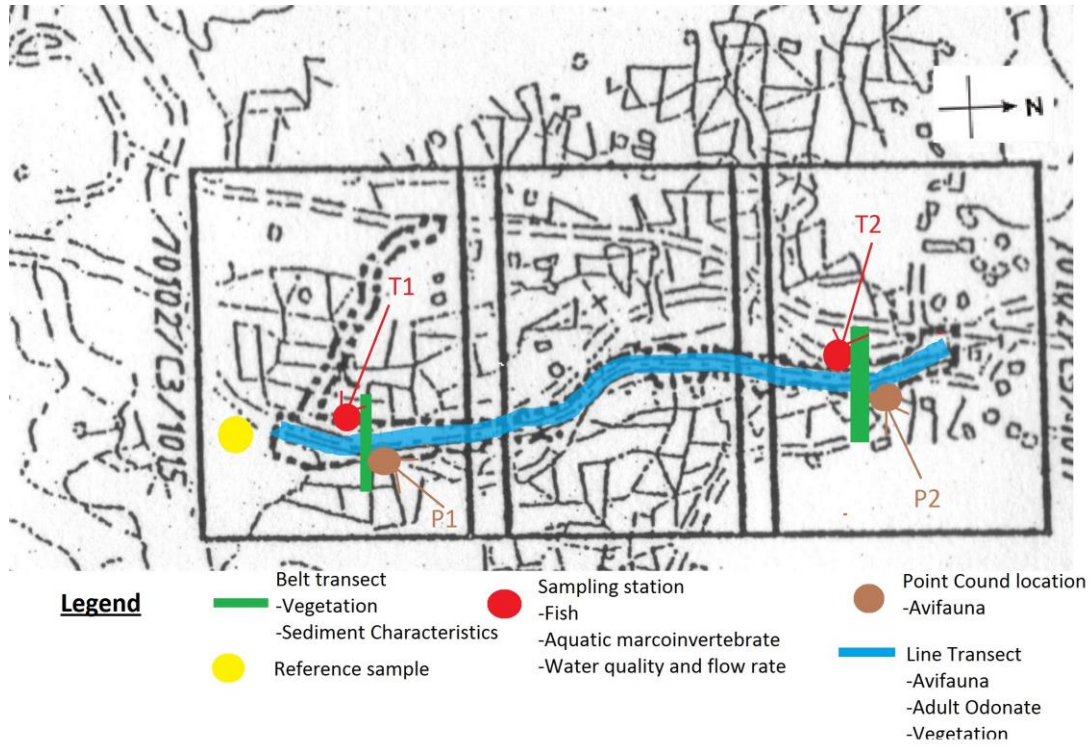


Figure 1. Sampling Location of Ecological Survey and Monitoring at Upper Tai Po River, Tai Po.

PHOTOS

	
<p>Photo 1: General view of the river channel (Reference site)</p>	<p>Photo 2: General view of the river channel (Upper section)</p>
	
<p>Photo 3: General view of the river channel (Middle section)</p>	<p>Photo 4: Vegetation growing on gabion (Middle section)</p>
	
<p>Photo 5: Abundant species - <i>Commelina diffusa</i> (Middle section)</p>	<p>Photo 6: Avifauna – <i>Motacilla alba</i></p>



Photo 7: Avifauna – *Egretta garzetta*



Photo 8: Odonata – *Macrodiplax cora*

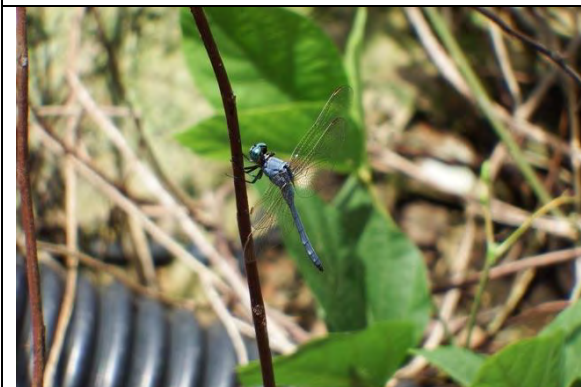


Photo 9: Odonata - *Orthetrum luzonicum*



Photo 10: Odonata - *Prodasineura autumnalis*



Photo 11: Aquatic samples shown invertebrates and fish.



Photo 12: Rare fish - *Glyptothorax pallozonum*

TABLE

Table 4.2. Flora species recorded from belt transect survey at the Upper Tai Po stream (T1 - Upper stream sampling site and T2 - Lower stream sampling site)

Family	Species	Chinese name	Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring											
			Jan-14		Feb-14		Mar-14		Apr-14		May-14		Jun-14		Jan-14		Feb-14		Mar-14		Apr-14		May-14		Jun-14		Jan-14		Feb-14		Mar-14		Apr-14		May-14		Jun-14	
			Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2			
Asteraceae	<i>Mikania micrantha</i>	蕨甘菊	0.4	40	0.4	5				0.4	40	0.4	8				0.3	5	0.3	20				0.3	5	0.3	25				0.3	5	0.3	25				
Moraceae	<i>Ficus hispida</i>	對葉榕																																				
Ulmaceae	<i>Celtis sinensis</i>	朴樹																																				
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹			0.6	3				0.6	5						0.4	5						0.4	5													
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐																0.5	1							0.5	1											
Araceae	<i>Alocasia odora</i>	海芋																																				
Araceae	<i>Colocasia esculenta</i>	芋	0.3	3					0.3	3																												
Myrtaceae	<i>Cleistocalyx operculatus</i>	水翁																																				
Athyriaceae	<i>Callipteris esculenta</i>	菜蕨																																				
Poaceae	<i>Phragmites karka</i>	卡開蘆	1.2	2					1.2	2							1.5	5						1.5	5													
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨																																				
Equisetaceae	<i>Equisetum debile</i>	箭筈草																																				
Asteraceae	<i>Ageratum conyzoides</i>	勝紅薊																																				
Commelinaceae	<i>Commelina diffusa</i>	箭筈草	0.4	6					0.4	6									0.1	5					0.1	3												
Solanaceae	<i>Solanum nigrum</i>	龍葵																																				
Euphorbiaceae	<i>Mallotus paniculatus</i>	白楸																																				
Poaceae	<i>Eleusine indica</i>	牛筋草			0.3	3				0.3	3																											
Poaceae	<i>Pennisetum purpureum</i>	象草																																				
Asteraceae	<i>Wedelia chinensis</i>	蟛蜞菊																																				
Asteraceae	<i>Bidens alba</i>	白花鬼針草	0.3	15	0.3	10			0.3	15	0.3	10																										
Poaceae	<i>Panicum repens</i>	結骨草	0.6	5					0.6	5							0.3	5						0.3	3													
Poaceae	<i>Coix lacryma-jobi</i>	薏苡																																				
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍																																				
Cucurbitaceae	<i>Benincasa hispida</i>	冬瓜																																				
Fabaceae	<i>Pueraria lobata</i>	野葛	0.2	10					0.2	10							0.4	10						0.4	15													
Convolvulaceae	<i>Merremia hederacea</i>	魚黃草																																				
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草															1.5	5						1.5	5													
Poaceae	<i>Brachiaria mutica</i>	巴拉草																																				
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香																																				
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大紅花			0.6	5				0.6	5																											
Cyperaceae	<i>Cyperus sp.</i>	莎草																																				
Balsaminaceae	<i>Impatiens walleriana</i>	非洲鳳仙																																				
Amaranthaceae	<i>Celosia argentea</i>	青葙																																				
Bare Ground			19		74				19		69						70		69					67		66						67		66				

- Reference point was the sampling location outside the works area used to compare with the data within works area.

P1 - Point count location 1; P2 - Point count location 2

Table 4.2. Flora species recorded from belt transect survey at the Upper Tai Po stream (T1 - Upper stream sampling site and T2 - Lower stream sampling site)

Family	Species	Chinese name	Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring					
			Reference		T1		T2		Reference		T1		T2		Reference		T1		T2		Reference		T1		T2		Reference		T1		T2		Reference		T1		T2	
			Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%				
Asteraceae	<i>Mikania micrantha</i>	蕨甘菊	0.4	8	0.4	25																																
Moraceae	<i>Ficus hispida</i>	對葉榕																																				
Ulmaceae	<i>Celtis sinensis</i>	朴樹																																				
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	0.6	5																																		
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐			0.6	1																																
Araceae	<i>Alocasia odora</i>	海芋																																				
Araceae	<i>Colocasia esculenta</i>	芋																																				
Myrtaceae	<i>Cleistocalyx operculatus</i>	水翁																																				
Athyriaceae	<i>Callipteris esculenta</i>	菜蕨																																				
Poaceae	<i>Phragmites karka</i>	卡開蘆	1.5	5																																		
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨																																				
Equisetaceae	<i>Equisetum debile</i>	筍管草																																				
Asteraceae	<i>Ageratum conyzoides</i>	勝紅蕒																																				
Commelinaceae	<i>Commelina diffusa</i>	箭筈草			0.2	4																																
Solanaceae	<i>Solanum nigrum</i>	龍葵																																				
Euphorbiaceae	<i>Mallotus paniculatus</i>	白楸																																				
Poaceae	<i>Eleusine indica</i>	牛筋草																																				
Poaceae	<i>Pennisetum purpureum</i>	象草																																				
Asteraceae	<i>Wedelia chinensis</i>	蟛蜞菊																																				
Asteraceae	<i>Bidens alba</i>	白花鬼針草																																				
Poaceae	<i>Panicum repens</i>	結骨草	0.4	3																																		
Poaceae	<i>Coix lacryma-jobi</i>	薏苡																																				
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍																																				
Cucurbitaceae	<i>Benincasa hispida</i>	冬瓜																																				
Fabaceae	<i>Pueraria lobata</i>	野葛	0.4	15																																		
Convolvulaceae	<i>Merremia hederacea</i>	魚黃草																																				
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草			1.5	5																																
Poaceae	<i>Brachiaria mutica</i>	巴拉草																																				
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香																																				
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大紅花																																				
Cyperaceae	<i>Cyperus sp.</i>	莎草																																				
Balsaminaceae	<i>Impatiens walleriana</i>	非洲鳳仙																																				
Amaranthaceae	<i>Celosia argentea</i>	青葙																																				
Bare Ground			64		65																																	

- Reference point was the sampling location outside the works area used to with the data within works area.

P1 - Point count location 1; P2 - Point count location 2

Table 4.2. Flora species recorded from belt transect survey at the Upper Tai Po stream (T1 - Upper stream sampling site and T2 - Lower stream sampling site)

Family	Species	Chinese name	Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring									
			Reference		T1		T2		Reference		T1		T2		Reference		T1		T2		Reference		T1		T2		Reference		T1		T2					
			Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%	Height (m)	%				
Asteraceae	<i>Mikania micrantha</i>	蕨甘菊	0.8	15			0.3	10	0.8	15					0.3	10	0.8	15			0.3	10	0.5	10			0.3	3	0.5	10			0.3	3		
Moraceae	<i>Ficus hispida</i>	對葉榕																																		
Ulmaceae	<i>Celtis sinensis</i>	朴樹																																		
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	1.3	5			1	5	1.3	5			1	5	1.3	5			1	5			1	5			1	3	1	5			1	3		
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐					0.6	1					0.6	1					0.6	1					0.5	1					0.5	1				
Araceae	<i>Alocasia odora</i>	海芋																																		
Araceae	<i>Colocasia esculenta</i>	芋	0.8	5					0.8	5					0.8	5			0.5	5							0.5	5								
Myrtaceae	<i>Cleistocalyx operculatus</i>	水翁																																		
Athyriaceae	<i>Callipteris esculenta</i>	菜蕨																																		
Poaceae	<i>Phragmites karka</i>	卡開蘆	1.7	10					1.7	10					1.7	10			1.5	10					1.5	10										
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨																																		
Equisetaceae	<i>Equisetum debile</i>	筇管草	0.3	5					0.3	5					0.3	5			0.3	5					0.3	5										
Asteraceae	<i>Ageratum conyzoides</i>	勝紅蕒			0.3	2					0.3	2					0.3	2			0.3	2								0.3	5			0.3	5	
Commelinaceae	<i>Commelina diffusa</i>	箭筈草	0.3	10			0.5	60	0.3	10			0.5	60	0.3	10			0.5	60	0.3	10			0.5	35	0.3	10			0.5	35			0.5	35
Solanaceae	<i>Solanum nigrum</i>	龍葵																																		
Euphorbiaceae	<i>Mallotus paniculatus</i>	白楸																																		
Poaceae	<i>Eleusine indica</i>	牛筋草																																		
Poaceae	<i>Pennisetum purpureum</i>	象草																																		
Asteraceae	<i>Wedelia chinensis</i>	錦雞菊																																		
Asteraceae	<i>Bidens alba</i>	白花鬼針草	1	5			0.8	2	1	5			0.8	2	1	5			0.8	2	0.7	5			0.6	2	0.7	5			0.6	2			0.6	2
Poaceae	<i>Panicum repens</i>	結骨草	0.6	5					0.6	5					0.6	5			0.4	5							0.4	5								
Poaceae	<i>Coix lacryma-jobi</i>	薏苡																																		
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍																																		
Cucurbitaceae	<i>Benincasa hispida</i>	冬瓜																																		
Fabaceae	<i>Pueraria lobata</i>	野葛																																		
Convolvulaceae	<i>Merremia hederacea</i>	魚貫草																																		
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草					4	10					4	10					4	10					2	7							2	7		
Poaceae	<i>Brachiaria mutica</i>	巴拉草																																		
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香			0.3	4					0.3	4					0.3	4							0.3	2					0.3	5				
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大紅花																																		
Cyperaceae	<i>Cyperus sp.</i>	莎草			0.2	6					0.2	6					0.2	6							0.2	3					0.2	5				
Balsaminaceae	<i>Impatiens walleriana</i>	非洲鳳仙					1	5					1	5																					1	3
Amaranthaceae	<i>Celosia argentea</i>	青葙	1.7	5					1.7	5					1.7	5					1.7	5					1.7	5								
Bare Ground				35		88		7		35		88		7		35		88		7		40		93		46		40		85					46	

- Reference point was the sampling location outside the works area used to with the data within works area.

P1 - Point count location 1; P2 - Point count location 2

Table 4.5 Aquatic Macro invertebrates recorded at Upper Tai Po River (T1- Upper stream sampling site and T2- Lower stream sampling site)

Species	Chinese name	Sampling point	Pre construction monitoring			Pre construction monitoring			Pre construction monitoring			Pre construction monitoring			Pre construction monitoring			Pre construction monitoring			Pre construction monitoring			Post construction monitoring			Post construction monitoring			Post construction monitoring			Post construction monitoring												
			Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2										
Molluscs																																													
<i>Biomphalaria sp.</i>	--	NP	VC	+			+			+			+			+			+			+			+			+			+			+			+			+					
<i>Brotia hainanensis</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
<i>Melanoides tuberculata</i>	縮擬黑螺	NP	VC				+																																						
<i>Physella acuta</i>	尖膀胱螺	NP	VC																																										
<i>Pomacea canaliculata</i>	福果螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
<i>Radix plicatulus</i>	羅白螺	NP	VC	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
<i>Sinotaia quadrata</i>	田螺	NP	VC	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Insects																																													
<i>Anisocentropus sp.</i>	--	NP	VC	+			+																																						
<i>Arctopora sp.</i>	--	NP	VC																																										
<i>Aulocodes sp.</i>	--	NP	VC																																										
<i>Baetis sp.</i>	--	NP	VC	+			+																																						
<i>Chironomus sp.</i>	蠓幼虫	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Ephemera sp.</i>		NP	VC	+			+																																						
<i>Indobaetis sp.</i>	--	NP	VC	+			+																																						
<i>Mnais sp.</i>	--	NP	VC	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Orthetrum sp.</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Perla sp.</i>	--	NP	VC				+																																						
<i>Rhaphium sp.</i>	--	NP	VC				+																																						
<i>Tipulidae spp.</i>	--	NP	VC																																										
Crustacea																																													
<i>Caridina cantonensis</i>	廣東米蝦	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Cryptopotamon anacoluthon</i>	肥刺溪蟹	NP	C	+			+																																						
<i>Macrobrachium hainanense</i>	海南沼蝦	NP	VC	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Note:
 "NP" – Not protected in Hong Kong
 "P" - Listed in Wild Animals Protection Ordinance (Cap. 170) and Listed as "Near Threatened" in IUCN Red List Status
 "VC" – Very Common; "UC" – Uncommon; "C" - Common
 "+" – Species exists in the study area
 "++" – Species common in the study area
 "+++" – Species abundance in the study area
 - Reference point was the sampling location outside the works area used to compare the with the data within works area.

Table 4.6 Fish species and Hong Kong Newt recorded at Upper Tai Po River (T1- Upper stream sampling site and T2 - Lower stream sampling site)

Species	Status	Commonness	Baseline survey		Post construction monitoring																							
			Oct-07		Dec-14		Jan-15			Feb-15			Mar-15			Apr-15			May-15			Jun-15						
			T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2	Reference	T1	T2			
<i>Cyprinus carpio var. viridivittatus</i>	錦鯉	NP	C																									
<i>Gambusia affinis</i>	食蚊魚	NP	VC	+	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
<i>Glyptothorax pallozonum</i>	白線紋胸鮡	NP	R			+																						
<i>Liniparhomaloptera disparis</i>	擬平鰻	NP	C			+																						
<i>Misgurnus anguillicaudatus</i>	泥鰻	NP	C			+																						
<i>Oreochromis niloticus</i>	尼羅口孵非鯽	NP	C	+			+																					
<i>Parazacco spilurus</i>	異鱸	V and NP	C	++		+	+																					
<i>Poecilia reticulata</i>	孔雀花魚將	NP	C	++	+																							
<i>Pseudobagrus trilineatus</i>	三線擬鱧	NP,GC	R			+																						
<i>Pseudogastromyzon myersi</i>	麥氏擬腹吸鰻	NP	C	+		+																						
<i>Pterocryptis cochinchinensis</i>	越南隱鱗鮡	NP	C			+																						
<i>Puntius semifasciolatus</i>	七星魚	NP	C	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
<i>Rhinogobius spp.</i>	鰻虎魚	NP	C	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
<i>Schistura fasciolata</i>	橫紋南鰻	NP	C	+		+																						
<i>Xiphophorus hellerii</i>	劍尾魚	NP	C	++		+																						
<i>Xiphophorus variatus</i>	雜色劍尾魚	NP	C	+																								
		2x2m fish		70	60	60	30	30	50	20	20	40	20	20	50	20	20	40	15	20	12	4	2	10	4	2		
Amphibian																												
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P	UC			+																						

Note: NP – Not protected in Hong Kong; P – Protected in Hong Kong

“VC” – Very Common; “UC” – Uncommon; “C” – Common

“+” – Species exists in the study area

“++” – Species common in the study area

“+++” – Species abundance in the study area

V – Listed as vulnerable in China Fish Red Data Book

GC- Global Concern - Fellowes *et al* (2002)

- Reference point was the sampling location outside the works area used to compare with the data within works area.

