

Issue No. : Issue 1
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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.14**

Prepared By:

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For:

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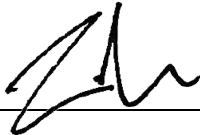
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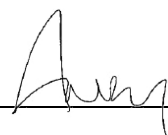
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Agreement No. CE65/2013(EP)
Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation

Post-Construction Ecological Monitoring Report (No. 14)
Upper Lam Tsuen River

February 2015



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March 9, 2015

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March 18, 2015

Ecology Team: China-Hong Kong Ecology Consultants

Post-Construction Ecological Monitoring Report (No. 14)

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 14 post-construction ecological monitoring report for the project conducted on **10th of February 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 **10th of February 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 ;
- Bird diversity and abundance was in natural fluctuation ; and
- Abundance of a target river fauna (i.e., Hong Kong Newt *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 AFCDC 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 and the other two located at the upper section of the river. The point count and survey transect locations for the bird survey and sampling sites for surveys of other faunal groups and flora were presented in **Figure 1**.

3.3 Adult Odonata Survey

Adult Odonata survey was conducted along transects (**Figure 1**). Binoculars, digital camera and hand net were utilized to aid identification. Numerical abundance, species identity and other notable behaviour were recorded. Nomenclature and protection status of the species has followed those documented in the AFCDC 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 AFCDC 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.hkbiodiversity.net) and Lee *et al* (2004).

3.6 Abiotic Data Collection

3.6.1 Water Quality Monitoring

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

3.6.2 Sediment Characteristics

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

3.6.3 Water Flow

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

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

4 Monitoring Results

4.1 Vegetation

Vegetation has generally covered the gabion and partially covered the riverbed along Lam Tsuen River. Higher density of vegetation was observed during current dry season since there was no heavy rain events which would wash away plants (Photos 1-3). In total, 63 flora species were recorded within the survey transects along the river course. Among those recorded flora, native species *Commelina diffusa* and exotic species *Brachiaria muticawas* were the dominated species recorded along the river (Photo 4). The recorded floras were generally in good health, and the height of the dominated riparian grass and herb species were in a range from 0.2m 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, 29 species of birds were recorded during the bird survey and 8 of the total were wetland dependent species including *Ardeola bacchus*, *Alcedo atthis*, *Actitis hypoleucos*, *Tringa ochropus*, *Motacilla cinerea*, *Egretta garzetta*, *Motacilla alba* and *Amaurornis phoenicurus* (Photos 4&5). , they were commonly observed foraging in the river channel. The dominant species mainly comprised of common species, *Pycnonotus jocosu*. 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). *Egretta garzetta* is classified as Regional Concern by Fellowes *et al* (2002), 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, only 2 species were recorded along the surveyed river and the result was similar to previous surveys conducted in approximate period of last year. A comparative low abundance of odonata continuously recorded in recent months was a natural phenomenon due to seasonality. The mean ambient temperature of current season is too low for most of the odonata species to emerge, therefore, only few particular species with relatively long flight period could be recorded such as *Trithemis aurora*, which is a abundant species in Hong Kong and could be found at all seasons. However, most of the species in Hong Kong are likely to emerge in late spring or early summer coinciding with the commencement of wet season and rising temperature (Wilson *et al*, 2004 & Tam *et al*, 2011). Thus, the low species richness observed was a natural pattern of most odonata's life cycle. 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* were observed at the Lam Tsuen River (Photo 7) where the habitat consisted of riparian vegetation during the survey. Riparian vegetation grown along the channel especially along water margin could provide shelter and breeding habitat for Hong Kong Newt. This amphibian species is commonly seen and captured by hand nets and the

abundance was higher than those recorded during the previous surveys of post-construction monitoring conducted in wet season. The higher abundance of newt in current season was recorded because newt normally breeds from September to March and much of the rest of the year is spent on land (Dudgeon, 2003). Hong Kong Newt is listed in Wild Animals Protection Ordinance (Cap. 170) and classified as “Near Threatened” under IUCN Red List Status and as “Potential Global Concern” by Fellowes *et al* (2002). Record of Hong Kong Newts can be referred to **Table 4.6**.

4.2.5 River Fish Fauna

Fish surveys were performed at Upper Lam Tsuen River during field monitoring (Photos 8&9). 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 species 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 increased than previous surveys conducted during wet season due to less flooding in current dry season that washing fish out of the river. Details of recorded of fish fauna refers to **Table 4.6**. Sampling location was shown on **Figure 1**.

4.3 **Abiotic Data**

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

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

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

5 **Summary and Commentary**

Post construction ecological monitoring was carried out in current month 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 high in abundance at river channel where the river margin covered with riparian vegetation. *Acrossocheilus parallens*, a rare freshwater fish species in Hong Kong, was observed a dominant species at a few locations in the river channel with pool. Except *Acrossocheilus parallens*, *Parazacco spilurus* recorded in the river is also considered with conservation interest and observed along the river with low abundance.

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.

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

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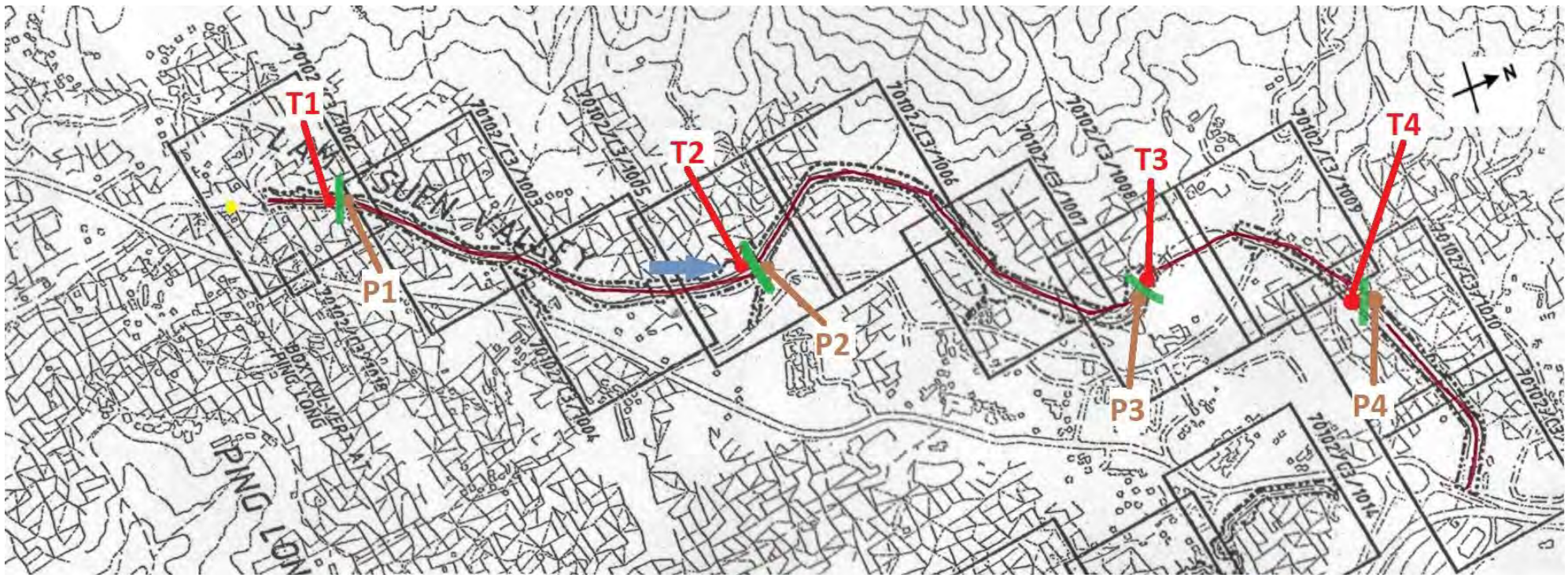
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FIGURES



Legend

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

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

PHOTOS

	
<p>Photo 1: General view of the river (Lower section)</p>	<p>Photo 2: General view of the river (Middle section)</p>
	
<p>Photo 3: General view of the river (Upper section)</p>	<p>Photo 4: Dominant species <i>Commelina diffusa</i> and <i>Brachiaria muticawa</i> .</p>
	
<p>Photo 5 : Avifauna - <i>Motacilla alba</i></p>	<p>Photo 6: Avifauna - <i>Alcedo atthis</i></p>



Photo 7: Hong Kong Newt



Photo 8: Kick sampling



Photo 9: Aquatic samples shown fish and invertebrates collected in Lam Tsuen River.

TABLE

Table 4.1. Flora species recorded along the Lam Tsuen River including riparian habitat.

Family	Species name	Species name in Chinese	Baseline monitoring	Impact monitoring												Post Construction monitoring												
			Jul to Aug 08	Jan-09	Jul-09	Jan-10	Jul-10	Jan-11	Jul-11	Jan-12	Jul-12	Aug-13	Dec-13	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	
Riparian Plant																												
Acanthaceae	<i>Ruellia coerulea</i>	藍花草																										
Amaranthaceae	<i>Celosia argentea</i>	青葙	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Amaranthaceae	<i>Amaranthus viridis</i>	野苣荬		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Amaranthaceae	<i>Abernethia philoxeroides</i>	空心蓮子草		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Amaranthaceae	<i>Abernethia sessilis</i>	蓮子草																										
Anacardiaceae	<i>Rhus hypoleuca</i>	白背漆																										
Annonaceae	<i>Uvaria macrophylla</i>	紫玉盤																										
Apiaceae	<i>Oenanthe javanica</i>	水芹																										
Apiaceae	<i>Centella asiatica</i>	崩大碗																										
Araceae	<i>Allocasia odora</i>	海芋	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Araceae	<i>Colocasia esculenta</i>	芋	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Araceae	<i>Pilea stratiotes</i>	大葉																										
Araceae	<i>Rhapis excelsa</i>	蔴竹																										
Asteraceae	<i>Bidens alba</i>	白花鬼針草	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Asteraceae	<i>Mikania micrantha</i>	微甘菊	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Asteraceae	<i>Ageratum conyzoides</i>	腸紅菊																										
Asteraceae	<i>Emilia sonchifolia</i>	一點紅																										
Asteraceae	<i>Wedelia chinensis</i>	錦雞娘																										
Asteraceae	<i>Erechtites hieracifolia</i>	革命菜																										
Asteraceae	<i>Conyza canadensis</i>	小蓬草																										
Asteraceae	<i>Youngia japonica</i>	黃鶉菜																										
Asteraceae	<i>Eclipta prostrata</i>	鵝腸																										
Asteraceae	<i>Spilanthes paniculata</i>	金鈕扣																										
Athyriaceae	<i>Callipteris esculenta</i>	菜蕨																										
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨																										
Brassicaceae	<i>Cardamine flexuosa</i>	碎米蕒		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜																										
Brassicaceae	<i>Rorippa indica</i>	塘葛菜																										
Brassicaceae	<i>Capsella bursa-pastoris</i>	青菜																										
Buddleiaceae	<i>Buddleja asiatica</i>	白背楓																										
Caesalpiniaceae	<i>Cassia alata</i>	翅英決明	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Caryophyllaceae	<i>Drymaria cordata</i>	荷蓮豆																										
Caryophyllaceae	<i>Myosoton aquaticum</i>	鵝腸菜																										
Commelinaceae	<i>Commelina diffusa</i>	錦蔴草	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍																										
Convolvulaceae	<i>Pharbitis nil</i>	牽牛																										
Convolvulaceae	<i>Ipomoea aquatica</i>	蘿藦																										
Cucurbitaceae	<i>Solenia amplicaulis</i>	茅瓜																										
Cuscutaceae	<i>Cuscuta australis</i>	南方菟絲子																										
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草																										
Cyperaceae	<i>Cyperus sp.</i>	莎草																										
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Euphorbiaceae	<i>Bischofia javanica</i>	秋楓																										
Fabaceae	<i>Pueraria lobata</i>	野葛	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Fabaceae	<i>Crotalaria pallida</i>	豬屎豆																										
Fabaceae	<i>Sesbania cannabina</i>	田菁																										
Fabaceae	<i>Pueraria lobata var. thomsonii</i>	粉葛																										
Magnoliaceae	<i>Michelia alba</i>	白蘭	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大紅花																										
Mimosaceae	<i>Acacia confusa</i>	台灣相思	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Mimosaceae	<i>Leucaena leucocephala</i>	銀合歡																										
Mimosaceae	<i>Mimosa pudica</i>	含羞草																										
Mimosaceae	<i>Calliandra haematocephala</i>	紅絨球																										
Moraceae	<i>Ficus hispida</i>	對葉榕	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Moraceae	<i>Ficus variegata</i>	青果榕																										
Musaceae	<i>Musa paradisiaca</i>	大蕉	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Myrtaceae	<i>Clitocalyx nervosum</i>	水翁																										
Nyctaginaceae	<i>Bougainvillea spectabilis</i>	勒杜鵑	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Onagraceae	<i>Ligustrum sinense</i>	山指甲																										
Onagraceae	<i>Labiata erecta</i>	美洲水丁香																										
Oxalidaceae	<i>Oxalis corniculata</i>	酢漿草																										
Plantaginaceae	<i>Plantago major</i>	車前草																										
Poaceae	<i>Panicum repens</i>	結莖草	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Poaceae	<i>Panicum purpuraceum</i>	象草	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Poaceae	<i>Rhynchosyrum repens</i>	紅毛草	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Poaceae	<i>Microstegium ciliatum</i>	圓莖竹	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Poaceae	<i>Brachiaria mutica</i>																											

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

Post-Construction Ecological Monitoring Report (No.14) - Upper Lam Tsuen Riv				Baseline monitoring		Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring				Post construction monitoring						
				Jul-08		Aug-08		Oct-14				Nov-14				Dec-14				Jan-15				Feb-15				
Species	Chinese name	Status	Sampling point	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	
Fish																												
<i>Acrossocheilus parallens</i>	側條光唇魚	NP	R		+		+		++	++	++	+		++	++	++	++		++	++	++	++		++	++	++	++	
<i>Channa maculate</i>	斑鱧	NP	Common				+																					
<i>Cirrhina molitorella</i>	鯪魚	NP	C																									
<i>Clarias fuscus</i>	胡子鯰	NP	C									+															+	
<i>Cyprinus carpio var. viridiviolaceus</i>	錦鯉	NP	C																									
<i>Gambusia affinis</i>	食蚊魚	NP	VC			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Liniparhomaloptera disparis</i>	擬平鰍	NP	C					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Misgurnus anguillicaudatus</i>	泥鰍	NP	Common	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Oreochromis niloticus</i>	尼羅口孵非鯽	NP	C		+		+		+	+	+	+		+	+	+	+		+	+	+	+		+	+	+	+	
<i>Parazacco spilurus</i>	異鱧	V and NP	Common	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Poecilia reticulata</i>	孔雀花魚將	NP	VC			+	+			+	+	+			+	+					+					+		
<i>Pseudogastromyzon myersi</i>	麥氏擬腹吸鰍	NP	C		+	+	+	+	+	+	+		+	+	+	+		+	+	+	+		+	+	+	+		
<i>Pterocryptis cochinchinensis</i>	黃鰱	NP	C					+	+	+	+		+	+	+			+	+	+		+	+	+	+	+		
<i>Puntius semifasciolatus</i>	七星魚	NP	C	++	+	++	+	+	+	++	++	+	+	+	++	++	+	+	+	++	++	+	+	+	++	++	+	
<i>Rhinogobius spp.</i>	鰕虎魚	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>	寬鰭鱈	NP	C	+	++	+	++	+	++	++	+	+	+	++	++	+	+	+	++	++	+	+	+	++	++	+	+	
2x2m fish counting		Number of fish		70	60	75	60	30	40	40	30	30	50	70	70	60	60	60	60	60	50	50	50	50	60	60	60	
Amphibian																												
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P (Cap 170, NT, PGC)	R	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Fejervarya limnocharis</i>	澤蛙	NP	VC																									

Note: NP – Not 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 Treated in IUCN Red List Status

"PGC"-Potential Golar Concern by Fellowes *et al* (2002)

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.14)
She Shan River

February 2015



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March 9, 2015

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March 18, 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.14) 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 14 post-construction ecological monitoring report for the project conducted **on 11st of February 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 11st of February 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, nesting behavior of *Accipiter trivirgatus* was observed in the woodland of She Shan River; and
- Odonata abundance was low in current dry season. *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, middle and lower 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, middle and upper 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.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 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, 46 flora species was recorded within the survey transects along the river course (Photo 1-3). 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 (Photo 4). Aquatic plants *Brachiaria mutica* and *Commelina diffusa* were the most abundant plants found along the river channel (Photo 5). Results of vegetation survey and belt transect survey were presented in **Table 4.1** and **Table 4.2**. **Figure 1** shows the transect line for the flora surveys.

4.2 Fauna

4.2.1 Avifauna

An avifauna survey was undertaken along survey transects and at three selected point count locations. In total, 25 species of birds were recorded during the bird surveys within project area. 6 species of total recorded were wetland dependant birds and observed foraging in the river channel including *Ardeola bacchus*, *Casmerodius alba*, *Motacilla cinerea*, *Egretta garzetta*, *Motacilla alba* and *Amaurornis phoenicurus* (Photos 6&7). *Pycnonotus jocosus* and *Passer montanus* were dominated and commonly found along the river. All the birds in Hong Kong are under protection of Wild Animals Protection Ordinance (Cap. 170). Some recorded species were also under protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) including *Milvus lineatus*, *Accipiter trivirgatus* and *Buteo buteo*, while *Milvus lineatus* was considered as Regional Concern by Fellowes *et al* (2002). An Uncommon species in Hong Kong, *Accipiter trivirgatus* is classified as rare in Red China Data Book Status, was observed above the tree at She Shan River this month (Photo 8). It is assumed that there is a nest of *Accipiter trivirgatu* inside the woodland that adjacent to the river, since February is a nesting season for the species. *Centropus sinensis* is classified as listed in Red China Data Book Status as Vulnerable. In addition, some of wetland dependent species including *Egretta garzetta*, *Ardeola bacchus* and *Casmerodius alba* are considered as Regional Concern by Fellowes *et al* (2002), were always found foraging in the river. 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 comparative low abundance of odonata was recorded during current dry season. The mean ambient temperature of current season is too low for most of the odonata species to emerge, therefore, only few particular species with relatively long flight period could be recorded such as *Trithemis aurora*, which is a abundant species in Hong Kong and could be found at all seasons. However, most of the species in Hong Kong are likely to emerge in late spring or early summer coinciding with the commencement of wet season and rising temperature (Wilson *et al*, 2004 & Tam *et al*, 2011). Thus, the low species richness observed was a natural pattern of most odonata's life cycle. There was only 1 common species recorded and the result was similar to previous surveys conducted in approximate period of last year. 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 locations were shown on **Figure 1**.

4.2.4 Hong Kong Newt

Survey of Hong Kong Newt was conducted at She Shan River. Adult Hong Kong Newt *Paramesotriton hongkongensis* was observed at the river channel where the habitat consisted of riparian vegetation during the survey. The abundance of Hong Kong Newt was low, only 2 mature newts were captured (Photo 10) from the area covered with dense vegetation in the middle section of the river (Photo 11). Abundant riparian vegetation regenerated along the channel could provide shelter and breeding habitat for Hong Kong Newt. Hong Kong Newt is listed in Wild Animals Protection Ordinance (Cap. 170) and classified as “Near Threatened” under IUCN Red List Status and as “Potential Global Concern” by Fellowes *et al* (2002). Record of Hong Kong Newts can be referred to **Table 4.6**.

4.2.5 Fish Fauna

Fish surveys were performed at She Shan River and total 13 species of freshwater fish were recorded (Photo 12). Native fish *Zacco platypus* was the abundant species dominating in the river channel. The density of fish including gobies recorded increased in dry season. Details of recorded 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. Results of water test are presented in the **Table 4.7**.

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

5 **Summary and Commentary**

Ecological monitoring was carried out in current months and relevant biotic and abiotic data was collected according to project specification and EM & A Manual. Mature amphibian Hong Kong newt *Paramesotriton hongkongensis* was recorded at river channel with low abundance. Nesting behavior of a rare species *Accipiter trivirgatus* was observed in the woodland of She Shan River. Odonata was showing the natural fluctuation of their abundance and species richness during dry season. Fish abundance

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

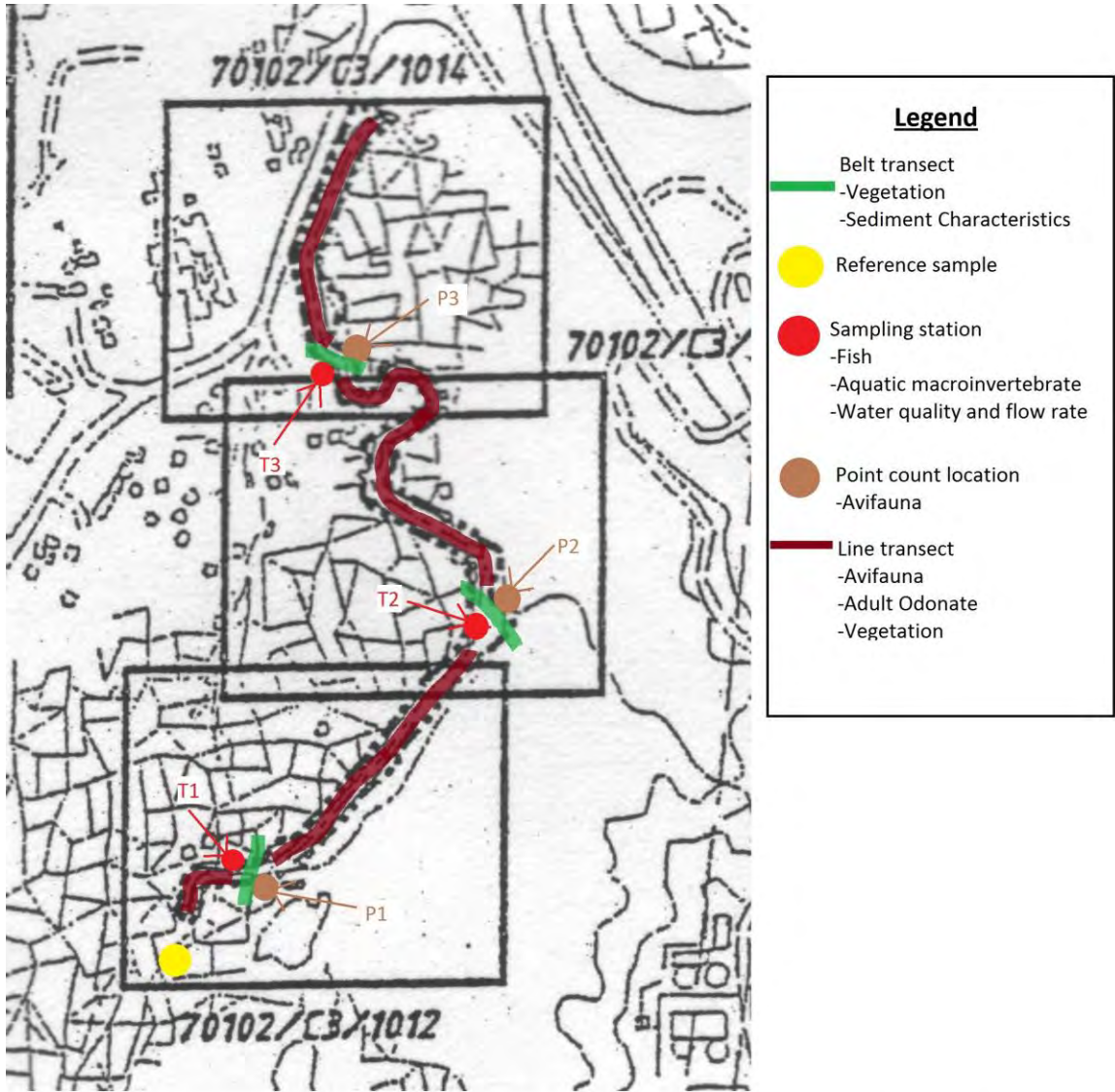


Figure 1. Sampling Location of Ecological Survey and Monitoring at She Shan River, Tai Po.

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: Vegetation coverage in river bed and gabion (Upper section)



Photo 5: Abundant vegetation species *Brachiaria mutica* and *Commelina diffusa*. (Upper section)



Photo 6: Avifauna – *Motacilla cinerea*



Photo 7: Avifauna – *Ardeola bacchus*.



Photo 8: Avifauna – *Accipiter trivirgatus*.



Photo 9: Taking water sample



Photo 10: Hong Kong Newt



Photo 11: Dense vegetation in middle section of the river

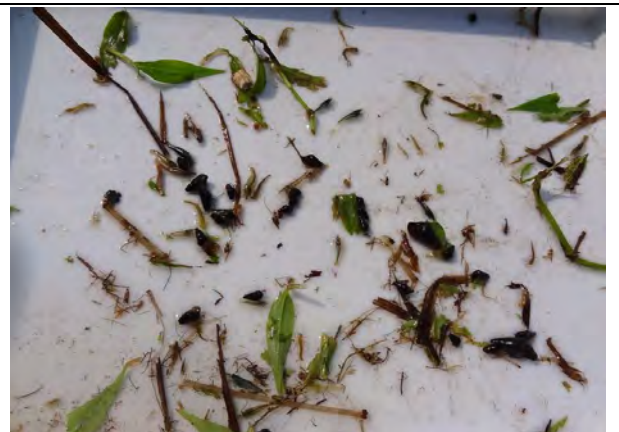
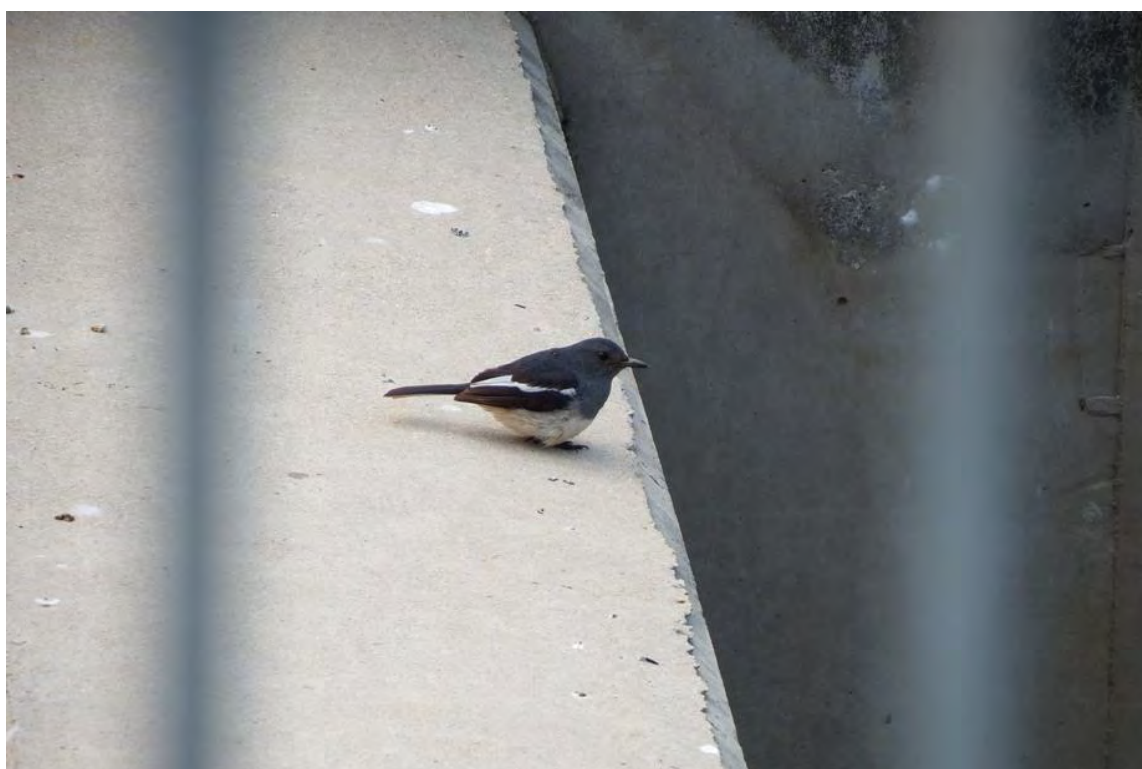


Photo 12: Aquatic sample showed the collected invertebrate and fish.

TABLE

**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.14)
Upper Tai Po River**

February 2015



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**Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
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- Photo 3: General view of the river channel (Middle section)
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- Photo 5: Abundant *Commelina diffusa* (Middle section)
- Photo 6: Avifauna – *Motacilla alba*
- Photo 7: Avifauna – *Egretta garzetta*.
- Photo 8: Avifauna – *Motacilla cinerea*.
- Photo 9: Aquatic samples shown invertebrates and fish.
- Photo 10: aquatic samples shown invertebrates and fish.

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- Table 4.6 Fish species and Hong Kong Newt recorded at Upper Tai Po River.
- Table 4.7 Abiotic data for Upper Tai Po River.

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 14 post-construction ecological monitoring report for the project conducted **on 12th of February 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, 63 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 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 (T1 and T2) 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 two locations with one located at the lower portion of the river channel and the other located at the upper section of the river. 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 and middle 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 (Photo 4) along the upper Tai Po River and the river bed with some common

plants including invasive species *Mikania micrantha*, and native species *Commelina diffusa*. 63 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, 20 species of birds were recorded during bird survey. Among them, 5 species were dependant birds observed feeding in the river channel including *Ardeola bacchus*, *Motacilla cinerea*, *Egretta garzetta*, *Motacilla alba* and *Amaurornis phoenicurus* (Photos 6-8). The dominated species were comprised of common species including *Pycnonotus jocosus* and *Passer montanus*. 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) including *Egretta garzetta* and *Ardeola bacchus*, they were usually observed feeding in the river. *Centropus sinensis* is listed in China Red Data Book Status as Vulnerable. 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 decreased during current dry season surveys when comparing with result of wet season. The mean ambient temperature of current season is too low for most of the odonata species to emerge, therefore, only few particular species with relatively long flight period could be recorded such as *Trithemis festiva*, which is a abundant species in Hong Kong and could be found at all seasons. However, most of the species in Hong Kong are likely to emerge in late spring or early summer coinciding with the commencement of wet season and rising temperature (Wilson *et al*, 2004 & Tam *et al*, 2011). Thus, the low species richness observed was a natural pattern of most odonata's life cycle. Only 1 species was recorded in this month and the result was similar to previous surveys conducted in approximate period of last year.. Sampling location was shown in **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

Aquatic-net and kick sampling were performed at the river. The river benthic fauna collected was mainly comprised of insects, mollusks and crustaceans (Photos 9 & 10). 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 site. 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. In total, 13 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. Low abundance of odonata was recorded during survey due to seasonality. Hong Kong Newt was found in low abundance in only reference site.

Aquatic and riparian vegetation along river channel has 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

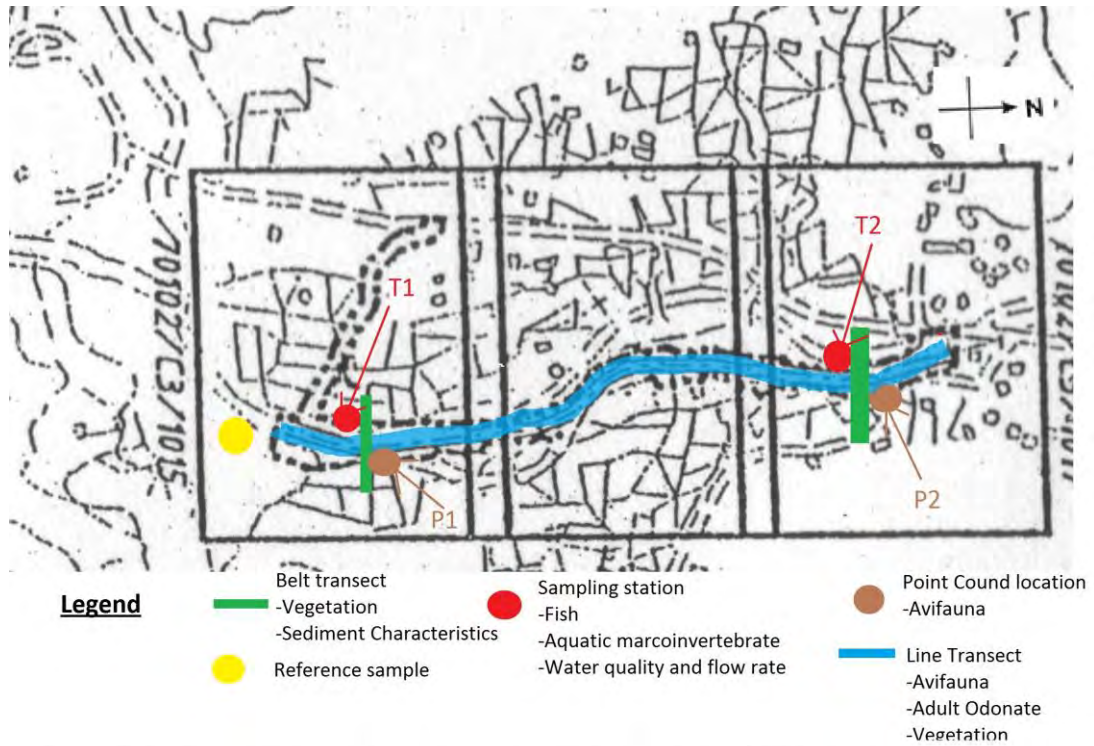


Figure 1. Sampling Location of Ecological Survey and Monitoring at Upper Tai Po River, Tai Po.

PHOTOS



Photo 1: General view of the reference site



Photo 2: General view of the river channel (Upper section)



Photo 3: General view of the river channel (Middle section)



Photo 4: Gabions and River bed (Middle section)



Photo 5: Abundant *Commelina diffusa* (Middle section)



Photo 6 Avifauna – *Motacilla alba*.



Photo 7 Avifauna – *Egretta garzetta*.



Photo 8 Avifauna – *Motacilla cinerea*.



Photo 9 Aquatic samples shown invertebrates and fish.



Photo 10: aquatic samples shown invertebrates and fish.

TABLE

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

Family	Species	Chinese name	At construction monitoring				Post construction monitoring					
			Jan-15		Feb-15		Reference		Feb-15			
			T1	T2	T1	T2	T1	T2	T1	T2		
Asteraceae	<i>Mitella mi-nantha</i>	藍汁菊			0.3	10	0.8	15			0.3	10
Moraceae	<i>Ficus hirtella</i>	紅果榕										
Ulmaceae	<i>Celtis sinensis</i>	朴樹										
Poaceae	<i>Microstegium ciliatum</i>	細香竹			1	5	1.3	5			1	5
Euphorbiaceae	<i>Macaranga tanarius</i>	烏節			0.6	1					0.6	1
Asteraceae	<i>Alopecurus odora</i>	狗牙草						0.8	5			
Asteraceae	<i>Colocasia esculenta</i>	芋										
Myrtaceae	<i>Cleistanthus aperculatus</i>	水前										
Adiantaceae	<i>Callipteris esculenta</i>	菜蕨										
Poaceae	<i>Phragmites karika</i>	土蘆葦						1.7	10			
Thelypteridaceae	<i>Cyrtosperma purpurilinum</i>	龍鳳草										
Equisetaceae	<i>Equisetum debile</i>	雙節草						0.3	5			
Asteraceae	<i>Ageratum conyzoides</i>	藍耳蕒	0.3	2						0.3	2	
Commelinaceae	<i>Commelina diffusa</i>	蘭花草			0.4	60	0.3	10			0.5	60
Solanaceae	<i>Solanum nigrum</i>	黑果										
Euphorbiaceae	<i>Melastoma paniculatum</i>	白藤										
Poaceae	<i>Elystine indica</i>	什格草										
Poaceae	<i>Peristichum purpureum</i>	象草										
Asteraceae	<i>Wedelia chinensis</i>	錦繡菊										
Asteraceae	<i>Bidens alba</i>	白背蕒科草			0.8	2	1	5			0.8	2
Poaceae	<i>Panicum repens</i>	結草						0.6	5			
Poaceae	<i>Cirsia lacryma-jobi</i>	藍花										
Convolvulaceae	<i>Ipomoea cativica</i>	五爪金龍										
Cucurbitaceae	<i>Bomarea hispida</i>	冬瓜										
Fabaceae	<i>Puraria lobata</i>	野葛										
Convolvulaceae	<i>Mecostema holosericeus</i>	魚腥草										
Poaceae	<i>Peristichum alopaeuroides</i>	細草			4	10					4	10
Poaceae	<i>Brychisma mutica</i>	鴨草										
Onagraceae	<i>Lathyrus erecta</i>	赤羽水丁香	0.2	4						0.3	4	
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大槭葵										
Cyperaceae	<i>Cyperus sp.</i>	苔草	0.2	6						0.2	6	
Balsaminaceae	<i>Impatiens walleriana</i>	非洲鳳仙			1	5					1	5
Amaranthaceae	<i>C. elatius argentea</i>	莧草						1.7	5			
Bare Ground					88	7		35			88	7

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

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

Table 4.7 Abiotic data for Upper Tai Po River (T1- Upper stream sampling site and T2- Lower stream sampling site.)

Stream	Baseline survey										
	Oct-07	Jan-09		Jul-09		Jan-10		Jan-15		Feb-15	
Replicate	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	
DO (mg/L)	8.2	9	4	6.3	6	9.4	8.8	8.9	9.0	8.5	8.4
pH	6.9	7.18	6.86	7.28	6.96	8.2	8.5	8.6	8.4	8.6	8.3
Nitrate (mg N/L)	0.39	0.1	1.3	0.07	1.32	0.12	0.71	0.4	0.5	0.5	0.5
Ammonia (mg/L)	<0.01	PO4-P (µg P/L) =100		0.01	0.22	<0.01	0.2	<0.1	<0.1	<0.1	<0.1
Salinity (ppm)	<0.1	<0.1	0.1	0	0	0	0	0	0.02	0.02	0.01
Conductivity (mS/cm)	40	40	190	34	118	42	72	23	84	82	50
BOD (mg/L)	<2	<2	12	<2	<2	<2	2	<2	<2	<2	<2
Water flow at pool (m/s)	0.01-0.2	0.01-0.2		0.01-0.2		0.01-0.2		0.01-0.3		0.01-0.3	
Water flow at riffle (m/s)	0.2-0.5	0.2-0.5		0.2-0.5		0.2-0.5		0.3-0.6		0.3-0.6	
Sand (%)	15	15	15	28	15	25	0	0	0	0	0
Stone (%)	80	80	80	70	80	70	40	20	40	20	20
Mud (%)	5	5	5	5	5	5	0	0	0	0	0
Concrete (%)	0	0	0	0	0	0	60	80	60	80	80