

Issue No. : Issue 1
Issue Date : December 2015
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**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. 16**

Prepared By:

ALLIED ENVIRONMENTAL CONSULTANTS LTD.

For:

Drainage Services Department

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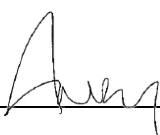
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**Agreement No. CE65/2013(EP)
Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation**

**Post-Construction Ecological Monitoring Report (No. 16)
Upper Lam Tsuen River**

April 2015



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May 22, 2015

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May 22, 2015

Ecology Team: China-Hong Kong Ecology Consultants

Post-Construction Ecological Monitoring Report (No. 16)

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 16 post-construction ecological monitoring report for the project conducted **on 22nd April 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 in **on 22nd April 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 was in natural fluctuation ; and
- Abundance of a target river fauna (i.e. *Paramesotriton hongkongensis* adult was recorded along the Lam Tsuen River and was abundant during the survey.

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 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 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 has followed 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 of the river channel (T3 and T4) and the other two located at the upper section of the river (T1 and T2). 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 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 has followed those documented in the AFCD website (www.hkbiobiodiversity.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, 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. Higher density of vegetation was observed during current months since there was no heavy rain events which would wash away plants (Photos 1-3). In total, 65 flora species were recorded within the survey transects along the river course. Among those recorded flora, native species

Commelina diffusa and exotic species *Brachiaria mutica* (Photo 4) were the dominated species recorded along the river. 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 3m 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, 31 species of birds were recorded during the bird and 8 of the total were wetland dependent species including *Ardeola bacchus*, *Alcedo atthis*, *Actitis hypoleucos*, *Motacilla cinerea*, *Egretta garzetta* (Photo 5), *Ardea alba*, *Motacilla alba* and *Amaurornis phoenicurus*, they were commonly observed foraging in the river channel. The dominant species were *Pycnonotus jocosus* and *Acridotheres cristatellus*, they are both very common species in Hong Kong. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Among the recorded species, *Milvus lineatus* is also protected by Endangered Species of Animals and Plants Ordinance (Cap. 586) and classified as Regional Concern by Fellowes *et al* (2002). Some of the recorded wetland dependent birds are classified as Regional Concern by Fellowes *et al* (2002), they were *Egretta garzetta*, *Ardeola bacchus* and *Ardea alba*, which usually observed feeding in the river. *Centropus sinensis* 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, 9 odonata species were recorded during the survey and all of recorded species were common species (Photos 6-7) and the result was similar to previous surveys conducted in approximate period of last year. Species richness significantly increased by 5 species in this month compared with last month due to seasonality. The increased temperature of current season is appropriate for odonata to emerge, their abundance will keep increasing from spring until later 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. 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 8). This amphibian species was seen and captured by hand nets along the river, but their density was low compared with the density recorded during their breeding season. 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). Riparian vegetation grown along the channel especially along water margin could provide shelter and breeding habitat for Hong Kong Newt. 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 9-10). In total, 16 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 considered with conservation interest and observed along the river with low abundance. Fish counting at 2 x 2 meter area were performed and number of fish individuals was similar to last month. 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 0.6m/second at riffle).

5 **Summary and Commentary**

Post construction ecological monitoring was carried out in April 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 individual of amphibian *Paramesotriton hongkongensis* were recorded in lower 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 parallen*, *Parazacco spilurus*

recorded in the river is also considered with conservation interest and observed along the river with low abundance.

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. Significant increased species richness of odonate was observed in this month due to seasonality.

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.

6 REFERENCES

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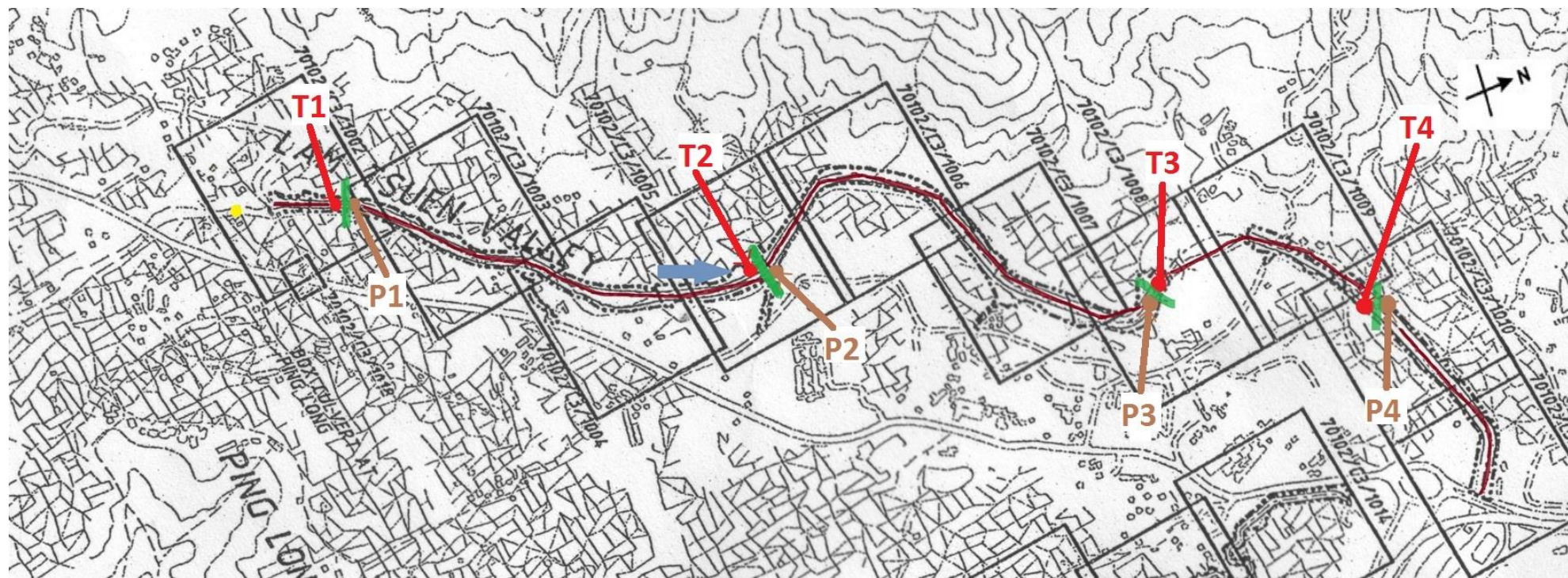
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FIGURES



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)

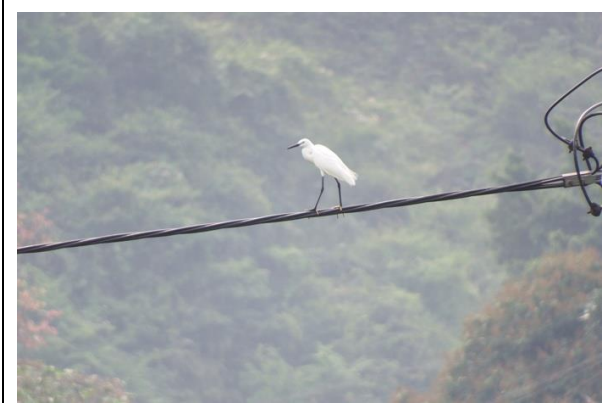


Photo 5: Avifauna - *Egretta garzetta*

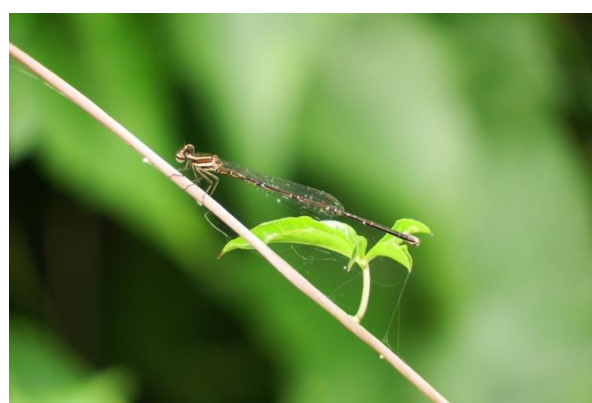


Photo 6: Dragonfly - *Copera marginipes*



Photo 7: Dragonfly - *Prodasineura autumnalis*



Photo 8: Hong Kong Newt



Photo 9 : Kicking sampling for fish



Photo 10: Aquatic samples obtained from kicking sampling to show 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)

Stream	Transect	Baseline monitoring								Post construction monitoring								Post construction monitoring								Post construction monitoring								
		Jul-08				Aug-08				Sep-14				Oct-14				Nov-14																
		P1		P4		P1		P4		T1		T2		T3		T4		T1		T2		T3		T4		T1		T2		T3		T4		
Family	Species	Chinese name	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	0.4	40			0.4	40			0.7	5																						
Fabaceae	<i>Pueraria lobata</i>	野葛	0.5	30			0.5	30					0.3	5	0.3	5														0.6	10			
Poaceae	<i>Pennisetum purpureum</i>	象草	3	20			3	20																										
Araceae	<i>Alocasia odora</i>	海芋	1	10			1	10															1.8	1						1.8	1			
Caesalpiniaceae	<i>Cassia alata</i>	翅葉決明			1.2	10			1.2	10																								
Magnoliaceae	<i>Michelia alba</i>	白蘭			6	10			6	10																								
Poaceae	<i>Brachiaria mutica</i>	巴拉草			1.2	70			1.2	70	0.6	10	0.8	12			0.8	8	1	10	1.5	15	1.3	30	1	5	1	10	1.5	15	1.3	30	1	5
Moraceae	<i>Ficus hispida</i>	對葉榕																																
Asteraceae	<i>Mikania micrantha</i>	薇甘菊											0.3	8	0.3	15	0.3	10	0.3	15	0.3	15	0.3	15	0.3	15	0.3	18	0.3	18	0.3	18	0.3	18
Musaceae	<i>Musa paradisiaca</i>	大蕉																																
Ulmaceae	<i>Celtis sinensis</i>	朴樹			6	10			6	10																								
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									0.5	20	0.6	12	0.7	15	0.6	10	0.5	5	0.8	12	0.7	10			0.5	5	0.8	12	0.7	10		
Poaceae	<i>Coix lacryma-jobi</i>	薏苡																	2	5							2	5						
Solanaceae	<i>Solanum nigrum</i>	龍葵																																
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草																																
Poaceae	<i>Miscanthus floridulus</i>	五節芒																																
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐																																
Asteraceae	<i>Wedelia chinensis</i>	錦雞菊																																
Commelinaceae	<i>Commelina diffusa</i>	節節草									0.3	10			0.3	5			0.3	10	0.8	20			0.3	20	0.3	12	0.8	22			0.3	20
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											0.3	1	0.3	2	0.3	1					0.3	2	0.1	1				0.3	2	0.1	1	
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香																	2	30	2	15	2	10	1.8	5	2	25	2	13	2	10	1.8	5
Amaranthaceae	<i>Celosia argentea</i>	青葙																																
Bare Gound											55		67		58		66		25		23		18		43		25		20		15		40	

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)

		Post construction monitoring								Post construction monitoring								Post construction monitoring								Post construction monitoring								Post construction monitoring							
Stream		Dec-14				Jan-15				Feb-15				Mar-15				Apr-15																							
Transect		T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4																
Family	Species	Chinese name	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																																							
Fabaceae	<i>Pueraria lobata</i>	野葛						0.6	10																0.6	10															
Poaceae	<i>Pennisetum purpureum</i>	象草											3	15											3	15															
Araceae	<i>Alocasia odora</i>	海芋				1.8	1						1.8	1											1.8	1															
Caesalpinaceae	<i>Cassia alata</i>	翅葉決明																																							
Magnoliaceae	<i>Michelia alba</i>	白蘭																																							
Poaceae	<i>Brachiaria mutica</i>	巴拉草	1	10	1.5	15	1.3	30	1	5	1	20	1	20	1.3	20	1	10	1	20	1	20	1.2	20	1.4	20	1	10													
Moraceae	<i>Ficus hispida</i>	對葉榕																																							
Asteraceae	<i>Mikania micrantha</i>	薇甘菊	0.3	18	0.3	18	0.3	18	0.3	18	0.4	10	0.4	15	0.3	5	0.3	20	0.4	10	0.4	15	0.3	5	0.3	20	0.4	10													
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	0.5	5	0.8	12	0.7	10			1	10	0.4	15	1	15			1	10	0.7	15	1	15			1	10													
Poaceae	<i>Coix lacryma-jobi</i>	薏苡	2	5																																					
Solanaceae	<i>Solanum nigrum</i>	龍葵																																							
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草																																							
Poaceae	<i>Miscanthus floridulus</i>	五節芒																																							
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐																																							
Asteraceae	<i>Wedelia chinensis</i>	蟛蜞菊																																							
Commelinaceae	<i>Commelina diffusa</i>	節節草	0.3	12	0.8	22			0.3	20	0.4	10	0.4	20			0.3	20	0.5	10	0.5	20			0.3	20	0.5	10													
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				0.3	2	0.1	1																																
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香	2	25	2	13	2	10	1.8	5	2	30	2	10	2	5	1.8	5	2	30	2	10	2	5	2	30	2	10													
Amaranthaceae	<i>Celosia argentea</i>	青葙				1.5	15																																		
Bare Gound				25		20		15		40		20		20		30		19		20		20		30		19															

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

Table 4.4. Odonate species recorded at the Upper Lam Tsuen River

					Baseline monitoring		Impact monitoring									
Species	Common name	Chinese name	Status	Common-ness	Jul-08	Aug-08	Jan-09	Jul-09	Jan-10	Jul-10	Jan-11	Jul-11	Jan-12	Jul-12	Aug-13	Dec-13
<i>Acisoma panorpoides panorpoides</i>	Asian Pintail	錐腹蜻	NP	VC												
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC										+	+	
<i>Ceriatrigon auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘黃蟳	NP	VC												
<i>Coeliccia cyanomelas</i>	Blue Forest Damsel	黃紋長腹蟳	NP	VC												
<i>Copera marginipes</i>	Yellow Featherlegs	黃狹扇蟳	NP	VC	+							+		+		
<i>Crocothemis servilia servilia</i>	Crimson Darter	紅蜻	NP	VC	+	+	+	+		++						
<i>Euphaea decorata</i>	Black-banded Gossamerwing	方帶幽蟳	NP	VC												
<i>Ictinogomphus pertinax</i>	Common Flangetail	霸王葉春蜓	NP	C												
<i>Ischnura senegalensis</i>	Common Blue Jewel	褐斑異痣蟳	NP	VC												
<i>Mnais lacteola</i>	Indochinese Copperwing	煙翅綠色蟳	P, LC	C												
<i>Nannophya pygmaea</i>	Scarlet Dwarf	侏紅小蜻	P, LC	C												
<i>Neurobasis chinensis</i>	Chinese Greenwing	華麗色蟳	NP	VC						+		+	+	+	+	+
<i>Neurothemis fulvia</i>	Russet Percher	網脈蜻	NP	VC												
<i>Neurothemis tullia tullia</i>	Pied Percher	截斑脈蜻	NP	C												
<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 pruinosum neglectum</i>	Common Red Skimmer	赤褐灰蜻	NP	VC								+				
<i>Orthetrum sabina sabina</i>	Green Skimmer	狹腹灰蜻	NP	VC						+						
<i>Pantala flavescens</i>	Wandering Glider	黃蜻	NP	VC	+	+		+				++				
<i>Paracercion calamorum duyeri</i>	Dusky Lilysquatter	葦尾蟳	P, LC	C												
<i>Prodasineura autumnalis</i>	Black Threadtail	烏齒原蟳	NP	VC												
<i>Pseudagrion rubriceps rubriceps</i>	Orange-faced Sprite	丹頂斑蟳	NP	UC		+										
<i>Rhinocypha perforata perforata</i>	Common Blue Jewel	三斑鼻蟳	NP	VC		+				+						
<i>Rhyothemis variegata arria</i>	Variegated 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,PGC	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 abundant/dominant in 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 Upper Lam Tsuen River

Species	Common name	Chinese name	Status	Common-ness	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
<i>Acisoma panorpoides panorpoides</i>	Asian Pintail	錐腹蜻	NP	VC						+										
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC								+								
<i>Ceriatrigon auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘黃蟳	NP	VC				+	+	+	+	+	+	+				+		
<i>Coeliccia cyanomelas</i>	Blue Forest Damsel	黃紋長腹蟳	NP	VC				+												
<i>Copera marginipes</i>	Yellow Featherlegs	黃狹扇蟳	NP	VC				+		+	+	+	+	+					+	
<i>Crocothemis servilia servilia</i>	Crimson Darter	紅蜻	NP	VC			+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Euphaea decorata</i>	Black-banded Gossamerwing	方帶幽蟳	NP	VC				+		+										
<i>Ictinogomphus pertinax</i>	Common Flangetail	霸王葉春蜓	NP	C							+									
<i>Ischnura senegalensis</i>	Common Blue Jewel	褐斑異痣蟳	NP	VC				+	+	+										
<i>Mnais lacteola</i>	Indochinese Copperwing	煙翅綠色蟳	P, LC	C				+												
<i>Nannophya pygmaea</i>	Scarlet Dwarf	侏紅小蜻	P, LC	C				+												
<i>Neurobasis chinensis</i>	Chinese Greenwing	華麗色蟳	NP	VC			+	+	+	+	+	+	+	+	+				+	
<i>Neurothemis fulvia</i>	Russet Percher	網脈蜻	NP	VC							+	+	+	+					+	
<i>Neurothemis tullia tullia</i>	Pied Percher	截斑脈蜻	NP	C								+								
<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 pruinosum neglectum</i>	Common Red Skimmer	赤褐灰蜻	NP	VC					+	+	+	+	+	+						
<i>Orthetrum sabina sabina</i>	Green Skimmer	狹腹灰蜻	NP	VC								+								
<i>Pantala flavescens</i>	Wandering Glider	黃蜻	NP	VC	+				+					+	+	+			+	
<i>Paracercion calamorum duyeri</i>	Dusky Lilysquatter	葦尾蟳	P, LC	C				+												
<i>Prodasineura autumnalis</i>	Black Threadtail	烏齒原蟳	NP	VC				+	+	+	+	+	+	+					+	
<i>Pseudagrion rubriceps rubriceps</i>	Orange-faced Sprite	丹頂斑蟳	NP	UC					+	+	+	+	+	+	+					
<i>Rhinocypha perforata perforata</i>	Common Blue Jewel	三斑鼻蟳	NP	VC				+			+	+	+	+	+					
<i>Rhyothemis variegata arria</i>	Variegated 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,PGC	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 abundant/dominant in 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 4.5 Aquatic Macro invertebrates recorded at Lam Tsuen River (T1- upper river channel sampling site . T4 - lower river channel sampling site)

Species	Chinese name	Sampling point		Baseline monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring											
		Status	Common	Jul-08		Aug-08		Jan-09				Jul-09				Jan-10				Jul-10				Jan-11				Jul-11				Jan-12				Jul-12				Aug-13				Dec-13			
				Upper stream	Lower stream	Upper stream	Lower stream	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4					
Molluscs																																															
<i>Biomphalaria</i> sp.	--	NP	VC	+	+	+																																									
<i>Brotia hainanensis</i>	--	NP	VC	+++	++	++	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Melanoides tuberculata</i>	縮腹黑螺	NP	VC	+																																											
<i>Pomacea canaliculata</i>	福寿螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Radix plicatulus</i>	蓮白螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Sinoia quadrata</i>	田螺	NP	VC	+																																											
Insects																																															
<i>Boetis</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Coenis</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Chironomus</i> sp.	孑孓幼虫	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Electrogenus</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Hydropsyche</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Indobaetis</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Mnais</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Orthotrum</i> sp.	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
Crustaceans																																															
<i>Caridina cantanensis</i>	廣東赤蟹	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Cryptopotamon anacoluthon</i>	蟹刺螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Macrobrachium hainanense</i>	海南沼蟹	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Somaniathelphusa zankon</i>	東螺蟹	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							

Note: NP - Not protected in Hong Kong;
P - Protected in Hong Kong
"VC" - Very Common; "UC" - Uncommon; "C" - Common; "R" - Rare
+, occurred; ++, common; +++, abundant/dominant. Species in the study area
"*" - including target species of *Rhinogobius cervicosquamis*
Reference point was the sampling location outside the works area.

Table 4.6 Fish species and amphibians at Upper Lam Tsuen River (T1- upper river channel sampling site , T4 - lower river channel sampling site)

Species	Chinese name	Status	Commonness	Baseline monitoring		Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact 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				Aug-13				Dec-13													
				Upper stream	Lower stream	Upper stream	Lower stream	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4															
Fish																																																									
<i>Acrossocheilus parallens</i>	副條光唇魚	NP	R		+		+																																																		
<i>Channa maculata</i>	斑鱧	NP	Common				+																																																		
<i>Cirrhina moliorella</i>	鯪魚	NP	C																																																						
<i>Clarias fuscus</i>	胡子鯪	NP	C																																																						
<i>Cyprinus carpio var. viridivittatus</i>	錦鯉	NP	C																																																						
<i>Gambusia affinis</i>	食蚊魚	NP	VC			+	+	+																																																	
<i>Limparhomaloptera disparis</i>	擬平鰲	NP	C																																																						
<i>Misgurnus anguillicaudatus</i>	泥鰌	NP	Common	+		+																																																			
<i>Oreochromis niloticus</i>	尼羅口孵非鯪	NP	C		+		+																																																		
<i>Parazacco spilurus</i>	黃魮	V and	Common	+		+																																																			
<i>Poecilia reticulata</i>	孔雀花魚	NP	VC			+	+																																																		
<i>Pseudogastromyzon myersi</i>	麥氏擬腹吸鰍	NP	C		+	+	+	+	++	++	++	+																																													
<i>Pterocryptis cochinchinensis</i>	黃魮	NP	C																																																						
<i>Puntius semifasciolatus</i>	七星魚	NP	C	++	+	++	+	+	+	++																																															
<i>Rhinogobius spp.</i>	鰻虎魚	NP	C/UN/R		+	+	+	+	+	+																																															
<i>Schistura fasciolata</i>	橫紋南鰍	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>	寬鳍鱮	NP	C		+	++	+	++	+++	+++	+++	+++																																													
2x2m fish counting			Number of fish	70	60	75	60	38	45	40	40	8	38	20	5	15	7	38	20	5	15	7	32	12	6	10	20	30	22	10	7	5	10	4	2	0	0	6	3	1	0	0	8	5	2	0	0	5	2	3	2	3	5	2	3	2	3
Amphibian																																																									
<i>Paramesotriton hongkongensis</i>	香港澤蛙	P (Cap 170, NT, PGC)	R		+		+																																																		
<i>Fejervarya limnocharis</i>	澤蛙	NP	VC																																																						

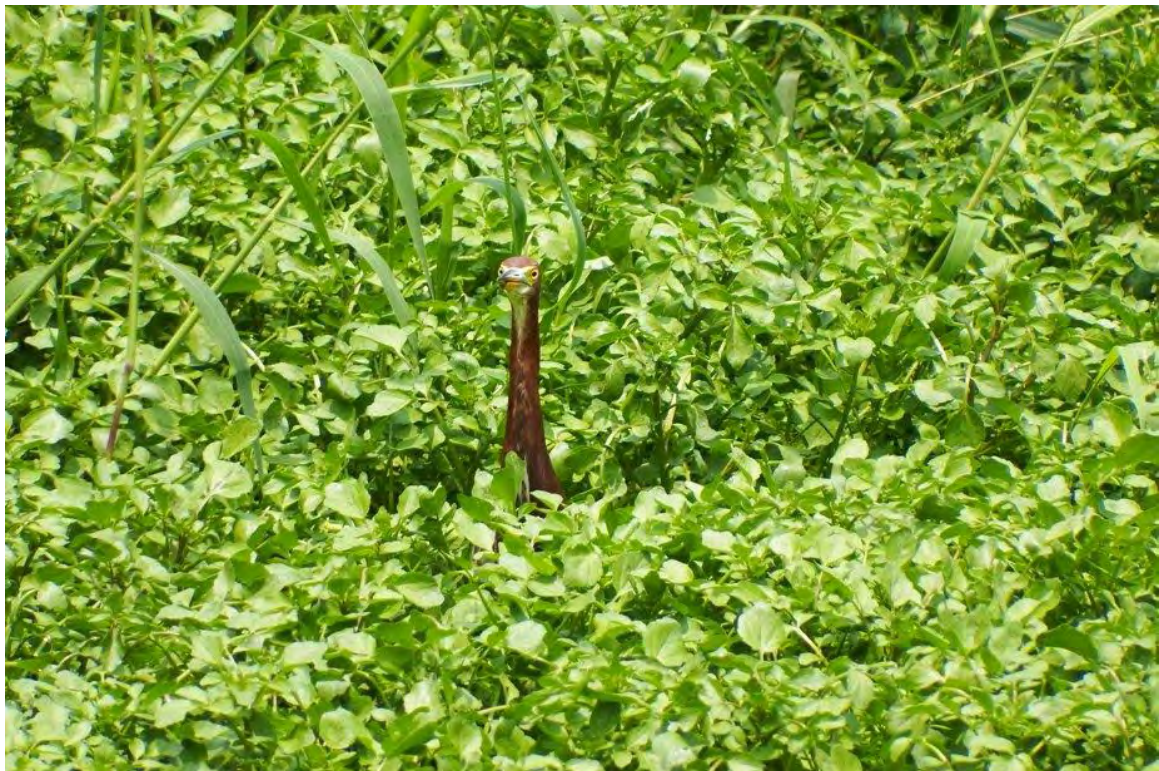
Note: NP - Not protected in Hong Kong ; P- Protected in Hong Kong
 "VC" - Very Common; "UC" - Uncommon; "C" - Common; "R" - Rare
 +, occurred; ++, common; +++, abundant/dominant Species in the the study area
 -V - Listed as Vulnerable in China Fish Red Data Book
 -Reference point was the sampling location outside the works area used to compare the with the data within works area.
 *Cap 170 - List in Wild Animals Protection Ordinance (Cap.170)
 *NT - Near Threatened in IUCN Red List Status
 *PGC - Potential Global Concern by Fellowes et al (2002)

Table 4.7 Abiotic data for Upper Lam Tsuen River(T1- upper river channel sampling site , T4 -lower river channel sampling site)

Parameter / date	Baseline monitoring	Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Post construction monitoring																		
	8-Aug	Jan-09				Jul-09				Jan-10				Jul-10				Jan-11				Jul-11				Jan-12				Jul-12				Aug-13				Dec-13				Jan-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	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4				
Replicate																																																
DO (mg/L)	9.2	9.8	9.9	9.4	9.1	6.4	6.4	6.5	6.8	9.7	9.5	9.5	9.3	8.3	8.5	8.5	8.7	9.6	9.5	9.5	9.1	9.5	9.6	9.4	9.3	9.4	9.2	9.4	9.2	8.2	8	7.8	7.3	8.9	8.5	8.7	8.8	9.3	8.6	8.8	8.7	9.1	9.0	8.6	8.5			
pH	7.89	7.24	7.36	7.53	7.44	7.1	7.25	7	7.05	7.9	8.1	8.1	8.2	7.4	7.5	7.3	7.4	7.1	7.2	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.2	6.9	6.8	6.7	6.8	6.7	6.8	7.1	7.3	7.6	6.5	6.8	6.8	7.1	6.2	6.9	7.1	7.1	6.2	6.9	7.1	7.1
Nitrate (mg NL)	0.36	0.79	1.1	1.2	1.2	0.31	0.48	0.48	0.39	0.56	1.11	1.13	1.33	0.1	0.2	0.2	0.3	0.1	0.2	0.4	0.5	0.1	0.2	0.3	0.45	0.2	0.3	0.5	0.6	0.13	0.67	0.62	0.82	0.74	0.72	0.83	0.79	0.48	0.57	0.77	0.89	0.9	0.8	1.3	1.26			
Ammonia (mg/L)	<0.01	PC4+P (µg P/L): <100				0.02	0.02	0.02	0.03	0.01	0.16	0.17	0.07	0.2	0.4	0.2	0.2	0.05	0.07	0.07	0.1	0.06	0.05	0.08	0.1	0.04	0.05	0.06	0.2	0.01	0.02	0.04	0.03	0.02	0.03	0.03	0.04	<0.01	<0.01	<0.01	<0.01	0.04	0.1	0.12	0.15			
Salinity (ppt)	<0.1	<0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conductivity (µS/cm)	60	80	100	120	120	45	51	52	63	62	96	98	114	84	100	460	54	90	87	93	120	93	90	90	100	92	84	96	110	41	38	73	86	67	77	74	75	62	64	90	110	72	78	88	108			
BOD (mg/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<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				0.01-0.2					0.01-0.2				0.01-0.2				0.01-0.2				0.01-0.2				0.01-0.2				0.01-0.2				0.01-0.2				0.01-0.2				0.01-0.2						
Water flow at riffle (m/s)	0.4-0.7				0.2-0.5					0.2-0.6				0.2-0.6				0.2-0.6				0.2-0.6				0.2-0.6				0.2-0.6				0.2-0.6				0.2-0.6										
Sand (%)	15	15	10	10	10	10	10	10	15	8	8	8	15	8	8	8	15	8	8	8	15	8	8	8	15	10	15	10	10	10	10	10	10	10	10	10	10	10	10	10	10	5	5	5	5	5	5	5
Stone (%)	80	80	88	88	88	88	88	88	70	90	90	90	90	90	90	70	90	90	90	90	70	90	90	90	70	80	70	80	70	60	60	60	60	75	75	75	75	90	85	85	85	90	85	85	85			
Mud (%)	5	5	2	2	2	2	2	2	5	5	2	2	2	5	2	2	2	5	2	2	2	5	2	2	2	5	10	15	10	30	30	30	30	15	15	15	15	5	10	10	10	5	10	10				

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.16)
She Shan River

April 2015



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May 22, 2015

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May 22, 2015

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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.16) She Shan River

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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 16 post-construction ecological monitoring report for the project conducted **on 21st April 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 21st April 2015**;
- Fauna and flora along the drainage project sections is in a process of re-establishing or restoration;
- Bird diversity and abundance was in natural fluctuation; and
- Odonata abundance was increasing compared to last month. Hong Kong Newt *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 (T3) portion 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 three locations located at the lower (T3), middle (T2) and upper (T1) portion of the river channel. 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, 51 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 0.4m to 2m 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 (Photos 1-3). Aquatic plants *Brachiaria mutica* and *Commelina diffusa* were 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, 28 species of birds were recorded during the bird surveys within project area (Photos 5&6). 6 species of total recorded were wetland dependant birds and observed foraging in the river channel including *Ardeola bacchus*, *Ardea cinerea*, *Egretta garzetta*, *Motacilla cinerea*, *Motacilla alba* and *Amaurornis phoenicurus*. The dominant species of the river was common species *Pycnonotus jocosus*. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Some recorded species was under protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) including *Milvus lineatus*, which was also considered as Regional Concern by Fellowes *et al* (2002). *Centropus sinensis* is listed in Red China Data Book Status as Vulnerable. In addition, some of wetland dependent species including *Egretta garzetta*, *Ardeola bacchus*, and *Ardea cinerea* are considered as Regional Concern and Potential Regional Concern by Fellowes *et al* (2002) respectively, they were always found foraging in the river. Due to seasonality, some of summer visitors were recorded such as *Cuculus sparverioides* and *Cacomantis merulinus*, among them *Cacomantis merulinus* was an uncommon summer visitor in Hong Kong. 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 significant increase in species richness was observed this month comparing to last month as the current season is the peak emergence for most of odonata species in Hong Kong, their abundance will keep increasing during current season until late autumn (Wilson *et al*, 2003 & Tam *et al* (2011). In total, 10 species were recorded, it was double amount of species recorded from last month and similar to the previous result of approximate period in last year. Mating behavior was observed. Sampling location was shown on **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

The river benthic fauna collected was mainly comprised of insects, molluscs and crustaceans. 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. The newts were only captured at sampling point T2 (Photo 9), where the habitat consisted of riparian vegetation. Abundant riparian vegetation regenerated along the channel could provide shelter and breeding habitat for Hong Kong Newt. This amphibian species was seen and captured by hand nets at only one sampling point and their density was low compared with the density recorded during their breeding season. 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 Fish Fauna

Fish surveys were performed at She Shan River (Photo 10&11) and total 13 species of freshwater fish were recorded. Native fish *Zacco platypus* was the 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 (Photo 12). The density of fish including gobies recorded slightly decreased comparing to last month. 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 levels were 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. *Paramesotriton hongkongensis* was only recorded at sampling point T2 with low abundance. Mating behavior of odonata was observed. The rest of fauna was in a natural fluctuation except slightly 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

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

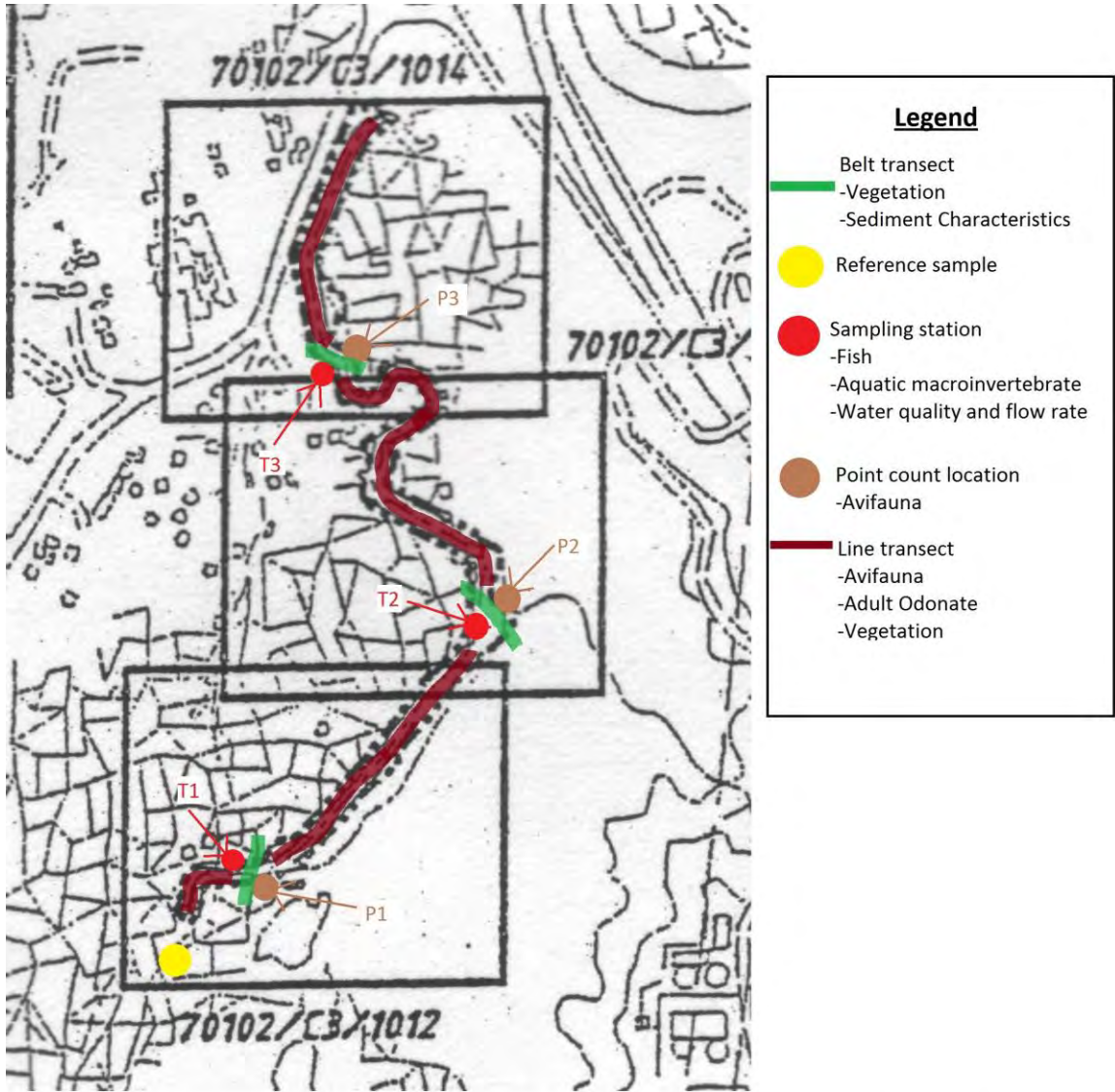


Figure 1. Sampling Location of Ecological Survey and Monitoring at She Shan River, Tai Po.

PHOTOS



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



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



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



Photo 4: Abundant species: *Brachiaria mutica* and *Commelina diffusa*

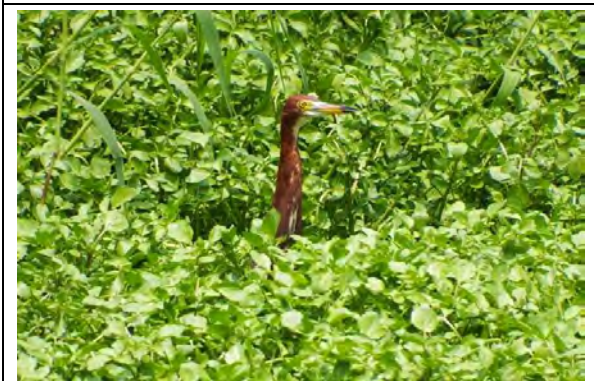


Photo 5: Avifauna - *Ardeola bacchus*

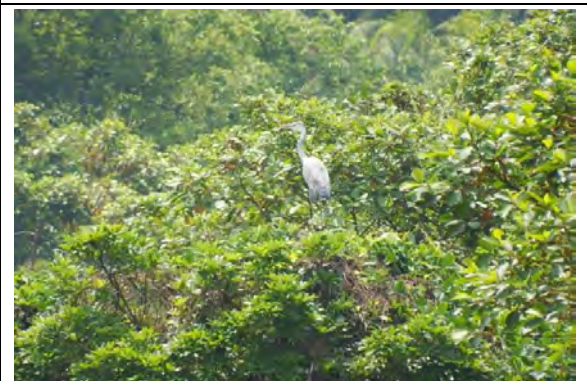


Photo 6 : Avifauna - *Ardea cinerea*



Photo 7: Odonata - *Ceriagrion auranticum ryukyuanum*



Photo 8: Odonata : *Neurothemis fulvia*



Photo 9: Hong Kong Newt



Photo 10: Benthic Sampling



Photo 11: Aquatic samples collected from kicking sampling



Photo 12: Fish observed in She Shan River - *Parazacco spilurus*

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	Stream Transect	Baseline monitoring								Post construction monitoring						Post construction monitoring					
			Jul-08				Aug-08				Oct-14						Nov-14					
			P1		P3		P1		P3		T1		T2		T3		T1		T2		T3	
Chinese name	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>	節節草			0.2	20			10	6	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	
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>	苧麻	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	
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	
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	
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨																				
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草								2	15	3	5			2	10	3	2			
Araceae	<i>Alocasia 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	
Bare Gound											2		0		75		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 Shan
 (T1- Upper stream section, T2 - middle stream section and T3 - Lower str

Family	Species	Chinese name	Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring						Post construction monitoring					
			Stream		Dec-14		Jan-15		Feb-15		Mar-15		Apr-15		T1		T2		T3		T1		T2		T3		T1		T2		T3	
			Transect	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)	%	
Comelinaceae	<i>Commelina diffusa</i>	節節草	1	10	1	50	0.1	2	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
Poaceae	<i>Panicum repens</i>	枯骨草																														
Asteraceae	<i>Mikania micrantha</i>	薇甘菊	0.3	5	1	15	0.3	2	0.4	10	0.5	15			0.4	10	0.5	15			0.4	10	0.5	15			0.4	10	0.5	15		
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																														
Fabaceae	<i>Pueraria lobata</i>	野葛																														
Araceae	<i>Colocasia esculenta</i>	芋																														
Urticaceae	<i>Boehmeria nivea</i>	苧麻																														
Asteraceae	<i>Bidens alba</i>	白花鬼針草	1	2	0.5	5	0.8	10																								
Poaceae	<i>Pennisetum purpureum</i>	象草																														
Poaceae	<i>Coix lacryma-jobi</i>	薏苡				1.5	1																									
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	1.8	70	1.8	25	1.5	8	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
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨																														
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草	2	10	3	2																										
Araceae	<i>Alocasia macrorrhizos</i>	海芋																														
Lemnaceae	<i>Lemna minor</i>	浮萍																														
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼			1	1																										
Cyperaceae	<i>Cyperus involucratus</i>	風車草			1.7	1					1.5	5					1.5	5					1.5	5				1.5	5			
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香	1.5	1			2	5					2	10					2	10					2	10				2	10	
Bare Gound				2		1		72		0		5		25		0		5		25		0		5		25		0		5	25	

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

Table 4.4. Odonate species recorded at the She Shan River

Species	Common name	Chinese name	Status	Commonness	Baseline monitoring		Post construction monitoring							
					Jul-08	Aug-08	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	
<i>Agriocnemis pygmalis</i>	Wandering Midget	黃尾小蠅	NP	VC										
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC										
<i>Ceriagrion auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘黃蠅	NP	VC								+	+	
<i>Copera ciliata</i>	Black-knees Featherlegs	白狹扇蠅	NP	VC										
<i>Copera 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 Flangetail	霸王葉春蜓	NP	C			+							
<i>Ischnura senegalensis</i>	Common Bluetail	褐斑異痣蠅	NP	VC										
<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 Sprit	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>	Variegated 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 4.5 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			Post construction monitoring			Post construction monitoring															
			Status	Common-ness	Jul-08		Aug-08		Jan-09			Jul-09			Jan-10			Jul-10			Jan-11			Jul-11			Jan-12			Jul-12			Jan-13			Dec-13			Jan-14			Feb-14		
					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	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>Melanoides tuberculata</i>	瘤擬黑螺	NP	VC	+	+	+	++																																					
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC	+	++	+	+	+		+	+	+		+	+	++		+	+	++	++		+	+++	+++	+++	+	++	++	+++	+	+	+	+	+	+	+	+	+					
<i>Radix plicatulus</i>	--	NP	VC	+	+	+	+	+		+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+						
<i>Sinotia quadrata</i>	田螺	NP	VC	+	+	+	++	+		+	+			+	+	++		+	+	++	++		+	+++	++	++	+	+++	++	+	+	+	+	+	+	+	+	+	+					
Insects																																												
<i>Baetis sp.</i>		NP	VC	+	+	+	+	+		+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+						
<i>Caenis sp.</i>	--	NP	VC	+	+	+	+	+		+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+						
<i>Chironomus sp.</i>	蠓幼虫	NP	VC	+	+	++	++			+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Euphaea sp.</i>		NP	VC																																									
<i>Indobaetis sp.</i>	--	NP	VC	+	+	+	+	+		+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Odonate larvae</i>		NP	VC																																									
<i>Orithetrum 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 Hk 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 River

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

Species	Chinese name	Sampling location		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				Post construction monitoring																			
				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			
				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	Reference	T1	T2	T3												
Molluscs																																																											
<i>Anodonta woodiana</i>	背角無齒蚌	NP	VC																																																								
<i>Biomphalaria sp.</i>	--	NP	VC	+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+									
<i>Brotia hatnamensis</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Corbicula fluminea</i>	河蜆	NP	VC	+				+				+				+				+				+				+				+				+				+				+				+											
<i>Melanooides tuberculata</i>	瘤擬黑螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Radix plicatulus</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Sinotia quadrata</i>	田螺	NP	VC	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+	++	+	+	+												
Insects																																																											
<i>Baetis sp.</i>		NP	VC	+	+	+		+				+				+	+			+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+													
<i>Caenis sp.</i>	--	NP	VC					+																																																			
<i>Chironomus sp.</i>	蠓幼虫	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Euphaea sp.</i>		NP	VC																																																								
<i>Indobaetis sp.</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Odonate larvae</i>		NP	VC																																																								
<i>Orithetrum 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 Hk P - protected species in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” - Common
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 “+++” – 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 She Shan River
(T1 - Upper stream section, T2 - middle stream section and T3 - Lower stream section)

Species	Status	Commonness	Baseline monitoring		Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Impact monitoring				Post construction monitoring																												
			Upper stream	Lower stream	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																							
<i>Channa maculata</i>	斑鱔	NP	C																																																						
<i>Clarias gariepinus</i>	星洲子鰍	NP	VC																																																						
<i>Gambusia affinis</i>	食蚊魚	NP	VC																																																						
<i>Mystus anguillicaudatus</i>	星鰻	NP	C																																																						
<i>Groscheornis sinensis</i>	紅尾鮑魚	NP	C																																																						
<i>Puntius ophiurus</i>	黃鰻	NP, V	C																																																						
<i>Pseudorasbora parva</i>	赤眼鰻	NP	VC																																																						
<i>Pterocryptus cochinchinensis</i>	越南鰻	NP	C																																																						
<i>Puntius semifasciatus</i>	七星鰻	NP	C																																																						
<i>Rhinogobius</i> spp.	紅背魚	NP	C																																																						
<i>Xiphophorus hellerii</i>	紅腹魚	NP	C																																																						
<i>Xiphophorus variatus</i>	綠色刺尾魚	NP	C																																																						
<i>Zacco platypus</i>	黃鰻	NP	C																																																						
3x2m fish number				80	60	80	60	30		15	45	30	0	0	300	30	0	13		20	5	20	200	22	16	3	0	6	4	2	3	8	2	4	0	4	2	2	0	5	3	4	2	5	3	4	2	12	16	30	40						
Amblybat																																																									
<i>Paramesotriton hongkongensis</i>	香港澤蛙	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 compare the with the data within works area.

*Cap 170 - List in Wild Animals Protection Ordinance (Cap.170)

*NT - Near Threatened in R/CN Red List Status

*PGC - Potential Global 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 section)

Species	Status	Commonness	Post construction monitoring																																																												
			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				
			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	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3									
<i>Channa maculata</i>	斑鱔	NP	C	+				+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+					
<i>Clarias gariepinus</i>	星洲子鮰	NP	VC	+				+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+					
<i>Gambusia affinis</i>	食蚊魚	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				
<i>Misgonyx anguillicaudatus</i>	泥鰌	NP	C	+				+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+					
<i>Oreochromis niloticus</i>	紅頭草魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+								
<i>Puntius spilargenteus</i>	吳鰱	NP	V	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+								
<i>Pseudorasbora reticulata</i>	孔鯉	NP	VC	+				+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+									
<i>Pterocryptus cochinchinensis</i>	越南鱖	NP	C	+				+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+		+	+	+													
<i>Puntius semifasciatus</i>	七星魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+								
<i>Rhinogobius spp.</i>	刺塘魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+								
<i>Xiphophorus hellerii</i>	刺塘魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Xiphophorus variatus</i>	刺塘魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+												
<i>Zacco platypus</i>	寬尾鱈	NP	C	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++								
32m fish number				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	30	30	16	40	30	40	30	50	50	60	50	60	50	50	40	50	40	40	50	40	30	40	40	40	40	50	50	30	35	55	45
Ampibian																																																															
<i>Paramesotriton hongkongensis</i>	香港澤螺	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 compare

*Cap 170 - List in Wild Animals Protection Ordinance (Cap.170)

*NT - Near Threatened in RUCN Red List Status

*PGC - Potential Global 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			Post construction monitoring			Post construction monitoring								
	Aug-08	Jan-09			Jul-09			Jan-10			Jul-10			Jan-11			Jul-11			Jan-12			Jul-12			Jan-13			Dec-13			Jan-14			Feb-14		
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	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	8.7	8.6	9.2	8.3	8.2	8.6	7.2	7.6	7.8
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	6.6	6.9	7.1	6.8	7.3	7.4	7.8	6.7	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	0.78	0.63	0.53	1.2	1.12	1.02	1.5	1.2	1.6
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	0.08	<0.01	0.42	1.9	1.8	1.73	0.8	1.2	1.4
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	0	0	0.03	0.04	0.07	0.03	0.03	0.04	0	0	0	0	0	0	0	0	0	0
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	116	116	134	124	118	132	128	113	132
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	<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	0.1	0.05	0.1	0.1	0.05	0.1	0.1	0.1	0.1	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	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
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	15	10	5	15	10	5	15	10	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	65	80	20	65	80	20	65	80	20
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	10	5	10	10	5	10	10	5	
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	10	0	70	10	0	70	10	0	

**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. 16)
Upper Tai Po River**

April 2015



Prepared by : Mike Pang

A handwritten signature in blue ink, appearing to be 'Mike Pang', enclosed in a small rectangular box.

May 21 , 2015

Validated by: Mark Shea

A handwritten signature in blue ink, appearing to be 'Mark Shea'.

May 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.16)
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 on.
- 1.4 This is the number 16 post-construction ecological monitoring report for the project conducted **on 24th April 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 *Parazacco 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, *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, total of 66 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.

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 (T2) 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 the 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 (T2) proportion 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 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 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, 66 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 4m 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 two defined point count locations. In total, 19 species of birds were recorded during bird survey. Among them, 4 species were dependant birds observed feeding in the river channel including *Egretta garzetta*, *Motacilla cinerea*, *Motacilla alba* and *Amaurornis phoenicurus* (Photos 6-7). The common species *Pycnonotus jocosus* was found the dominant species of the river channel. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Among the recorded species, *Milvus lineatus* is also protected by Endangered Species of Animals and Plants Ordinance (Cap. 586) and classified as Regional Concern by Fellowes *et al* (2002). Some of the wetland dependent species recorded are classified as Regional Concern by Fellowes *et al* (2002) such as *Egretta garzetta*, which was 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 was higher than last survey by double and the result was similar to previous surveys conducted in approximate period of last year. In total, 6 species odonata were found (Photo 8). Increasing 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 (Photos 9-10). 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 (Photos 9-10). In total, 14 species freshwater fish were recorded within project area. Fish abundance was low along the modified river channel. The *Glyptothorax pallozonum*, *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. 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. 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.

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.

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FIGURE

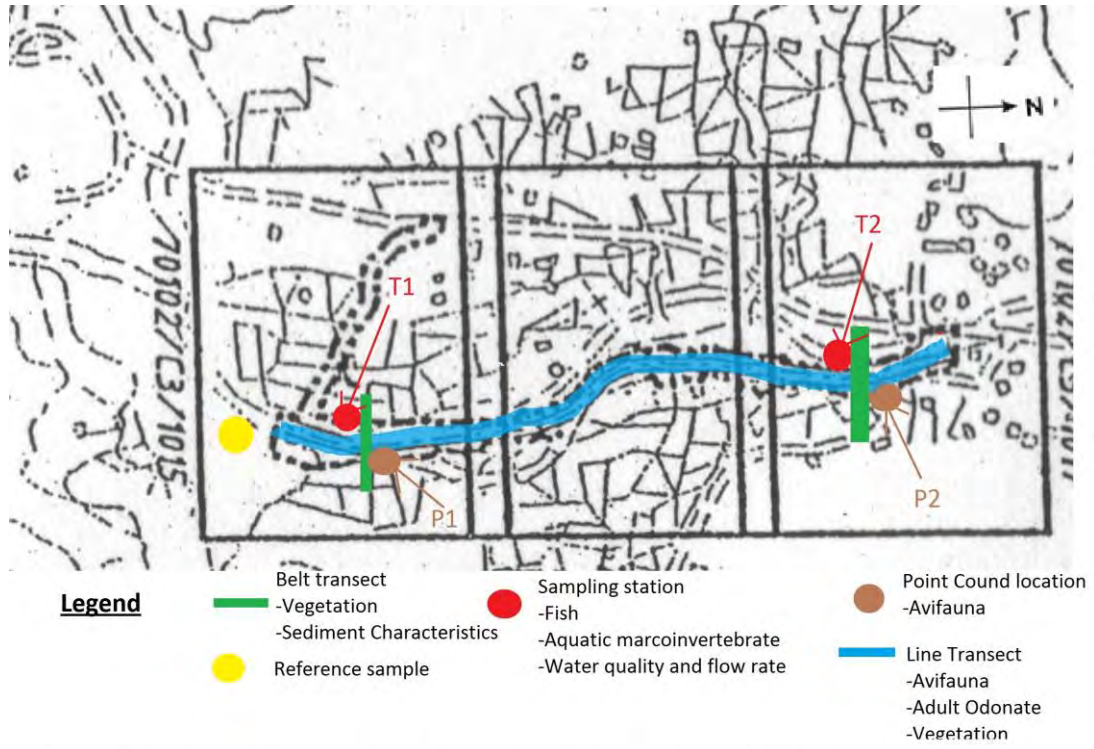






Figure 1. Sampling Location of Ecological Survey and Monitoring at Upper Tai Po River, Tai Po.

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>Ardeola bacchus</i> .</p>

	
<p>Photo 7: Avifauna – <i>Egretta garzetta</i>.</p>	<p>Photo 8: Dragonfly – <i>Ceriagrion auranticum ryukyuanum</i></p>
	
<p>Photo 9: Aquatic samples shown invertebrates and fish.</p>	<p>Photo 10: Aquatic samples shown invertebrates and fish.</p>

TABLE

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	Baseline survey		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		st construction monitor		st construction monitor		
			Oct-07		Jan-09		Jul-09		Jan-10		Jul-10		Jan-11		Jul-11		Jan-12		Jul-12		Mar-13		Jul-13		Jan-14		Feb-14		Jan-14		Feb-14				
			T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	Referenc	T1	T2	
Mollusca																																			
<i>Biomphalaria</i> sp.	--	NP	VC	+			+		+		+		+		+		+		+		+		+		+		+		+		+		+		
<i>Brotia hainanensis</i>	--	NP	VC	++	+	++			++		++	+	++	+	+		+		+		+		+		+		+		+		+		+		
<i>Melanooides tuberculata</i>	瘤擬黑螺	NP	VC				+	+	+	+	+	+	+	++	+		+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Physella acuta</i>	尖膀胱螺	NP	VC												+	+	++		+		+		+		+		+		+		+		+		
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC				+	+		++	+		+	+	++	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Radix plicatulus</i>	羅白螺	NP	VC		++		+		+	+		+	+		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Sinoiaia quadrata</i>	田螺	NP	VC				++		+	++		++		+++			+		+		+		+	+	+	+	+	+	+	+	+	+	+	+	
Insecta																																			
<i>Anisocentropus</i> sp.	--	NP	VC											+																					
<i>Arctopora</i> sp.	--	NP	VC											+																					
<i>Aulocodes</i> sp.	--	NP	VC											+																					
<i>Baetis</i> sp.	--	NP	VC	+		+			+		+		+		+								+			+			+			+			
<i>Chironomus</i> sp.	蠓幼虫	NP	VC	+	+	+			+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Ephmera</i> sp.		NP	VC																																
<i>Indobaetis</i> sp.	--	NP	VC	+		+			+	+		+	+		+											+			+			+		+	
<i>Mnais</i> sp.	--	NP	VC		+	+			+	+		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Orthetrum</i> sp.	--	NP	VC	+	+	+			+	+		+	+		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Perla</i> sp.	--	NP	VC							+			+																						
<i>Rhaphium</i> sp.	--	NP	VC																						+	+		+							
<i>Tipulidae</i> spp.	--	NP	VC																																
Crustacea																																			
<i>Caridina cantonensis</i>	廣東米蝦	NP	VC						+			+	++		+	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Cryptopotamon anacoluthon</i>	鯉刺溪蟹	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		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring		Impact monitoring									
			Oct-07	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	Reference	T1	T2						
<i>Cyprinus carpio var. viridiviolaceus</i>	錦鯉	NP	C																																									
<i>Gambusia affinis</i>	食蚊魚	NP	VC	+	++																																							
<i>Glyptothorax pallozomum</i>	白線紋胸鰾	NP	R																																									
<i>Liniparhomaloptera disparis</i>	擬平鰾	NP	C																																									
<i>Misgurnus anguillicaudatus</i>	泥鰾	NP	C																																									
<i>Oreochromis niloticus</i>	尼羅口孵非鯽	NP	C	+																																								
<i>Parazacco spilurus</i>	異鱾	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>	麥氏擬腹吸鰾	NP	C	+																																								
<i>Pterocryptis cochinchinensis</i>	越南隱鱗鯪	NP	C																																									
<i>Puntius semifasciolatus</i>	七星魚	NP	C	+																																								
<i>Rhinogobius spp.</i>	假虎魚	NP	C	+																																								
<i>Schistura fasciolata</i>	橫紋南鰾	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	15	8	25	10	20	100	10	2	8	10	7	100	10	5	20	6	2	4	6	2	5	5	2	2	5	2	1	5	2	1	12	8	6	10	12	10	16	10	8
Amphibian																																												
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P	UC																																									

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“+” – Species exists in the study area

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“+++” – 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.

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

Post construction monitoring																																										
Species	Status	Commonness	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			
			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	Reference	T1	T2				
<i>Cyprinus carpio var. viridiviolaceus</i>	錦鯉	NP	C																																							
<i>Gambusia affinis</i>	食蚊魚	NP	VC	+	+	+	+			+			+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Glyptothorax pallozomum</i>	白線紋胸鰾	NP	R	+			+			+			+			+			+			+			+			+			+			+			+			+		
<i>Liniparhomaloptera disparis</i>	擬平鰈	NP	C	+			+			+			+			+			+			+			+			+			+			+			+			+		
<i>Misgurnus anguillicaudatus</i>	泥鰍	NP	C	+			+			+			+			+			+			+			+			+			+			+			+			+		
<i>Oreochromis niloticus</i>	尼羅口孵非鯽	NP	C	+			+			+			+			+			+			+			+			+			+			+			+			+		
<i>Parazacco spilurus</i>	異鱧	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>	麥氏擬腹吸鰈	NP	C	+	+		+			+			+			+			+			+			+			+			+			+			+			+		
<i>Pterocryptis cochinchinensis</i>	越南隱鱗鰻	NP	C				+			+			+			+			+			+			+			+			+			+			+			+		
<i>Puntius semifasciolatus</i>	七星魚	NP	C	+		+	+			+			+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Rhinogobius spp.</i>	鰕虎魚	NP	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Schistura fasciolata</i>	橫紋南鰈	NP	C	+	+		+			+			+			+			+			+			+			+			+			+			+			+		
<i>Xiphophorus hellerii</i>	劍尾魚	NP	C	+			+			+			+			+			+			+			+			+			+			+			+			+		
<i>Xiphophorus variatus</i>	雜色劍尾魚	NP	C	+			+			+			+			+			+			+			+			+			+			+			+			+		
			2x2m fish	16	10	8	12	4	2	12	4	2	15	5	4	20	8	5	30	10	10	40	15	20	50	20	30	60	30	30	50	20	20	40	20	20	50	20	20	40	15	20
Amphibian																																										
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P	UC	+			+			+			+			+			+			+			+			+			+			+			+			+		

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