

DC/2009/22
Drainage Improvement Works in Shuen Wan, Tai Po
Contract 1

Baseline Environmental Monitoring Report

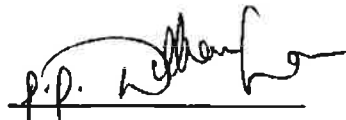
Environmental Pioneers & Solutions Limited

Flat B, 6/F., Hop Shi Factory Building,
29 Lee Chung Street, Chaiwan, Hong Kong
Tel: 2556 9172 Fax: 2856 2010

APPROVAL SHEET

Prepared and Certified by:

ET Leader (Environmental Pioneers & Solutions Limited)

Signature: 

Date: 11 FEB 2011

Mr Johnny Lee
(ET Leader)

• ET - Environmental Team

Baseline Landscape and Visual Review Certified by:

Registered Landscape Architect

Signature: 

Date: 16 DEC 2010

Ms. Christina Ip
(Registered Landscape Architect)

Verified by:

IEC (ENVIRON Hong Kong Limited)

Signature: 

Date: 11 Feb 2011

Mr Tony Cheng
(IEC)

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	5
1. INTRODUCTION	6
1.1 Project Background Information	6
1.2 Purpose	6
2. NOISE MONITORING.....	7
2.1 Monitoring Methodology and Parameters.....	7
2.2 Monitoring Stations	7
2.3 Monitoring Equipment	8
2.4 Monitoring Results and Observations.....	8
2.5 Revisions for Inclusion in the EM&A Manual.....	9
2.6 Conclusions.....	9
2.7 Action and Limit Levels.....	10
3. Ecological Impact	11
3.1 Introduction	11
3.2 Background Information.....	11
3.3 Ecological Monitoring.....	12
3.3.1 Monitoring Methodology and Duration.....	12
3.3.2 Types of equipment used for survey	20
3.3.3 Monitoring locations/transects.....	20
3.3.4 Monitoring time and frequency	21
3.3.5 Details of influencing factors.....	21
3.3.6 Monitoring results	21
3.4 Action and Limit Levels in the ECA	33
3.5 Conclusion and Recommendation	34
3.6 References	37
4. Landscape and Visual	40
4.1 Introduction	40
4.2 Background Information.....	40
4.3 Landscape and Visual Monitoring	44
4.3.1 Monitoring Methodology and Duration.....	44
4.4 Baseline Review Results	45
4.5 Conclusion and Recommendation	51
4.6 References	52
5. WATER QUALITY MONITORING.....	53
5.1 Monitoring Methodology and Parameters.....	53
5.2 Monitoring Stations	53
5.3 Monitoring Equipment	54

5.4 Monitoring Results and Observations.....	54
5.5 Revisions for Inclusion in the EM&A Manual.....	55
5.6 Conclusions.....	55
5.7 Action and Limit Levels.....	55
6. HYDROLOGICAL CHARACTERISTICS MONITORING.....	57
6.1 Monitoring Methodology and Parameters.....	57
6.2 Monitoring Stations.....	57
6.3 Monitoring Equipment.....	58
6.4 Monitoring Results and Observations.....	58
6.5 Revisions for Inclusion in the EM&A Manual.....	58
6.6 Conclusions.....	59
6.7 Action and Limit Levels.....	59

EXECUTIVE SUMMARY

In accordance with the Environmental Permit (EP-303/2008) and the Environmental Monitoring and Audit Manual (EM&A Manual, revision 3) for the Project “Drainage Improvement Works in Shuen Wan, Tai Po”, a baseline environmental monitoring report is required. This baseline monitoring report presents the Noise baseline monitoring results performed from 24th of September to 8th of October, 2010 and 11th to 25th of December, 2010, Ecological baseline monitoring results performed on 11th, 12th and 15th of November 2010, Landscape and Visual baseline review results performed on 11th of November, 2010 and Water Quality and Hydrological Characteristics baseline monitoring results from 7th of January to 2nd of February, 2011.

Baseline noise, water quality and hydrological characteristics monitoring was conducted at monitoring stations as stipulated in their respective sections in the EM&A Manual (revision 3). Data obtained from the monitoring was processed to establish action and limit levels.

The baseline landscape and visual review identified 11 landscape resources within the Survey Area and the status of the landscape resources remain largely unchanged since the approval of the EIA.

The baseline ecological monitoring was conducted for updating the latest habitat characteristics and fauna utilization and flora colonization within the works areas and in its proximity. Fourteen habitat types were identified within the 100m buffer area of the Project. Action and Limit Levels for monitoring and maintaining the Ecological Compensatory Area (ECA) is also included in this report.

Details of the monitoring locations and results are presented in this baseline monitoring report.

1. INTRODUCTION

1.1 Project Background Information

The Sha Tin and Tai Po Drainage Master Plan (DMP) Study, completed in October 1999, indicated that certain stormwater drains and natural rivers/streamcourses in the Sha Tin and Tai Po areas did not have the required hydraulic capacity to meet the flow requirements. To minimize the risks of flooding and to cope with future developments as identified in the DMP Study, construction of river channels, upgrading of existing stormwater drains, construction of flood pumping stations in the low-lying areas and other minor drainage facilities were recommended.

In accordance with the EP and the EM&A Manual (revision 3), baseline monitoring of noise, water quality and hydrological characteristics of Wai Ha River, baseline review of the landscape and visual condition of works area and baseline ecological impact are required to be carried out prior to the commencement of construction of the project. The site boundaries of the two contracts are displayed in **Appendix A**.

1.2 Purpose

By establishing the baseline level of noise, ecological impact, landscape and visual impact, water quality and hydrological characteristics, the performance of the construction contractor shall be measured in meeting required environmental protection standards and requirements under the Environmental Permit (EP-303/2008), during the course of the construction work. This report presents the baseline monitoring requirements, methodologies and results in accordance with the EM&A Manual (revision 3).

2. NOISE MONITORING

2.1 Monitoring Methodology and Parameters

Monitoring was undertaken to establish noise baseline levels in the vicinity of the works areas of Drainage Improvement Works in Shuen Wan, Tai Po, and to provide data against which any environmental impacts due to construction activities can be compared.

The construction noise levels were measured in terms of A-weighted equivalent continuous sound pressure level (L_{eq}). $L_{eq(30 \text{ minutes})}$ was used as the monitoring parameter for the time period between 0700 and 1900 hours on normal weekdays. For all other time periods, $L_{eq(5 \text{ minutes})}$ was employed for comparison with the Noise Control Ordinance (NCO) criteria.

Table 2.1 summarizes the monitoring parameters, frequency and duration of baseline noise monitoring. Consecutive noise measurements were carried out for 14 consecutive days using the $L_{Aeq(5min)}$ parameters (24th September, 2010 – 8th October 2010 and 11th December, 2010 – 25th December, 2010).

Table 2.1 - Noise Monitoring Parameters, Period and Frequency

Time Period	Duration	Parameters
Daytime: 0700-1900	30 min (6 $L_{Aeq} 5min$)	L_{Aeq} , L_{10} , L_{90}
Evening and Night Time and Holidays: 1900-0700	5 min ($L_{Aeq} 5min$)	

2.2 Monitoring Stations

In accordance with the EM&A Manual (revision 3), monitoring stations were established at 2 locations, which are summarized in **Table 2.2** and depicted in **Appendix B**:

Table 2.2 – Noise Monitoring Stations

Noise Monitoring Station	Location
M1	14, Shuen Wan Chim Uk
AL1	Joint Village Office for Villages in Shuen Wan, Tai Po

M3	31, Wai Ha
M4	Block 15, Treasure Spot Garden

2.3 Monitoring Equipment

Baseline monitoring was conducted using Rion NL-31, which complied with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1 985 (Type 1) Specifications as referred to in the Technical Memorandum to the Noise Control Ordinance. The equipment was calibrated and verified by certified laboratory or manufacturer every year to ensure they perform to the same level of accuracy as stated in the manufacturer's specification. Before and after the baseline measurement, the reading of sound level meter was checked with the acoustic calibrator and the measurements were accepted as valid if the calibration levels before and after the noise measurement agreed to within 1.0 dB. The acoustic calibrator used was Rion NC-73. Calibration Certificates of the sound level meter and acoustic calibrator are given in **Appendix C**.

2.4 Monitoring Results and Observations

5 minute, "fast" detector response, L_{Aeq} , L_{10} , and L_{90} levels were recorded. Monitoring during the daytime period (ie. 0700-1900) are represented with six $L_{Aeq(5mins)}$ readings for a logging interval of 30 minutes. Whereas the evening (ie. 1900-2300), night time (ie. 2300-0700) and holiday periods are represented with a $L_{Aeq(5mins)}$ reading for a logging interval of 5 minutes. The monitoring results are summarized in **Table 2.3** to **2.5**. All monitoring data and associated graphical presentation are given in **Appendix D** and **E**.

Table 2.3 Summary of Day-Time (0700-1900) Monitoring Results

Daytime (0700-1900)	Range of Noise Level, dB(A)		
	$L_{Aeq(30 min)}$		
	Mean	Max	Min
M1	57.1	63.1	51.6
AL1	66.6	78.1	53.4
M3	64.0	74.1	51.7
M4	53.9	65.6	40.2

Table 2.4 Summary of Evening-Time (1900-2300) and Holidays (0700-2300) Monitoring Results

Evening-Time (1900-2300) and Holidays	Range of Noise Level, dB(A) L _{Aeq} (5 min)		
	Mean	Max	Min
M1	56.3	64.3	48.8
AL1	61.5	69.5	52.8
M3	64.8	79.9	41.3
M4	54.8	72.0	35.0

Table 2.5 Summary of Night-Time (2300-0700) Monitoring Results

Night Time (2300-0700)	Range of Noise Level, dB(A) L _{Aeq} (5 min)		
	Mean	Max	Min
M1	53.6	63.8	37.0
AL1	56.2	65.9	37.6
M3	60.1	78.4	36.4
M4	48.3	63.1	29.0

The weather conditions during the monitoring period were mostly fine. No noise monitoring was conducted under increment weather condition such as in the presence of fog, rain, wind with a steady speed exceeding 5 m/s or gust exceeding 10 m/s.

Since the monitoring stations were established at residences near Ting Kok Road and Tung Tze Road, noise from vehicular traffic with a considerable portion of buses, cars, and trucks were considered the dominant noise source. It was noted that the noise level was fairly constant throughout the day.

2.5 Revisions for Inclusion in the EM&A Manual

The baseline monitoring was conducted according to the EM&A Manual (revision 3) for noise.

The monitoring methodology, parameters monitored and monitoring locations are in line with the EM&A Manual (revision 3).

2.6 Conclusions

Baseline monitoring was conducted at 14, Shuen Wan Chim Uk (M1) and Joint Village Office for Villages in Shuen Wan, Tai Po (AL1) from 24th of September, 2010 to 8th of October, 2010 and 31, Wai Ha (M3) and Block 15, Treasure Spot Garden (M4) from 11th to 25th of December, 2010.

Noise level of mid-fifty dB(A) had been consistently recorded throughout the all periods for all stations with the exception of mid-sixty for daytime and early-sixty for evening and holidays period for AL1 and M3. These baseline levels are within the requirements under the Noise Control Ordinance.

The major noise sources are noticed from the vehicular traffic of Ting Kok Road and Tung Tze Road. The baseline monitoring results are considered representative to the ambient noise level.

2.7 Action and Limit Levels

From the baseline results and in accordance with the EM&A Manual (revision 3), the Action and Limit levels are set as follows:

Action level exceedance occurs when one or more documented complaints are received.

Limit level is set at $L_{Aeq(30 \text{ min})}$ 75 for normal working hours, as suggested in EIAO-Technical Memorandum. For restricted periods, limit level shall be subjected to control under the Noise Control Ordinance (NCO) and the condition in the Construction Noise Permit (CNP).

The Action and Limit levels for all sensitive receivers are summarized in **Table 2.6**, which would be applied for compliance assessment of construction noise for this project.

Table 2.6 Action and Limit Levels for Construction Noise at All Sensitive Receivers

Time Period	Action	Limit
Daytime 0700 – 1900 hrs on normal weekdays	When one documented complaint is received	75 dB(A)*
1900 – 2300 on all days and 0700 – 2300 on general holidays (including Sundays)		60/65/70 dB(A)**
2300 – 0700 on all days		45/50/55 dB(A)**

* Reduced to 70dB(A) for schools or institution and 65dB(A) during examination periods

** To be selected based on the Area Sensitivity Rating of A/B/C, and the conditions of the applicable CNP(s) must be followed.

3. Ecological Impact

3.1 Introduction

The Ecological Impact Assessment in the EIA Report identified that ecological impacts resulting from the proposed drainage improvement works are anticipated to be very minor in scale. Nevertheless, ecological mitigation measures and ecological monitoring were identified and recommended in the EM&A Manual (revision 3) as stipulated under Environment Permit No. EP-303/2008 Clause 2.4.

This section of the Baseline Environmental Monitoring Report will detail the project background, monitoring methodology, types of equipment used in ecological monitoring, monitoring transects and locations, monitoring time, frequency and duration, and influencing factors on the ecological monitoring during the pre-construction, construction and operation phases of the Project. Action and Limit Levels for monitoring and maintaining the Ecological Compensatory Area (ECA) will be detailed.

A baseline ecological monitoring survey covering the works boundary of Contracts 1 and 2 and areas within 100m of these works boundaries was conducted on 11, 12 and 15 November 2010. The Survey Area is provided in **Figure 6.1** and **Section 3.3** details the data collected from the baseline ecological monitoring survey.

3.2 Background Information

The proposed drainage improvement work at Shuen Wan involves a construction of approximately 1.0km of twin-cell box-culvert with internal cell dimension of 3m in width by 3m in height along Tung Tsz Road which leads to the loss of marsh (0.3ha) and secondary woodland (0.08ha) and impact on several individuals of locally protected tree species Hong Kong Pavetta *Pavetta hongkognensis*, the construction of Shuen Wan Storewater Pumping Station to the east of Tung Tsz Nursery and Ting Kok Road, the construction of a DN2100 drain pipe along Ting Kok Road, an automatic mechanical penstock at Wai Ha River estuary, and an approximately 280m drainage pipe near Wai Ha Village. Compensation for the habitat loss is required by creating an ECA (i.e. Area C under Contract 1) in order to satisfy EP-303/2008. The identified

individuals of *Pavetta hongkongensis* will be transplanted to the ECA for *ex-situ* protection of this protected species.

3.3 Ecological Monitoring

3.3.1 Monitoring Methodology and Duration

Monitoring methodology and duration will be undertaken following the survey methodology in the approved Habitat Compensatory Plan (HCP) for the ECA and the EM&A Manual (revision 3) for the areas under Contracts 1 and 2.

Ecological monitoring of the ECA

Construction phase ecological monitoring of the ECA includes monthly monitoring of vegetation health and water quality, and weekly site inspections.

During the 12-month establishment phase of the ECA, ecological monitoring includes bi-annual monitoring of habitat types, vegetation cover, intertidal fauna and other fauna (include bird, herpetofauna (i.e. amphibians and reptiles),, fish, odonata and butterfly) and monthly monitoring of vegetation health and water quality. Site inspections will be conducted twice per month.

Monitoring of vegetation health

Monthly monitoring on the health condition of the retained and transplanted trees and vegetation will be conducted. Once the proposed vegetation are planted in the ECA, monitoring on the growth and health conditions of these planted vegetation in various created habitats (i.e. brackish marsh, mangrove, woodland areas of planted trees and shrubs, and wooded areas with retained and (trans)planted trees) within the ECA will be conducted.

All planted, retained and transplanted trees and shrubs will be surveyed to update their growth and health. Any signs of pests and/ or poor growth of planted, retained and transplanted trees and shrubs will be recorded. Appropriate treatment or removal of pest will be implemented if necessary. Supplemental planting will be arranged if needed.

A fixed transect line will be run through the wetland habitats (including

intertidal mudflat, brackish marsh and mangrove) and the general growth and health of the planted vegetation along both sides of the transect will be inspected and evaluated. Any adverse plant health, such as dieback of planted species, will be noted and supplemental planting will be arranged. Any signs of pests which cause adverse health problems to the plants will be identified and recorded.

Monitoring of water quality

Since there will be free movement of brackish river water in and out of the ECA, water quality in the ECA will be largely dependent on water quality in the river. In this open system it is not appropriate to set specific targets for water quality parameters. Nevertheless, baseline data on water quality, in particular seasonal patterns, would potentially be useful long term management of the ECA. Once the ECA is filled with water during Construction Phase of the ECA, *in-situ* water quality will be measured once per month during both Construction and Establishment Phases. The following parameters will be monitored:

- Temperature
- pH
- Salinity
- Turbidity
- Dissolved oxygen

Additional measurements of these parameters should also be made by the ecologist in response to unexpected events (e.g. algal blooms or fish die-offs) in order to inform remedial management measures.

Monitoring of habitat types and vegetation cover

Monitoring of habitat types and vegetation cover will be conducted twice during the 12 month Establishment Phase of the ECA; specifically at the end of the wet season (September 2011) and the end of the subsequent dry season (March 2012) after completion of the planting work. The monitoring aims to determine the exact extent of the wetland habitats and vegetation cover (i.e. open water, intertidal mudflat, brackish marsh and mangrove) during the establishment period and control any excessive colonization of unwanted

vegetation specific habitats.

Monitoring of habitat types and vegetation cover

Monitoring of habitat types and vegetation cover will be conducted twice during the 12 month Establishment Phase of the ECA; specifically at the end of the wet season (September 2011) and the end of the subsequent dry season (March 2012) after completion of the planting work. The monitoring aims to determine the exact extent of the wetland habitats and vegetation cover (i.e. open water, intertidal mudflat, brackish marsh and mangrove) during the establishment period and control any excessive colonization of unwanted vegetation specific habitats.

Monitoring of intertidal fauna

As the ECA would largely comprise an intertidal mudflat, monitoring for intertidal fauna will be conducted. Recolonisation will take time: accordingly monitoring will be conducted in August 2011 and February 2012 (the fourth and the tenth months after the ECA has been constructed). As the important aim of monitoring of intertidal fauna in the ECA is to examine the diversity of the colonising community, a qualitative manner by walk-through survey (i.e. walk through the site with species and relative abundance recorded) will be conducted. Core sampling will also be conducted at different levels to record infauna. Three samples at each level (low, middle and high) will be collected during each monitoring event and the monitoring will be conducted at low tide.

Monitoring of other fauna

Monitoring of other faunal groups, including birds, herpetofauna, fish, odonate and butterflies, will be conducted. Monitoring of any aquatic invertebrates will be covered by the intertidal surveys. Since the site will be intertidal, it is considered no suitable for local amphibian species. Therefore, no nighttime survey for detecting mating calls of amphibians is necessary and only daytime surveys are needed. Monitoring of these faunal groups will be conducted on a walk-through survey basis. The surveyor will walk through the site, recording and counting the fauna observed. Microhabitats for herpetofauna will be actively searched. This monitoring will be conducted

twice within the establishment period (once in the wet season (August 2011) and once in the dry season (February 2012)).

Monitoring of wild mammals is not necessary in this case; however, if signs of wild mammals are observed (such as footprints) during any field surveys, these will be recorded.

Table 3.1 details the ecological monitoring programme of the ECA during its Construction and Establishment Phases.

Table 3.1. Construction and Establishment Phase Ecological Monitoring for the ECA.

	Construction Phase Ecological Monitoring	Establishment Phase Ecological Monitoring
Habitat types	Not required.	At six monthly intervals at the end of the wet season (i.e. September 2011) and the end of the dry season (i.e. March 2012) when tide height is <1.5 mPD.
Vegetation cover	Not required.	At six monthly intervals at the end of the wet season (i.e. September 2011) and the end of the dry season (i.e. March 2012) when tide height is <1.5 mPD.
Vegetation health	Monthly check of planted, retained and transplanted trees and shrubs, and planting (once this has commenced).	Monthly check of planted, retained and transplanted trees and shrubs.
Water Quality	Following filling with water monthly for <i>in situ</i> water quality.	Monthly for <i>in situ</i> water quality.
Intertidal fauna	Not required.	At six monthly intervals in wet season (August 2011) and dry season (February 2012).
Other fauna (include bird, herpetofauna, fish, odonata and butterfly)	Not required.	At six monthly intervals in wet season (August 2011) and dry season (February 2010).
Site Inspections	Weekly.	Twice per month.

Ecological monitoring during post-establishment phase should be undertaken by AFCD to maintain the wetland health and engineering stability of the created wetland (**Table 3.2**). Monitoring results should be reported to EPD on a quarterly basis.

Table 3.2. Maintenance and Management Schedule for the ECA during the Post-establishment Phase.

Action	Frequency	Notes
Structural maintenance		
Inspect condition of bunds and repair / maintain as necessary	Annual inspection.	Also after any flood events/ typhoons. Repair/maintenance of bunds will only be carried out if necessary.
Vegetation management		
Supplemental planting	Requirement to be assessed annually.	Depending upon health status of the wetland vegetation, trees and shrubs during the bi-annual monitoring. Planting to be restricted to the wet season; monthly inspection on any newly planted vegetation should be conducted in the first three months to monitor their survival and establishment rates in early planting period.
Monitoring the health of trees and shrubs, vegetation cover, pruning and removal	Bi-annual monitoring of vegetation cover and health; Annual pruning of trees and shrubs if necessary in the whole ECA.	Annual pruning of trees and shrubs will be conducted only if necessary.
Removal of exotic / undesirable invasive plants (including algae, unwanted terrestrial species and exotics) (weeding)	Quarterly checking of unwanted vegetation in particular wetland habitats (i.e. open water, intertidal mudflat, brackish marsh and mangrove) with removal to be scheduled in subsequent 30 days.	Aggressive exotics such as floating herb <i>Eichhornia crassipes</i> and emergent herb <i>Typha angustifolia</i> to be removed immediately. Any significant number of established mangrove seedlings in intertidal mudflat and open water to be removed immediately.
Control of excessive colonization of brackish marsh in the adjacent intertidal mudflat	Quarterly checking of any excessive colonization of brackish marsh vegetation with removal to be scheduled for subsequent 30 days.	Removal of excessive colonization of brackish marsh will be conducted on a case-by-case basis.
Monitoring of intertidal fauna, bird, herpetofauna, fish, odonata and butterfly	Bi-annually.	
Pest control	Quarterly check for presence of pests.	Review and consider appropriate treatment on a case-by-case basis.

Ecological monitoring for other areas of ecological importance under Contracts 1 and 2

A baseline ecological monitoring survey for fauna (including bird, mammal, herpetofauna, butterfly and odonate) and flora within the works boundary and areas within 100m of the work boundaries under Contracts 1 and 2 were surveyed on 11, 12 and 15 November 2010. Aquatic fauna, including freshwater fish and macroinvertebrates, were surveyed at specific locations along Wai Ha River (**Figure 6.2**). **Figure 6.1** shows the surveyed areas for the

baseline ecological monitoring and monitoring methodology of the surveyed fauna groups and flora will be details in the following paragraphs.

Bi-monthly and quarterly ecological monitoring covering the works areas and any ecologically sensitive areas within 100m of the works boundary will be carried out during the Construction and Operation Phases of Contracts 1 and 2. These monitoring events include regular check on the retained and transplanted trees and shrubs, monitoring on fauna groups and aquatic fauna.

Update of habitat map and botanical monitoring

Habitat survey to update and characterize the habitats within the 100m buffer areas of Contracts 1 and 2 was conducted in the baseline ecological monitoring survey. A habitat map (**Figure 6.1**) was prepared from a recent aerial photographs supported by ground-truthing.

A botanical survey was conducted to characterise vegetation types within the 100m buffer areas of Contracts 1 and 2 during the recent baseline ecological monitoring survey, with a focus in areas within the works boundaries and those in proximity to the works areas. The dominant and notable plant species, their status in Hong Kong and relative abundance were identified and recorded. Any rare and protected species were identified.

Monitoring of vegetation

Bi-monthly and quarterly checks of retained and transplanted trees and shrubs within the works boundary and riparian vegetation adjacent to construction site and wetland vegetation (mainly mangrove and mangrove-associated vegetation) will be conducted during the Construction and Operation Phases of Contracts 1 and 2. This aims to monitor the vegetation health which could be adversely influenced by any bad site practice. Any signs of damages and adverse health problems directly caused the works will be recorded and reported.

Monitoring of bird

Bird surveys will be conducted by following the proposed transects which

cover the major ecologically sensitive areas of the Project (**Figure 6.2**). Bi-monthly and quarterly bird monitoring will be conducted during the Construction and Operation Phases respectively. All bird species will be recorded and species of conservation importance and wetland-dependent species will be enumerated.

Monitoring of herpetofauna (reptiles and amphibians)

Monitoring of reptiles and amphibians will be conducted on a bi-monthly and quarterly basis during Construction and Operation Phases. The monitoring will be conducted during April to October (i.e. wet season the main period when herpetofauna groups are active). Day/night surveys will be carried out during April to June, the main period of amphibian breeding activity, to detect calling amphibians. All herpetofauna species will be recorded and species of conservation importance will be enumerated. Monitoring will be undertaken by following the proposed transects (**Figure 6.2**) but with a focus in the works areas as these groups are relatively less mobile than birds and mammals and hence more likely to be directly adversely affected by construction works.

Monitoring of butterflies and odonata

Monitoring of butterflies and odonata will be conducted on a bi-monthly and quarterly basis during Construction and Operation Phases. The monitoring will be conducted during April to October (i.e. the main period of activity of these groups). All butterflies and odonata will be recorded and species of conservation importance will be enumerated. Monitoring will be undertaken by following the proposed transects (**Figure 6.2**) but with a focus in the works areas. Any odonata encountered during the aquatic fauna monitoring along Wai Ha River should be identified and recorded.

Monitoring of mammals

Detailed mammal monitoring will not be conducted; however, mammals and their signs (scats and tracks) will be searched for and recorded during surveys of other faunal groups.

Monitoring of aquatic fauna

Monitoring of aquatic fauna will be conducted on a bi-monthly and quarterly basis during Construction and Operation Phases of Contracts 1 and 2. In case for any occurrence of bad site practices which may adversely influence the water quality of Wai Ha River (e.g. discharge of muddy water or wastewater into the stream and site runoff), monthly monitoring of aquatic fauna shall be considered to evaluate the adverse impact.

Monitoring of aquatic fauna will be carried out mainly by bank-side observation, sometimes with the aid of binoculars, at four stream ecological monitoring points (SEMP). These points are selected for covering representative sections of Wai Ha River and are shown in **Figure 6.2**. Netting was also conducted at these points to collect supplementary data. Aquatic vertebrates/ invertebrates seen/collected will be identified in situ to the lowest possible taxon.

Table 3.3 details the monitoring schedule for the according ecological monitoring to be undertaken during Pre-construction, Construction and Operation Phases of the Project.

Table 3.3. *Pre-construction, Construction and Operation Phase Ecological Monitoring for areas under Contracts 1 and 2.*

	Pre-construction Phase Ecological Monitoring	Construction Phase Ecological Monitoring	Operation Phase Ecological Monitoring
Habitat map	Once before the commencement of construction of Contracts 1 and 2	Not required.	Not required.
Vegetation	Once before the commencement of construction of Contracts 1 and 2	Bi-monthly check on the retained and transplanted trees and shrubs within and in proximity to the works boundary.	Quarterly check on the retained, transplanted and planted trees and shrubs within and in proximity to the works boundary.
Fauna (includes birds, herpetofauna, odonata and butterflies)	Once before the commencement of construction of Contracts 1 and 2	Bi-monthly monitoring on faunal groups in any ecologically sensitive area within 100m of the works boundary.	Quarterly monitoring on faunal groups in any ecologically sensitive area within 100m of the works boundary.
Stream (includes fish and macroinvertebrates)	Once before the commencement of construction of Contracts 1 and 2	Bi-monthly monitoring on stream fauna along Wai Ha River.	Quarterly monitoring on stream fauna along Wai Ha River.

Monitoring of the transplanted individuals of *Pavetta hongkongensis*

Monitoring methodology, frequency and duration will follow the Transplantation Proposal of *Pavetta hongkongensis* to be approved by EPD before the commencement of the construction work. According to the latest Transplantation Proposal, monitoring of the transplanted individuals of *Pavetta hongkongensis* will cover a period of 12 months after the transplanting exercise. The monitoring will be conducted once a week in the first 3 months and once in each subsequent month in the remaining monitoring period. Health condition and growth of each transplanted individuals will be assessed and photographic records will be undertaken for each inspection.

3.3.2 Types of equipment used for survey

The monitoring equipments for ecological monitoring of fauna groups and flora include binoculars and notebook. Aquatic fauna monitoring along Wai Ha River uses a net of at least 500 μ m mesh. A water quality checker is used for measuring *in-situ* water quality (parameters: temperature, pH, salinity, turbidity and dissolved oxygen) of the ECA.

3.3.3 Monitoring locations/transects

Monitoring locations and transects for habitat types, vegetation cover, vegetation health, water quality, intertidal fauna and other fauna (including birds, herpetofauna, fish, odonata and butterflies) are restricted in the ECA only.

As aforementioned in **Section 3.3.1**, monitoring of birds, butterflies, odonata and herpetofauna will follow transects through the ECA and the 100m buffer area of Contracts 1 and 2 (**Figure 6.2**). Aquatic fauna surveys will be conducted at the four selected SEMP, which are representative sections of Wai Ha River (**Figure 6.2**). Any odonata species encountered during the aquatic fauna surveys along Wai Ha River will be identified and recorded. Regular checking of retained and transplanted trees and shrubs within and in proximity to the works boundaries of Contracts 1 and 2, and riparian vegetation and wetland vegetation adjacent to the construction site will be carried out.

3.3.4 Monitoring time and frequency

Monitoring frequency during the Construction and Establishment Phases of the ECA and during Construction and Operation Phases of other works areas under Contracts 1 and 2 is detailed in **Tables 3.1 and 3.3**. Monitoring for birds should commence within one hour of sunrise, while monitoring for others faunal groups should take place during the warmer part of the day, during suitable weather conditions.

3.3.5 Details of influencing factors

Survey time and season could influence the monitoring results of the faunal groups. As aforementioned in **Sections 3.3.1 and 3.3.3**, monitoring of birds should commence within one hour of sunrise, when is the peak activity period for birds. Other fauna groups shall be undertaken during the warmer part of the monitoring day.

Monitoring of herpetofauna, butterflies and odonata should be conducted during the wet season from April to October, when these groups are most active. Nighttime survey of herpetofauna should be conducted during April to June, the period of amphibian breeding activity, to detect calling amphibians.

3.3.6 Monitoring results

A baseline ecological monitoring on fauna groups and flora, and habitat ground-truthing were conducted on 11, 12 and 15 November 2010 for updating the latest habitat characteristics and fauna utilization and flora colonization within the works areas and in its proximity. Survey data and evaluation are detailed in **Sections 3.3.6.1 – 3.3.6.6**. It should be noted that November is sub-optimal month for surveys of herpetofauna, butterflies and odonata and this is reflected in the species diversity listed in the according tables.

3.3.6.2 Habitat and vegetation

A total of 14 habitat types were identified within the 100m buffer area of the Project. These habitat types include human-dominated habitats (Developed Area and Village) and semi-natural to natural habitats (Cultivated Land, Fish

Pond, Plantation, Grassland, Shrubland, Wooded Area, Secondary Woodland, *Fung Shui* Woodland, Marsh, Mangrove, River/Stream and Marine). The habitat types and their dominance remain broadly similar since the approval of the EIA report (as shown in Figure 7.1 of the report (Register No. AEIAR-110/2007)) of the Project. However, many cultivated lands close to Wai Ha Village have been abandoned and subsequently become overgrown by grass and invasive creepers. As observed, the marshy area along the access road to Treasure Spot Garden II was largely covered by grass (such as *Microstegium ciliatum* and *Panicum maximum*) and invasive creepers (such as *Mikania micrantha* and *Ipomoea cairica*), with isolated patches of wetland-associated herbs such as *Colocasia esculenta* and *Cyclosorus interruptus*. This vegetation composition implies that the wetland has been drying up over the years and has become susceptible to vegetative succession.

A total of 98 and 118 plant species were recorded within the works areas under Contracts 1 and 2 respectively. **Appendix F** details the plant species recorded in this baseline ecological monitoring survey.

Under Contract 1, Area A largely comprises scattered tree groups of naturally established native species (including *Bridelia tomentosa*, *Celtis sinensis*, *Litsea glutinosa* and *Macaranga tanarius*). Vegetated dominated by common coastal plants such as *Hibiscus tiliaceus*, *Thespersia populnea* and *Excoecaria agallocha* was recorded along the southern and eastern boundaries of the Area. A strip of common exotic trees *Bombax ceiba* and *Melaleuca quinquenervia* was planted along Ting Kok Road and falls within Area A. No rare or protected species were recorded within Area A.

The majority of the construction of the twin-cell box-culvert will fall within Tung Tsz Nursery under the management of LCSD. The existing vegetation along the proposed affected area mainly includes exotic ornamental vegetation such as trees *Terminalia mantaly*, *Terminalia catappa* and *Aleurites moluccana*, other ornamental shrubs and herbs. Individual ornamental trees such as *Cassia fistula*, *Grevillea robusta*, *Archontophoenix alexandrae* and *Dillenia indica* was also recorded within Area B. A potted seedling of a protected tree *Rhodoleia championii* falls within Area B. This species is protected under Cap. 96, and is proposed to be transplanted within the nursery according to the latest Tree Felling Application of the Project. A small section of roadside planting of *Casuarina equisetifolia* and *Lagerstroemia indica* along the cycle

track adjacent to Ting Kok Road also falls within Area B. Common tree species (such as *Bauhinia purpurea*, *Celtis sinensis* and *Macaranga tanarius*) and small patch of mangrove (*Kandelia obovata* and *Avicennia marina*) and wetland-associated vegetation located to the west of Tung Tsz Nursery are also included within Area B.

Area C is a recreation pond mainly dominated with planted fruit trees (*Dimocarpus longan*, *Litchi chinensis* and *Mangifera indica*) and invasive herbs *Bidens alba* along the pond bunds. Other self-sown native trees (such as *Macaranga tanarius*, *Celtis sinensis*, *Melia azedarach* and *Bridelia tomentosa*) were also recorded. No rare or protected species were recorded within Area C.

Works areas under Contract 2 fall along Tung Tsz Road, fringe of Shuen Wan Conservation Area, part of the bank of Wai Ha River close to Wai Ha Village, and the access road and its adjacent marshy area towards Treasure Spot Garden II. Isolated trees (such as *Celtis sinensis* and *Macaranga tanarius*), clumps of weedy, exotic trees *Leucaena leucocephala* and tree groups of tall, semi-mature trees (dominated by *Dimocarpus longan*, *Celtis sinensis*, *Sapium sebiferum*, *Cleistocalyx operculatus* and *Bischofia javanica*) grow along Tung Tsz Road. The affected fringe of Shuen Wan Conservation Area is dominated by herbaceous vegetation (including small patches of reed *Phragmites australis*, grass such as *Panicum maximum* and *Brachiaria mutica*, weedy climbers *Ipomoea cairica* and *Mikania micrantha*, creeper *Commelina diffusa*, and fern *Cyclosorus interruptus*) and mangroves (mainly *Acanthus ilicifolius* and *Kandelia obovata*). A section of the bank of Wai Ha River falls within the works areas and is vegetated by herbaceous plants (such as creeper *Wedelia trilobata*), trees (such as *Ficus hispida*, *Cleistocalyx operculatus* and *Syzygium jambos*) and shrubs (such as *Psychotria asiatica* and *Melicopa pteleifolia*). The remaining bank connecting to the northern Wai Ha River is concreted-lined and dominated by grass and weedy tree *Leucaena leucocephala*. Individuals of protected shrub species *Pavetta hongkongensis* were recorded within tree clumps opposite to Wai Ha Village. *Pavetta kongkongensis* is a shrub/small tree species commonly found in lowland forest and *fung shui* woodland. It is protected under Cap. 96 in Hong Kong.

A total of 237 species were recorded within 100m buffer area under the Project. **Appendix F** details the plant species recorded within the 100m buffer area. In general, the surveyed habitats are dominated by common and

widespread species. Hillside shrubland close to Wai Ha Village, and secondary woodland and *Fung Shui* woodland behind Kam Shan Garden were not surveyed in the baseline botanical survey as these areas are distant from the proposed works areas under the Project.

The roadside plantation close to Tung Tsz Shan Road is dominated by planted trees *Acacia confusa*, *Pinus elliottii*, *Eucalyptus torelliana* and *Gordonia axillaria* and other dominated herbs such as grasses *Bothriochloa bladhii* and *Microstegium ciliatum*, and self-seeded shrubs *Bridelia tomentosa* and *Melastoma candidum*.

The surveyed grassland is largely developed from abandoned agricultural land through natural succession. It is mainly overgrowth by grass (such as *Panicum maximum*, *Paspalum conjugatum* and *Microstegium ciliatum*), other herbs (*Bidens alba* and *Colocasia esculenta*) and creepers *Ipomoea cairica* and *Mikania micrantha*. Grassland close to Shuen Wan Conservation Area is dominated by herb *Commelina diffusa* and creepers *Ipomoea cairica*.

Secondary woodland is found along the fringe of the surveyed 100m buffer area. It supports a closed canopy of semi-mature to mature trees such as *Cinnamomum camphora*, *Alangium chinensis*, *Acronychia pedunculata*, *Machilus* spp. and *Litsea monopetala*. Other common understory shrubs (such as *Psychotria asiatica*, *Litsea rotundifolia* var. *oblongifolia* and *Maesa perularius*) and herbs (such as *Lophatherum gracile* and *Alocasia odora*) were also identified. Three protected species, namely shrub *Pavetta hongkongensis*, tree *Aquilaria sinensis* and fern *Cibotium barmetz*, were recorded in the secondary woodland adjacent to Tung Tsz Shan Road. *Aquilaria sinensis* is regarded as “Vulnerable” in the IUCN Red List of Threatened Species (IUCN 2010), and is under threat due to habitat destruction and over-exploitation for medicinal use in China. It is categorized as “Endangered” and Category II nationally protected species (Near Threatened) in the List of Wild Plants under State Protection in China (SCIB and AFCD 2003; Yip and Lai 2004). In Hong Kong, this species is protected under Cap. 96 and Cap. 586, but is common in lowland forest and *Feng Shui* woodlands (Xing *et al.* 2000). *Cibotium barmetz* is a locally very common fern, but is listed as “Vulnerable” and a Category II Protected Wild Plant under the State Protection due to massive collection for its medicinal uses outside Hong Kong (SCIB & AFCD 2003). This species is locally protected under Cap. 96 and Cap. 586. However, no direct/indirect

impact on these protected species would be caused by the proposed drainage works.

Marsh habitats within the 100m buffer area include Shuen Wan Conservation Area and the marshy area close to Treasure Spot Garden II. This type of marsh area is extensively covered by grass (*Microstegium ciliatum*, *Neyraudia reynaudiana* and *Brachiaria mutica*), creepers (*Ipomoea cairica*, *Wedelia trilobata* and *Pueraria lobata*) and other herbs (*Cyclorous interruptus*, *Colocasia esculenta* and *Kyllinga* spp.). Extensive patches of mangroves (*Acanthus ilicifolius*, *Kandelia obovata*, *Avicennia marina* and *Acrostichum aureum*) and isolated trees (such as *Ficus hispida*, *Hibiscus tiliaceus*, *Sapium sebiferum* and *Leucaena leucocephala*) also cover Shuen Wan Conservation Area.

Part of the mangrove to the northeastern corner of the 100m buffer area falls within the registered Ting Kok SSSI, which ranked as the second important mangrove community in Hong Kong (Tam & Wong 2002). It supports high diversity of mangal community, including mangroves *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Excoecaria agallocha*, *Kandelia obovata* and *Lumnitzera racemosa* (Tam & Wong 2000). The mangrove area adjacent to Area A under Contract 1 is covered by common associate mangroves (*Hibiscus tiliaceus* and *Thespesia populnea*) along the shore and low number of mangrove species (*Avicennia marina* and *Kandelia obovata*).

Wooded area to the north of Area A is vegetated by self-seeded trees *Macaranga tanarius* and *Leucaena leucocephala* which are very common in Hong Kong. Developed area and village are usually vegetated with ornamental species. Cultivated land is vegetated with crops (such as *Allium fistulosum*, *Brassica chinensis* and *Carica papaya*) and weedy herbs, while ponds are largely covered by a low diversity of plants along the pond bunds due to regular maintenance. No rare or protected species were identified in these areas.

3.3.6.3 Birds

A total of forty-seven bird species were recorded in all three areas (see **Table 3.4**). A total of seven species are recognized as being of conservation concern, though these are common in suitable habitats in Hong Kong.

In the works areas under Contract 1, 11 bird species were recorded, five of which are considered to be wetland-dependant species. These are Little Grebe *Tachybaptus ruficollis*, Grey Heron *Ardea cinera*, Little Egret *Egretta garzetta*, Chinese Pond Heron *Ardeola bacchus* and Common Kingfisher *Alcedo atthis* are commonly occurring species in wetland habitats in Hong Kong (Carey *et al.* 2001).

In the works areas under Contract 2, nine bird species were recorded within the works boundary, none are considered to be of conservation concern. All species are considered to be common and widespread in Hong Kong (Carey *et al.* 2001).

Table 3.4. Bird species recorded (Maximum Counts).

Species	Conservation Status in HK	Works areas under Contract 1	Works areas under Contract 2	100m Buffer Area of Contracts 1 and 2
Little Grebe <i>Tachybaptus ruficollis</i>	LC	3	-	-
Grey Heron <i>Ardea cinera</i>	PRC	1	-	-
Little Egret <i>Egretta garzetta</i>		1	-	-
Chinese Pond Heron <i>Ardeola bacchus</i>	PRC (RC)	2	-	-
Common Buzzard <i>Buteo buteo</i>	-	-	-	1
Common Kestrel <i>Falco tinnunculus</i>	-	-	-	1
White-breasted Waterhen <i>Amaurornis phoenicurus</i>	-	-	-	2
Common Sandpiper <i>Actitis hypoleucos</i>	-	-	-	1
Oriental Turtle Dove <i>Streptopelia orientalis</i>	-	-	-	3
Spotted Dove <i>Streptopelia chinensis</i>	-	1	3	7
Common Koel <i>Eudynamis scolopacea</i>	-	-	-	2
Common Kingfisher <i>Alcedo atthis</i>	-	1	-	1
White-throated Kingfisher <i>Halcyon smyrnensis</i>	(LC)	-	-	1
Barn Swallow <i>Hirundo rustica</i>	-	-	-	2

DC/2009/22 Drainage Improvement Works in Shuen Wan, Tai Po
Baseline Environmental Monitoring Report

Species	Conservation Status in HK	Works areas under Contract 1	Works areas under Contract 2	100m Buffer Area of Contracts 1 and 2
Grey Wagtail <i>Motacilla cinerea</i>	-	-	1	1
White Wagtail <i>Motacilla alba</i>	-	-	-	1
Scarlet Minivet <i>Pericrocotus flammeus</i>	-	-	-	3
Red-whiskered Bulbul <i>Pycnonotus jocosus</i>	-	-	4	20+
Chinese Bulbul <i>Pycnonotus sinensis</i>	-	4	2	20+
Long-tailed Shrike <i>Lanius schach</i>	-	-	-	1
Oriental Magpie Robin <i>Copsychus saularis</i>	-	1	2	4
Daurian Redstart <i>Phoenicurus aureus</i>	-	-	-	1
Common Stonechat <i>Saxicola torquata</i>	-	-	-	1
Blue Whistling Thrush <i>Myophonus caeruleus</i>	-	-	-	1
Common Blackbird <i>Turdus merula</i>	-	-	-	2
Grey-backed Thrush <i>Turdus hortulorum</i>	-	-	-	1
Masked Laughingthrush <i>Garrulax perspicillatus</i>	-	-	-	12
Asian Stubtail Warbler <i>Urosphena squameiceps</i>	-	-	-	1
Japanese Bush Warbler <i>Cettia diphone</i>	-	-	-	2
Yellow-bellied Prinia <i>Prinia flaviventris</i>	-	1	2	4
Common Tailorbird <i>Orthotomus sutorius</i>	-	-	-	1
Dusky Warbler <i>Phylloscopus fuscatus</i>	-	1	1	1
Yellow-browed Warbler <i>Phylloscopus inornatus</i>	-	-	1	1
Red-throated Flycatcher <i>Ficedula albicilla</i>	-	-	-	1
Great Tit <i>Parus major</i>	-	4	2	2
Scarlet-backed Flowerpecker <i>Dicaeum cruentatum</i>	-	-	-	2
Fork-tailed Sunbird <i>Aethopyga christinae</i>	-	-	-	1
Chestnut Bunting <i>Emberiza rutila</i>	-	-	-	6
Japanese White-eye <i>Zosterops japonicus</i>	-	-	-	10
Black-faced Bunting <i>Emberiza spodocephala</i>	-	-	-	1
Yellow-billed Grosbeak <i>Eophona migratoria</i>	LC	-	-	1
Scaly-breasted Munia <i>Lonchura punctulata</i>	-	-	-	4
Eurasian Tree Sparrow <i>Passer montanus</i>	-	-	-	10
Red-billed Starling	GC	-	-	2

Species	Conservation Status in HK	Works areas under Contract 1	Works areas under Contract 2	100m Buffer Area of Contracts 1 and 2
<i>Sturnus sericeus</i>				
Black-collared Starling <i>Sturnus nigricollis</i>	-	-	-	5
Crested Myna <i>Acridotheres cristatellus</i>	-	-	-	2
Common Magpie <i>Pica pica</i>	-	-	-	1
Collared Crow <i>Corvus torquatus</i>	LC, NT	-	-	2

Key: PRC= Potential Regional Concern; RC=Regional Concern; LC = Local Concern, as of Fellowes *et al.* (2002). Those in parenthesis indicate that the assessment is on the basis of restrictedness in breeding and/or roosting rather than general occurrence. (Fellowes *et al.* 2002)

NT = Near Threatened (Birdlife International 2010)

3.3.6.3 Herpetofauna

Three species of reptile were recorded during surveys of all three surveyed areas (see **Table 3.5**), no reptiles were recorded within either of the works area boundaries. None of the species are of conservation concern. Habitats within the works boundary for both contracts offer few ecological opportunities for herpetofauna and this is reflected in the low numbers of species recorded from these areas.

Table 3.5. Herpetofauna species recorded (Maximum Counts).

Species	Conservation Status in HK	Works area under Contract 1	Works area under Contract 2	100m Buffer Area of Contracts 1 and 2
Red-eared Slider <i>Trachemys scripta</i>	-	-	-	1
Reeves' Smooth Skink <i>Scincella reevesii</i>	-	-	-	1
Bamboo Pit Viper <i>Trimeresurus albolabris</i>	-	-	-	1 (dead)

3.3.6.4 Butterflies

A total of 22 butterfly species were recorded during the surveys, none were of conservation concern (**Table 3.6**). Three butterfly species were recorded within the works boundary of Contract 1 but none was found under Contract 2. Habitats within the works boundary for both contracts offer few ecological opportunities for butterflies and this is reflected in the low numbers of species

recorded from these areas.

Table 3.6. Butterfly species recorded (Maximum Counts).

Species	Conservation Status in HK	Works area under Contract 1	Works area under Contract 2	100m Buffer Area of Contracts 1 and 2
Tailed Jay <i>Graphium agamemnon</i>	-	-	-	1
Red Helen <i>Papilio helenus</i>	-	-	-	1
Common Mormon <i>Papilio polytes</i>	-	-	-	2
Paris Peacock <i>Papilio paris</i>	-	-	-	1
Painted Jezebel <i>Delias hyparete</i>	-	-	-	2
Red-based Jezebel <i>Delias hyparete</i>	-	1	-	4
Lemon Emigrant <i>Catopsilia pomona</i>	-	-	-	1
Common Grass Yellow <i>Eurema hecabe</i>	-	2	-	2
Common Cerulean <i>Jamides celeno</i>	-	-	-	1
Pale Grass Blue <i>Zizeeria maha</i>	-	-	-	5
Plum Judy <i>Abisara echerius</i>	-	-	-	1
Dark Evening Brown <i>Melanitis phedima</i>	-	-	-	1
Dark-brand Bush Brown <i>Mycalesis mineus</i>	-	-	-	15
Banded Tree Brown <i>Lethe confusa</i>	-	-	-	3
Common Five Ring <i>Ypthima baldus</i>	-	-	-	5
Duffer <i>Discophora sonaica</i>	-	-	-	2
Rustic <i>Cupha erymanthis</i>	-	-	-	1
Blue Admiral <i>Kaniska canace</i>	-	-	-	1
Common Sailer <i>Neptis hylas</i>	-	-	-	2
Common Lascar <i>Pantoporia hordonia</i>	-	-	-	1
Common Tiger <i>Danaus genutia</i>	-	1	-	-
Blue-spotted Crow <i>Euploea midamus</i>	-	-	-	2

3.3.6.5 Odonata

A total of 11 odonata species were recorded during the surveys, none were of conservation concern (**Table 3.7**). Habitats within the works boundary for both contracts offer few ecological opportunities for dragonflies and this is

reflected in the low numbers of species recorded from these areas. The majority of records came from the Wai Ha River, especially the presence of Indochinese Copperwing *Mnais mneme* and Chinese Greenwing *Neurobasis chinensis* at the middle section of Wai Ha River (i.e. SEMP 3) indicates comparatively good water quality of the river at this portion.

Table 3.7. Odonata species recorded (Maximum Counts).

Species	Conservation Status in HK	Works area under Contract 1	Works area under Contract 2	100m Buffer Area of Contracts 1 and 2
Indochinese Copperwing <i>Mnais mneme</i>	-	-	-	3
Chinese Greenwing <i>Neurobasis chinensis</i>	-	-	-	2
Common Blue Jewel <i>Rhinocypha perforata</i>	-	-	-	2
Orange-faced Sprite <i>Pseudagrion rubriceps</i>	-	-	-	2
Yellow Featherlegs <i>Copera marginipes</i>	-	-	-	1
Black Threadtail <i>Prodasineura autumnalis</i>	-	-	-	1
Red-faced Skimmer <i>Orthetrum chrysis</i>	-	-	-	5
Common Blue Skimmer <i>Orthetrum glaucum</i>	-	-	-	5
Wandering Glider <i>Pantala flavescens</i>	-	10	-	30
Crimson Dropwing <i>Trithemis aurora</i>	-	-	-	5
Indigo Dropwing <i>Trithemis festiva</i>	-	-	-	10

3.3.6.6 Aquatic fauna

The section of Wai Ha River within the 100 m buffer of works boundary under Contract 1 is tidal. Aquatic organisms recorded were mainly intertidal species and marine vagrants. A total of 17 fish species were recorded and most of them are typical species appearing in brackish environments (i.e. mangrove) (**Table 3.8**). A snail, *Cassidula* sp., was recorded in a large numbers under the mangrove along the bank. This species is uncommon at other mangrove habitats in Hong Kong. Overall, no species of very high conservation concern were recorded.

Although the river mouth area is modified, the entire banks of this section are largely natural (i.e. lined with mangroves). Bottom of this section is naturally covered with muddy substrate with some gravels; this is a typical intertidal

creek environment in eastern Hong Kong. It should also be noted that this section also connects to Shuen Wan Marsh. Indeed, this section acts as a potential corridor for seawater and organisms to move between Tolo Harbour and the marsh.

Table 3.8. Aquatic species recorded in Wai Ha River within the 100 m buffer of works boundary under Contract 1.

Species name	Common name	Life-cycle Characteristic	Origin	SEMP 1	SEMP 2
Fish					
<i>Liza affinis</i>	Eastern Keelback Mullet	M	N	++	-
<i>Liza</i> sp.	Mullet	M	N	+++	++++
<i>Mugil cephalus</i>	Flathead Grey Mullet	M	N	+	-
<i>Ambassis gymnocephalus</i>	Glassperch	M	N	+++++	+++++
<i>Gerres filamentosus</i>	Whipfin Silverbidy	M	N	+	-
<i>Gerres macracanthus</i>	Longspine Silverbidy	M	N	++	+++
<i>Gerres oyena</i>	Common Silverbidy	M	N	+	-
<i>Acanthopagrus latus</i>	Yellowfin Seabream	M	N	+	-
<i>Acanthopagrus schlegelii</i>	Blackhead Seabream	M	N	+++	-
<i>Monodactylus argenteus</i>	Silver Moony	M	N	++	-
<i>Terapon jarbua</i>	Jarbua Terapon	M	N	+++	++++
<i>Oreochromis mossambicus</i>	Mozambique Tilapia	F*	I	++++	+++++
<i>Oreochromis niloticus</i>	Nile Tilapia	F*	I	++++	+++++
<i>Tilapia zillii</i>	Redbelly Tilapia	F*	I	+	-
<i>Pseudogobius javanicus</i>	Javanese Flatnose Goby	M	N	-	+++
<i>Scatophagus argus</i>	Spotted Scat	M	N	++	+
<i>Platycephalus indicus</i>	Bartail flathead	M	N	+	-
Crustacean					
<i>Eriocheir japonicus</i>	Mitten Crab	D	N	+	+
<i>Perisesarma bidens</i>	Sesarmino Crab	M	N	+	-
<i>Uca arcuata</i>	Fiddler Crab	M	N	+	-
Bivalve					
<i>Geloina erosa</i>	Large Mangrove Clam	M	N	-	+
<i>Isognomon isognomum</i>	Hammer Oyster	M	N	+++++	-
<i>Saccostrea cucullata</i>	Rock Oyster	M	N	++++	+++
Gastropod					
<i>Cassidula</i> sp.	Snail	M	N	-	++++
<i>Cerithidea cingulata</i>	Mud Snail	M	N	+++	++
<i>Cerithidea ornata</i>	Mud Snail	M	N	-	+
<i>Cerithidea rhizophorarum</i>	Mud Snail	M	N	++	++++
<i>Terebralia sulcata</i>	Large Mangrove Snail	M	N	-	+++
<i>Clithon oualeniensis</i>	Clithon	M*	N	-	++++

-: not recorded; +: rare, ++: uncommon, +++: common, ++++: abundant, +++++: dominant;

M: marine vagrant, F: freshwater species, D: diadromous species; N: native, I: introduced;

*: euryhaline species.

The section of Wai Ha River within the 100 m buffer of works boundary under Contract 2 is not tidal. Although a short section along Tung Tsz Road is modified (with concrete banks), much of the riverbed is natural substrate (i.e. gravel and sand) which is favourable to aquatic wildlife. Comparatively high fish diversity was recorded (21 species) (**Table 3.9**), although more than half of them are introduced or exotic species. However, eight native fish species were recorded from this section, and most of them usually only appear in natural streams with good water quality (i.e. Minnow, Predaceous Chub; Lee *et al.* 2004). Some diadromous species (i.e. those that migrate between freshwater and the sea during various life-stages) were recorded; the presence of these species indicates that the stream-ocean corridor has been maintained (i.e. larvae of these species can migrate from the sea to this section). Predaceous Chub is considered to be Vulnerable in Mainland China (CSIS 2010) but is common and widespread in Hong Kong (Lee *et al.* 2004). *Caridina longirostris* is considered to be uncommon in Hong Kong (AEC Staff pers. obs.).

Table 3.9. Aquatic species recorded in Wai Ha River within the 100 m buffer of works boundary under Contract 2.

Species Name	Common Name	Life-cycle Characteristic	Origin	SEMP 3	SEMP 4
Fish					
<i>Carassius auratus</i>	Goldfish	F	I	++	-
<i>Cirrhinus molitorella</i>	Mud Carp	F	I	+	-
<i>Cyprinus carpio</i>	Common Carp/ Ornamental Carp	F	I	++	+
<i>Opsariichthys evolans</i>	Minnow	F	N	+++	+++
<i>Parazacco spilurus</i>	Predaceous Chub	F	N	+++	+++
<i>Puntius semifasciolatus</i>	Chinese Barb	F	N	+	-
<i>Liniparhomaloptera disparis</i>	Broken-band Hillstream Loach	F	N	-	++
<i>Pterygoplichthys</i> sp.	Sailfin Catfish	F	I	-	+
<i>Gambusia affinis</i>	Mosquito Fish	F	I	+	+
<i>Poecilia reticulata</i>	Guppy	F	I	+++	++++
<i>Poecilia salvatoris</i>	Guppy	F	I	+	-
<i>Xiphophorus hellerii</i>	Swordtail	F	I	++++	++++
<i>Monopterus albus</i>	Swampy Eel	F	N	-	+
<i>Oreochromis mossambicus</i>	Mozambique Tilapia	F	I	++	++
<i>Oreochromis niloticus</i>	Nile Tilapia	F	I	+++	++++
<i>Tilapia zillii</i>	Redbelly Tilapia	F	I	+	-
<i>Tropheus diboisi</i>	Cichlid	F	I	+	-
<i>Vieja</i> sp.	Cichlid	F	I	+	-
<i>Glossogobius giuris</i>	Fork-tongue Goby	D	N	+	-
<i>Rhinogobius duospilus</i>	Goby	F	N	++	+++
<i>Rhinogobius giurinus</i>	Barcheek Goby	D	N	+	+
Arthropod					
Libellulidae sp.	Odonata (Nymph)	F	N	-	++
<i>Caridina longirostris</i>	Atyid Shrimp	D	N	-	+
<i>Eriocheir japonicus</i>	Mitten Crab	D	N	++	++

Species Name	Common Name	Life-cycle Characteristic	Origin	SEMP 3	SEMP 4
Molluscus					
<i>Clithon retropictus</i>	Freshwater Clithon	D	N	++++	++

-: not recorded; +: rare, ++: uncommon, +++: common, ++++: abundant, +++++: dominant;

M: marine vagrant, F: freshwater species, D: diadromous species; N: native, I: introduced.

3.4 Action and Limit Levels in the ECA

If the construction and establishment phase monitoring identify that certain criteria (e.g. area of preferred habitats and health of vegetation) are not being met, action will be conducted to improve the habitats in the ECA. **Table 3.10** details the action and limit levels and the action plan for the ECA under Contract 1.

Table 3.10. Action and Limit Levels for monitoring and maintaining the ECA.

Parameters	Action Level	Limit Level	Action
Flooding/storm damage	N.A.	N.A.	Review damage in conjunction with short-term weather forecast. Review damage (e.g. vegetation condition) and determine severity and undertake repairs/modifications to the design.
Area of water in the open water in pond at tide height of < 1.5 mPD	< 70%	< 60 %	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem persists, the action plan for limit level exceedance should be implemented. Limit level exceedance: re-profiling as required.
Emergent or floating vegetation in the open water pond at tide height of < 1.5 mPD(although it is not proposed to plant emergent or floating vegetation as part of the restoration process, it is to be expected that these will colonise the wetland over time)	> 10 %	> 20 %	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem persists, the action plan for limit level exceedance should be implemented. Limit level exceedance: manual or mechanical vegetation clearance.
Woodland area with a mixture of planted trees and shrubs; wooded area with retained and/or (trans)planted trees	< 80%	< 70%	Action level exceedance: review tree status and growth. If the problem (such as dead trees, shrubs or >50% diseased leaves in tree canopy) persists, the action plan for limit level exceedance should be implemented. Limit level exceedance: undertake supplemental tree and/or shrub planting.
Emergent, mangrove propagules or unwanted vegetation in the intertidal mudflat (it is expected	> 20%	> 30%	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem persists, the action plan for limit level exceedance should be implemented.

Parameters	Action Level	Limit Level	Action
that such vegetation will colonize the wetland over time)			Limit level exceedance: manual or mechanical vegetation clearance.
Brackish marsh vegetation cover	< 80%	< 70%	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem (such as dead plants or invasion of undesirable plant species) persists, the action plan for limit level exceedance should be implemented. Limit level exceedance: carry out weeding or planting.
Undesirable plant species (all wetland) including unwanted terrestrial species and exotics (including but not limited to exotic, invasive climbers <i>Mikania micrantha</i> , <i>Ipomoea aquatica</i> , <i>Ipomoea cairica</i> , <i>Eichhornia crassipes</i> and <i>Typha angustilia</i> .	> 10% of vegetation in the ECA	> 20% of vegetation in ECA	Action level exceedance: removal by weeding. Limit level exceedance: removal by weeding, if problem persists or further deterioration occurs, review design and management regime.
Undesirable fauna including invasive/exotic aquatic invertebrates (including but not limited to Red Imported Fire Ant)	Presence	Negatively impacting wetland function	Action level exceedance: treatment or removal (or other method if suitable). Limit level exceedance: increase frequency of treatment or removal (or other method if suitable), review management protocols and design.

3.5 Conclusion and Recommendation

This section of Baseline Environmental Monitoring Report details the project background, monitoring methodology, types of equipment used in ecological monitoring, monitoring transects and locations, monitoring time and frequency, and influencing factors on the ecological monitoring during the pre-construction, construction and operation phases of the Project. Action and Limit Levels for monitoring and maintaining the Ecological Compensatory Area (ECA) is also included.

A baseline ecological monitoring was conducted on 11, 12 and 15 November 2010 for updating the latest habitat characteristics and fauna utilization and flora colonization within the works areas and in its proximity.

Fourteen habitat types were identified within the 100m buffer area of the Project. A total of 98 and 118 plant species were recorded within works boundary of Contracts 1 and 2 respectively. Potted seedling of a protected tree *Rhodoleia championii* was identified in Area B under Contract 1, while

individuals of protected shrub *Pavetta hongkongensis* were found in area under Contract 2. Both species will be transplanted appropriately according to the latest Tree Felling Application and Transplantation Proposal.

Eleven and nine bird species were recorded within the works boundary of Contracts 1 and 2 respectively. All recorded species are common and widespread in Hong Kong. No herpetofauna species were recorded in either Contract areas as the habitats offer few ecological opportunities for this faunal group.

Three butterfly and one odonata species were recorded in areas under Contract 1, but none recorded for Contract 2. All recorded butterflies and odonata are common and widespread in Hong Kong. Habitats within the works boundary for both contracts offer few ecological opportunities for these faunal groups and this is reflected in the low numbers of species recorded from these areas.

The section of Wai Ha River within the 100m buffer area of works boundary under Contract 1 is a tidal, largely natural stream. Aquatic organisms recorded were mainly intertidal species and marine vagrants, and 17 fish species adapted to brackish environments were recorded in SEMP 1 and 2. Shallow muddy habitats and mangroves are important fish nursery in Hong Kong (Nip and Wong 2010). The lower section of Wai Ha River (SEMP 1 and 2) and Shuen Wan Marsh provide this kind of environment, and both are thus considered as a nursery habitat for fishes. In order to maintain the nursery function, this section and the marsh should be connected to the sea so that juvenile fishes and other marine organisms can enter the stream and the marsh freely. It is noted that in the future there is a gate proposed at the river mouth to control the movement of water – the gate will be closed in extreme flooding events and water will be diverted through the pumping station to Tolo Harbour (AECOM 2007). It is recommended that this mechanism should only work in extreme flooding events. In normal condition, this gate should not be closed so as to ensure that water (seawater/ stream water) and aquatic organisms can move between Tolo Harbour and Wai Ha River, thus maintaining the stream-ocean corridor.

The section of Wai Ha River within the 100m buffer area of works boundary under Contract 2 is not tidal. A total of 21 fish species, with eight native fish

species, was recorded in SEMP 3 and 4. Diadromous species (those that travel between salt and fresh water) were recorded in the middle section of Wai Ha River (SEMP 3 and 4), and most of these species are amphidromous (those species that move between fresh and salt water during their life cycle, but not to breed). Although none of the recorded species are considered to be of high conservation concern, the presence of these species indicates that Wai Ha River is capable to provide habitats for amphidromous species; many amphidromous species in Hong Kong are of very high conservation concern (Nip 2010). Indeed, *Caridina longirostris*, which is amphidromous, recorded in the present survey is considered to be uncommon in Hong Kong. AECOM (2007) also recorded a diadromous species, *Anguilla japonica*, which is considered to be Vulnerable (Chan 2001) and uncommon (Lee *et al.* 2004) in Hong Kong, in Wai Ha River. In order to protect amphidromous species (also applicable to diadromous species), the stream-ocean corridor should be maintained and kept open; the natural stream flow should not be affected and the stream environment should remain natural (Nip 2010).

It is noted that a portion of this section close to Tung Tsz Shan Road will be directly impacted (AECOM 2007). From the available information, the area to be affected will be small as compared to the whole stream. It is recommended that the section to be directly affected should be reinstated into a natural condition (i.e. natural bottom with sand and gravel) as stated in the EIA report (AECOM 2007).

According to AECOM (2007), during extreme flooding events, water from Wai Ha River will be diverted into an opening under Tung Sze Shan Road, through the culvert to be constructed under Tung Tsz Road and drained into Tolo Harbour. In order to reduce the impact on diadromous species, it is suggested that this diversion should only happen in extreme conditions. In normal conditions, the stream flow should not be diverted and the flow volume should be kept natural.

The presence of Predaceous Chub and Minnow indicates that the middle section of Wai Ha River is in general clean and the water quality is good. Therefore, it is recommended that any works that may potentially affect this section should be conducted in a manner that water quality degradation can be avoided (i.e. control construction runoff). Mitigation measures for protecting the water quality and naturalness of the watercourse, as stated in

the EM&A Manual (revision 3) and Program, should be strictly followed during the Construction and Operation Phases of the Project.

In order to indicate that the ecological function and integrity of Wai Ha River has not been significantly affected by the works, it is recommended that some species can be considered as “indicator species” for future monitoring. For instance, to indicate that the stream-ocean corridor is open, so that the lower section of Wai Ha River (and Shuen Wan Marsh) can provide fish nursery and the middle section can provide habitats for diadromous species, marine vagrants and intertidal species (i.e. Mulletts, Seabreams, Jarbua Terapon) should be present in the lower section and diadromous species such as *Clithon retropictus* and Barcheek Goby (or other diadromous fish species) should be recorded in the middle section during the monitoring. In order to make sure that the stream water quality and stream environment in the middle section is maintained in an ecologically acceptable condition, species such as Minnow (*Opsariichthys evolans*, previously known as *Zacco platypus* in Hong Kong) and Predaceous Chub should be present as both these species are sensitive to water quality changes and easy to be observed (and both are reasonably abundant in the section at present).

3.6 References

AECOM 2007. Agreement No. CE 50/2001 Drainage Improvement in Shatin and Tai Po Design and Construction EIA Report. AECOM, Hong Kong.

BirdLife International (2010) Species factsheet: *Corvus torquatus*. Downloaded from <http://www.birdlife.org> on 16/11/2010. Recommended citation for factsheets for more than one species: BirdLife International (2010) IUCN Red List for birds. Downloaded from <http://www.birdlife.org> on 16/11/2010.

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

Chan, B.P.L. 2001. *Sustainability and Biodiversity: The Impact, Alternative Design and Prospects of Restoration of Channelized Lowland Streams in Hong Kong*. Unpublished PhD Thesis, The University of Hong Kong.

CSIS. 2010. *China Species Information System Red List* (www.baohu.org).

Fellowes, J.R., Lau, M.W.N., Dudgeon, D., Reels, G.T., Ades, G.W.J. Carey, G.J., Chan, B.P.L., Kendrick, R.C., Lee, K.S., Leven, M.R., Wilson, K.D.P and Yu, Y.T. 2002. Wild animals to watch: terrestrial and freshwater fauna of conservation concern in Hong Kong. *Memoirs of the Hong Kong Natural History Society* (25): 123-160.

Karsen, S., Lau, M.W.N. and Bogadek, A. 1998. *Hong Kong Amphibians and Reptiles*. Hong Kong, Provisional Urban Council.

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

Nip, T.H.M. (2010) First records of several sicydiine gobies (Gobiidae, Sicydiinae) from mainland China. *Journal of Threatened Taxa* 2(11): 1237-1244.

Nip, T.H.M. and Wong, C.K. (2010) Juvenile fish assemblages in mangrove and non-mangrove soft shore habitats in eastern Hong Kong. *Zoological Studies* 49(6): 760-778.

South China Institute of Botany (SCIB) and Agriculture, Fisheries and Conservation Department (AFCD). 2003. *Rare and precious plants of Hong Kong*. Agriculture, Fisheries and Conservation Department, Hong Kong, 234pp.

Tam, N.F.Y. and Wong, Y.S. 2000. *Field Guide to Hong Kong Mangroves*. Hong Kong, City University of Hong Kong.

Tam, N.F.Y. and Wong, Y.S. 2002. *Conservation and sustainable exploitation of mangroves in Hong Kong*. *Trees*, 16: 224-229.

Wilson, K.D.P. 2004. *Field Guide to the Dragonflies of Hong Kong*. Second edition. Hong Kong, Agriculture, Fisheries and Conservation Department.

Xing, F.W., Ng, S.C., Chau, K.C., 2000. Gymnosperms and Angiosperms of Hong Kong. *Memoirs of the Hong Kong Natural History Society* 23: 21-135.

Yip, J.K.L. and Lai, P.C.C. (2004). The nationally rare and endangered plant, *Aquilaria sinensis*: its status in Hong Kong. *Hong Kong Biodiversity* 7: 14-16.

4. Landscape and Visual

4.1 Introduction

According to Clauses 5.2 and 5.3 of EP-303/2008 and the EM&A Manual (revision 3), a baseline review of the landscape and visual condition of the works area under Contracts 1 and 2 should be conducted.

This section of Baseline Environmental Monitoring Report will detail the project background, monitoring methodology and frequency during pre-construction, construction and operation phases.

A baseline landscape and visual review covering the landscape resources within the Survey Area (i.e. areas within and immediately adjacent to the construction sites and works areas of Contracts 1 and 2) was conducted on 11 November 2010. The Survey Area is illustrated in **Figure 7.1**, and **Section 4.4** details the results of the baseline review.

4.2 Background Information

According to the Landscape and Visual Mitigation Measures recommended in the approved EIA report (EIA-130/2007) and Review Note for Final Environmental Impact Assessment Report (January 2008), landscape and visual mitigation measures under Contracts 1 and 2 of the Project during construction and operation phases should consider the Conditions listed in **Table 4.1**.

Table 4.1 Recommended Landscape and Visual mitigation measures as listed in the approved EIA Report and Review Note for Final Environmental Impact Assessment Report (January 2008).

ID No.	Landscape and Visual Mitigation Measures	Funding	Implementation	Management	Maintenance
CONSTRUCTION					
CM-01	<u>Visual Screen</u> Hoardings shall serve as visual screen for the construction in certain area. They shall be properly designed to be compatible to the surroundings.	DSD	Contractor	-	-

DC/2009/22 Drainage Improvement Works in Shuen Wan, Tai Po
Baseline Environmental Monitoring Report

ID No.	Landscape and Visual Mitigation Measures	Funding	Implementation	Management	Maintenance
CM-02A	<p><u>Contaminant/Sediment Control</u> Suitable temporary barriers, covers and drainage provisions shall be provided around construction works to avoid discharge of contaminants (such as bleeding from in-situ concrete works) and sediments into sensitive water-based habitats including marshes, fish ponds and mangroves.</p>	DSD	Contractor	-	-
CM-02B	<p><u>Pollution control</u> The implementation of environmental pollution control measures, such as those for controlling water quality and ecological impacts as illustrated in Sections 5 and 7, to minimise any adverse impacts to the surrounding habitats.</p>	DSD	Contractor	-	-
CM-03	<p><u>Liaison with Nursery</u> The proposed box culvert passing through the existing nursery may affect its daily operation and substantially reduce its holding capacity for plants. DSD and the Contractor could continue to liaise with the nursery operator for mutual benefits as necessary.</p>	DSD	Contractor	-	-
CM-04	<p><u>Existing Trees within Works Areas</u> All existing trees within work sites shall be properly maintained and protected for their crowns, trunks and roots.</p>	DSD	Contractor	-	-
CM-05	<p><u>Construction Light</u> Security floodlight for construction areas shall be controlled at night to avoid excessive glare to the surrounding villages</p>	DSD	Contractor	-	-

DC/2009/22 Drainage Improvement Works in Shuen Wan, Tai Po
Baseline Environmental Monitoring Report

ID No.	Landscape and Visual Mitigation Measures	Funding	Implementation	Management	Maintenance
	and to Plover Cove.				
OPERATION					
OM-01	<p><u>Viewing Areas Formation</u></p> <p>The proposed concrete pipe between the pump house and mechanical gate will affect the existing strip of vegetation, which visually separates the naturalistic shore of Plover Cove from Ting Kok Road. Unlike the proposed box culvert, the concrete pipe will not support any tree planting above due to both technical and maintenance reasons. While it is apparent that the impact cannot be reversed, there is room for enhancing the overall landscape design of the strip to form a roadside landscaped viewing area overlooking Plover Cove. Although Ting Kok Road has been constructed along the shore, it is actually only few sections of the road that have an open view to Plover Cove. The area shall be planted with shrubs and grasses and a few benches.</p>	DSD	Contractor	HyD	HyD/ LCSD/ ArchSD
OM-02A	<p><u>Architectural Design for Pump House</u></p> <p>The appearance of proposed pump house shall be properly designed, including a careful selection of material colour and texture, so that it fits into the existing suburban, natural to semi-natural surroundings. The aesthetic design of the pumping station will be circulated to ASD for comment in accordance with ETWB TCW 8/2005.</p>	DSD	Contractor	DSD	DSD

DC/2009/22 Drainage Improvement Works in Shuen Wan, Tai Po
Baseline Environmental Monitoring Report

ID No.	Landscape and Visual Mitigation Measures	Funding	Implementation	Management	Maintenance
OM-02B	<u>Landscape Design for Pump House</u> Sufficient planting shall be provided around the boundary fence of the pump house for screening.	DSD	Contractor	DSD	DSD
OM-03A	<u>Enhancement Planting along Tung Tsz Road</u> An existing strip of disturbed woodland with some large trees and the marsh edge area with mostly grasses and small trees will be affected by the proposed box culvert. After the construction, the area shall be planted with shrubs/ trees of suitable species, such as <i>Ficus</i> spp., <i>Schefflera octophylla</i> , <i>Hibiscus tiliaceus</i> , which help to protect the stream and the marshes.	DSD	Contractor	LCSD	LCSD
OM-03B	<u>Soil Depth for Enhancement Planting</u> The box culvert shall be designed with sufficient loading capacity and with at least 1.0m soil depth for shrub/tree planting above.	DSD	Contractor	LCSD	LCSD
OM-04A	<u>Transplanting of Trees to Adjacent Locations</u> Existing trees to be affected shall be directly transplanted to other locations in vicinity, where no construction will take place.	DSD	Contractor	LCSD	LCSD
OM-04B	<u>Preparation for Transplanting</u> The construction program should also allow sufficient time for root pruning and rootball preparation prior to transplanting.	DSD	Contractor	LCSD	LCSD
OM-05	<u>Reinstatement of affected area</u> The works area should be properly reinstated to the satisfaction of relevant government	DSD	Contractor	HAD	HAD

ID No.	Landscape and Visual Mitigation Measures	Funding	Implementation	Management	Maintenance
	departments.				
OM-06	<p><u>Reinstatement of planters and reprovision of trees and vegetation.</u></p> <p>The plantings including all planted trees and vegetations should be properly reinstated to the satisfaction of relevant government departments.</p>	DSD	Contractor	LCSD	LCSD

4.3 Landscape and Visual Monitoring

4.3.1 Monitoring Methodology and Duration

Monitoring methodology for landscape and visual mitigation measures will follow the requirements listed in the EM&A Manual (revision 3). Accordingly, landscape and visual monitoring will be conducted during the pre-construction, construction and operation phases of the Project.

Baseline Review

According to the EM&A Manual (revision 3), a baseline review should be undertaken before the commencement of the construction works for the Project. The purposes of the baseline review are:

- To check the status of the landscape resources within and immediately adjacent to, the construction sites and works areas.
- To determine whether any change has occurred to the status of the landscape resources since the EIA.
- To determine whether amendments in the design of the landscape and visual mitigation measures are required for those changes.
- To recommend any necessary amendments to the design of the landscape and visual mitigation measures.

Baseline monitoring updating the landscape conditions within the Survey Area was conducted on 11 November 2010 and the results and evaluation are detailed in **Section 4.4**.

Landscape and Visual Monitoring during the Construction Phase

The design, implementation and maintenance of landscape and visual mitigation measures should be checked bi-weekly to ensure that they are fully realized. Any potential conflicts between the proposed landscape measures and any other project works or operational requirements should also be recorded for the Contractor to resolve in early stage, without compromising the intention of the mitigation measures.

The mitigation measures (CM-01 – CM-05) to be implemented during the construction phase listed in **Table 4.1** should be checked during each monitoring activity.

Landscape and Visual Monitoring during the Operation Phase

All landscape and visual mitigation measures should be monitored quarterly during the first year of the Operational Phase to check on the effectiveness of the mitigation measures.

The mitigation measures (OM-01 – OM-06) to be implemented during the operation phase listed in **Table 4.1** should be checked to in each monitoring activity to determine their effectiveness in minimizing the potential impacts.

4.4 Baseline Review Results

A baseline review updating the existing landscape and visual conditions was undertaken on 11 November 2010. The review mainly focused on updating the existing status and sensitivity to change (if any) of the landscape resources within the Survey Area, and to update the landscape and visual mitigation measures due to any changes in the landscape resources.

A total of 11 landscape resources were identified from the Survey Area (**Figure 4.2**). The landscape resource “LR7 – Fung Shui Woodland” identified in the approved EIA (AEIAR-110/2007) is not included in this baseline review as it

falls outside the Survey Area. The landscape resources are identified and described as follows:

LR1 – Roadside Amenity Planting

The roadside amenity planting along Ting Kok Road mainly consists of exotic tree species, including *Melaleuca quinquenervia*, *Casuarina equisetifolia*, *Lagerstroemia indica* and other exotic shrubs. Many of these trees are of moderate size and have been planted in the past decade for landscaping the roadworks and utility works along Ting Kok Road. This roadside amenity planting has low landscape characteristics and value, and is largely tolerant of change. Therefore, the sensitivity to change is Low, which remains the same as in the approved EIA report.

LR2 – Nursery

This landscape resource refers to Tung Tsz Nursery under the management of LCSD. The existing vegetation in the nursery mainly includes exotic ornamental vegetation such as trees *Terminalia mantaly*, *Terminalia catappa*, *Cassia fistula*, *Grevillea robusta*, *Archontophoenix alexandrae* and *Aleurites moluccana* and other ornamental shrubs and herbs. Native trees and shrubs are also maintained within the nursery. The majority of the managed vegetation is young and with insignificant landscape quality and characteristics. They are also tolerant of change as most of them are potted specimens. Therefore, the sensitivity to change is Low, which remains the same as in the approved EIA report.

LR2A – Open Space Planting

A small public playground, which is under the management of LCSD, situated to the north of Tung Tsz Nursery is identified as a landscape resource. It consists of a mix of common, exotic ornamental trees, shrubs and palms for landscape and amenity purpose. A row of moderate-sized exotic tree *Melaleuca quinquenervia* is present along the playground boundary, next to Tung Tsz Road. Since the trees and other planted vegetation are not mature and have no special landscape quality, the sensitivity to change is Low, which remains the same as in the approved EIA report.

LR3 – Disturbed Vegetation and Farmland

This landscape resource refers to the existing cultivated land and the abandoned farmland that has been become overgrown by vegetation. Low numbers of farmland species were identified in the area close to Wai Ha Village. The farmland was under management and cultivated with common crops such as *Brassica chinensis*, *Carica papaya* and *Musa x paradisiaca*. The abandoned farmland is largely overgrown with grassy vegetation, weedy creepers and isolated self-seeded trees and shrubs. Vegetation and trees recorded in this landscape resource are not mature and have no particular landscape value and characteristic. Therefore, the sensitivity to change is Low, which remains the same as in the approved EIA report.

A small farmland is newly identified among the marsh (LR9) close to Treasure Spot Garden II. This farmland was planted with isolated, ornamental plants *Citrus reticulata*.

A large strip of disturbed vegetation was identified close to the proposed pump house area (i.e. Area A). This newly identified landscape resource area is mainly vegetated with self-seeded native trees and shrubs such as *Macaranga tanarius*, *Cetis sinensis*, *Litsea glutinosa* and *Bridelia tomentosa*.

These newly identified areas were vegetated with either young, planted fruit trees (in the farmland) or self-seeded trees and other vegetation of low landscape quality. The sensitivity to change for this landscape resource is Low, the same as evaluated in the approved EIA report.

LR4 – Manmade Slope Vegetation

A small vegetated manmade slope was identified within the Survey Area. It is largely overgrown with common grasses (*Panicum maximum* and *Microstegium ciliatum*), weedy creepers (*Mikania micrantha* and *Ipomoea cairica*) and exotic trees *Leucaena leucocephala*. The landscape quality and characteristics of the vegetation is low and the vegetation composition is rather simple. Hence, the sensitivity to change remains Low, the same as evaluated in the approved EIA report.

LR5 - Shrubland

An area of hillside shrubland was identified close to Treasure Spot Garden II. This mainly consists of grasses, herbs, shrubs and a few isolated trees that are common in such shrubby areas in Hong Kong. The vegetation and trees recorded in this landscape resource are young, and with no special landscape characteristic and value. They are largely tolerant of change, and hence, the sensitivity to change is Low, the same as evaluated in the approved EIA report.

LR6 – Secondary Woodland

A very small patch of secondary woodland was identified within the Survey Area. This comprises a woodland fringe area and consists of native vegetation, including shrubs (such as *Psychotria asiatica* and *Litsea rotundifolia* var. *oblongifolia*) and mature trees (such as *Cinnamomum camphora*, *Bischofia javanica*, *Sterculia lanceolata* and *Litsea cubeba*). Two protected species, namely a shrub *Pavetta hongkongensis* and a tree *Aquilaria sinensis*, were recorded in this small woodland patch within the Survey Area. Both species are locally protected under Cap. 96 and Cap. 586. However, no direct/indirect impact on this woodland patch would be caused by the proposed drainage works. No significant human disturbance in this landscape resource was observed since the approval of the EIA report. With the presence of the protected species and the mature vegetation composition and high landscape quality, the sensitivity of this landscape resource to change is High.

LR6A – Disturbed Woodland

This landscape resource is a subset of LR6. Vegetation maturity and species pattern resembles those in LR6, although it is smaller in size and isolated following the development of villages, farmlands, roads, and slope works. Apparent human disturbance was observed. A mixture of native (*Cleistocalyx operculatus*, *Litsea glutinosa*, *Microcos paniculata* and *Celtis sinensis*) and exotic, planted (*Litchi chinensis*, *Dimocarpus longan* and *Syzygium jambos*) trees could be found in this area. Some of these trees recorded along this landscape resource are of mature age and size, and provide moderate landscape value and characteristic to the surrounding. However, human disturbance in this wooded area was observed, and therefore its sensitivity to change is Moderate. Its sensitivity remains the same as the evaluation in the approved EIA report.

LR7 – Fung Shui Woodland

This landscape resource refers to the *Fung Shui* woodland identified in the approved EIA (AEIAR-110/2007). Two *Fung Shui* woodlands were identified behind San Tau Kok Village and Shuen Wan Chim Uk in the EIA report (AEIAR-110/2007), but these do not fall within the current Survey Area. These are mature woodlands comprising old, native tree species (such as *Cinnamomum camphora*, *Machilus* spp., *Schfflera* spp., *Ficus* spp., *Macaranga tanarius* and *Sterculia lanceolata*) (AEIAR-110/2007). The protected shrub *Pavetta hongkongensis* and tree *Aquilaria sinensis* were recorded in these woodlands (AEIAR-110/2007). Due to their mature size and composition, their sensitivity to change is High.

LR8 – Fish Pond

This landscape resource refers to fish ponds that are abandoned or used for recreational purposes. The pond to the south of Tung Tsz Nursery (i.e. Area C under Contract 1) has been fenced by DSD for the wetland construction required as part of this project, while the adjacent fish pond to the east used for recreational purposes. The pond bunds are largely planted with fruit trees and a row of self-seeded trees (including *Macaranga tanarius*, *Celtis sinensis* and *Melia azedarach*) were identified. The fish pond is heavily maintained and its bunds are concreted-paved. Planted and self-seeded trees and other vegetation are young and with low landscape quality. The sensitivity to change is Low, the same as the evaluation in the approved EIA report.

LR9– Marsh and Stream

This landscape resource refers to the marshy area identified in the Shuen Wan Conservation Area and the small marsh areas close to Treasure Spot Garden II. This is a natural to semi-natural habitat extensively covered by grass (*Microstegium ciliatum*, *Neyraudia reynaudiana* and *Brachiaria mutica*), creepers (*Ipomoea cairica*, *Wedelia trilobata* and *Pueraria lobata*) and other herbs (*Cyclorous interruptus*, *Colocasia esculenta* and *Kyllinga* spp.). Extensive patches of mangroves (*Acanthus ilicifolius*, *Kandelia obovata*, *Avicennia marina* and *Acrostichum aureum*) and isolated trees (such as *Ficus hispida*, *Hibiscus tiliaceus*, *Sapium sebiferum* and *Leucaena leucocephala*) also cover the Shuen Wan Conservation Area. A section of Wai Ha River which falls within the

Survey Area is vegetated with common grasses, creepers and some mature trees. The vegetation of this landscape resource is important for maintaining the ecological and landscaping characteristics and functions in the areas, hence, the sensitivity to change is High.

LR10 – Mangrove

This landscape resource includes part of the mangrove area that falls within the Ting Kok SSSI, (and which is ranked as the second most important mangrove community in Hong Kong (Tam & Wong 2002). It supports a highly diverse mangal community, including *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorhiza*, *Excoecaria agallocha*, *Kandelia obovata* and *Lumnitzera racemosa* (Tam & Wong 2000). The sensitivity to change is High due to the mature and complex mangal community in Ting Kok SSSI. However, the mangrove area potentially influenced by Area A is insubstantial.

LR11 – Natural Seashore

This landscape resource includes an area of natural seashore vegetation and boulder shore within the Survey Area, and which has limited human disturbance. This natural seashore area adjacent to Area A under Contract 1 comprises common mangrove associates (*Hibiscus tiliaceus* and *Thespesia populnea*) along the shore and low numbers of mangrove species (*Avicennia marina* and *Kandelia obovata*). This is a natural landscape resource with limited human interference, and hence, its sensitivity to change is High.

LR 12 – Manmade Seashore

This landscape resource includes a section of manmade rocky seashore along the Ting Kok Road next to Area A. Levels of human disturbance along this shore are expected to be low. Vegetation such as common grass *Panicum maximum*, creeper *Wedelia trilobata* and isolated trees *Macaranga tanarius*, *Celtis sinensis* and *Hibiscus tiliaceus* was identified along the shore. Since it is a man-made habitat with self-seeded trees of low landscape quality, the sensitivity to change is Low.

Figure 7.3 shows the updated status of the landscape resources within Survey Area.

No major habitat and vegetation changes were identified in the above landscape resources since the approval of EIA report. As assessed above, the status and sensitivity to change of the landscape resources within the Survey Area is unchanged in respect to location and magnitude relative to the evaluation in the approved the EIA report (as shown in **Table 8.2** and **Figure 8.4** of the report (AEIAR-110/2007).

The recommended landscape and visual mitigation measures, as listed in **Table 4.1**, still apply during the construction and operation phases of the Project. **Figure 7.4** details the implementation of the landscape and visual mitigation measures in the respective areas during the construction and operation phases of the Project. The application of particular measures follows the approved EIA report. This Landscape and Visual Mitigation Measures Plan are also included in the latest Landscape Plan (Revision 2). Since no significant changes were identified in landscape resources and their sensitivity, application of the mitigation measure remains valid. As specified in the approved EIA report, mitigation measures during construction (i.e. CM-01 – CM-05) should be implemented by the Contractor throughout the whole construction period of the Project, while the mitigation measures for the operation phase (i.e. OM-01 – OM-06) will further reduce any residual impacts from the Project. Unlike Figure 8.29 of the approved EIA report which only specified the measures for the operation phase, **Figure 7.4** is updated to include all mitigation measures for the construction and operation phases of the Project respectively. **Figure 7.4** is also updated to include the revised alignments of twin-cell box culvert passing underneath Tung Tsz Nursery and precast concrete pipe along Ting Kok Road, and location of the stormwater pumping station. Mitigation measures to be implemented in Area C are to protect the existing trees during construction are also specified in **Figure 7.4**.

4.5 Conclusion and Recommendation

This section of Baseline Environmental Monitoring Report details the project background, monitoring methodology and frequency during pre-construction, construction and operation phases.

A baseline landscape and visual review was conducted on 11 November 2010. A total of 11 landscape resources were identified within the Survey Area and

the status of the landscape resources remain largely unchanged since the approval of the EIA. Implementation of the landscape and visual mitigation measures proposed under the EIA remain valid and are sufficient to mitigate for any potential landscape and visual impacts arising from the Project.

4.6 References

Tam, N.F.Y. and Wong, Y.S. 2000. *Field Guide to Hong Kong Mangroves*. Hong Kong, City University of Hong Kong.

Tam, N.F.Y. and Wong, Y.S. 2002. Conservation and sustainable exploitation of mangroves in Hong Kong. *Trees*, 16: 224-229.

5. WATER QUALITY MONITORING

5.1 Monitoring Methodology and Parameters

Monitoring was undertaken to establish water quality baseline levels of sections of Wai Ha River adjacent to Drainage Improvement Works in Shuen Wan, Tai Po, and to provide data to establish action and limit levels in comparison to baseline levels and control point data.

The water quality was measured by temperature, turbidity, pH, dissolved oxygen and suspended solids. Temperature, turbidity, pH and dissolved oxygen measurements were in-situ measurements and suspended solids measurements were performed by a HOKLAS accredited laboratory using recommended reference method APHA 2540D. Measurements for each monitoring station were performed at mid-flood and mid-ebb tides for 3 days per week for 4 weeks (7th of January, 2011 – 2nd of February 2011). Since water depths for all monitoring stations were less than 1m throughout the whole baseline measurement period, only mid-depth level was monitored.

Table 5.1 summarizes the monitoring parameters, frequency and measurement methods.

Table 5.1 – Water Quality Monitoring Parameters, Frequency and Measurement Methods

Parameter	Frequency	Measurement Method
Temperature (°C)	Mid-Flood and Mid-Ebb tides per day, 3 days per week	<i>in-situ</i>
Turbidity (NTU)		
pH		
Dissolved Oxygen (mg/L and %)		
Suspended Solids (mg/L)		Reference method APHA 2540D

5.2 Monitoring Stations

In accordance with the EM&A Manual (revision 3), monitoring stations were established at 4 locations, which are summarized in **Table 5.2** and depicted in **Appendix I**:

Table 5.2 – Water Quality Monitoring Stations

Monitoring Station	Location	Coordinates
W1	Between the Shuen Wan Marsh and ECA	E:839301 N:836386
W2	Between Tolo Harbour and Proposed Penstock	E:839542 N:836184
W3	Upstream of Tung Tze Shan Road	E:838760 N:836714
W4	Wai Ha Village 29D	E:838865 N:836621

5.3 Monitoring Equipment

Baseline monitoring for *in-situ* measurements was performed by a portable and weatherproof multi-meter, model TOA-DKK WQC-24. The equipment was calibrated and verified by certified laboratory or manufacturer every 3 months to ensure they perform to the same level of accuracy as stated in the manufacturer’s specification. Calibration Certificate of the multi-meter is given in **Appendix J**.

5.4 Monitoring Results and Observations

The monitoring results are summarized in **Table 5.3**. All monitoring data are given in **Appendix K**.

Table 5.3 Summary of Water Quality Monitoring Results

	Average of Monitoring Results					
	Temperature (°C)	Turbidity (NTU)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Suspended Solids (mg/L)
W1 (Flood)	16.5	1.1	7.81	8.89	94	4.6
W1 (Ebb)	16.6	0.9	7.71	8.45	89	5.1
W2 (Flood)	16.1	0.6	7.79	9.02	97	4.9
W2 (Ebb)	16.5	0.8	7.54	8.21	90	4.6
W3 (Flood)	16.6	0.6	8.10	9.91	103	2.6
W3 (Ebb)	16.8	0.4	8.03	9.71	99	3.1
W4 (Flood)	16.7	0.2	7.75	9.78	104	2.4
W4 (Ebb)	16.8	0.9	7.69	10.15	104	2.5

The weather conditions during the monitoring period were mostly fine. No water quality monitoring was conducted under increment weather condition such as in the presence of rain.

Possible influences in monitoring results include: animals, birds and marine creatures movements to disturb riverbed sediment, domestic discharges and other human activities such as washing farming equipment in the river.

5.5 Revisions for Inclusion in the EM&A Manual

The baseline monitoring was conducted according to the EM&A Manual (revision 3) for water quality.

The monitoring methodology, parameters monitored and monitoring locations are in line with the EM&A Manual (revision 3).

5.6 Conclusions

Baseline monitoring was conducted at all monitoring locations (W1, W2, W3 and W4, as listed in **table 5.2**) from 7th of January, 2011 to 2nd of February, 2011.

Average values for parameters per location per tide are displayed in **table 5.3** and action and limit levels are calculated in the following section.

5.7 Action and Limit Levels

The water quality criteria – the Action/Limit levels as shown in table 5.4 have been provided in the EM&A Manual (revision 3).

Table 5.4 Action and Limit Levels for Water Quality at All Monitoring Stations

Parameters	Action	Limit
DO in mg/L	5 percentile of baseline data	4 mg/L or 1 percentile of baseline data
pH	N/A	6.0 – 9.0
SS in mg/L	95 percentile of baseline data or 120% of upstream control station's SS	99 percentile of baseline data or 130% of upstream control station's SS
Turbidity in NTU	95 percentile of baseline data or 120% of upstream control station's Turbidity	99 percentile of baseline data or 130% of upstream control station's Turbidity

The Action and Limit levels for all monitoring stations are summarized in **Table 5.5 and 5.6**, which would be applied for compliance assessment of water quality for this project.

Table 5.5 Action and Limit Levels for Water Quality at All Monitoring Stations for Flood Tide

Parameters	Monitoring Stations (at Flood Tide)							
	W1		W2		W3		W4	
	Action Level	Limit Level	Action Level	Limit Level	Action Level	Limit Level	Action Level	Limit Level
DO in mg/L	8.07	8.07	7.81	7.69	8.66	8.00	8.52	7.78
pH	N/A	6.0 – 9.0	N/A	6.0 – 9.0	N/A	6.0 – 9.0	N/A	6.0 – 9.0
SS in mg/L	7.7	8.1	7.7	8.6	6.4	6.9	6.6	7.6
Turbidity in NTU	4.9	5.3	1.7	1.8	3.1	4.1	0.5	0.9

Table 5.6 Action and Limit Levels for Water Quality at All Monitoring Stations for Ebb Tide

Parameters	Monitoring Stations (at Ebb Tide)							
	W1		W2		W3		W4	
	Action Level	Limit Level	Action Level	Limit Level	Action Level	Limit Level	Action Level	Limit Level
DO in mg/L	7.12	7.02	6.77	6.31	8.71	8.61	9.44	9.30
pH	N/A	6.0 – 9.0	N/A	6.0 – 9.0	N/A	6.0 – 9.0	N/A	6.0 – 9.0
SS in mg/L	10.5	10.9	9.4	9.9	7.8	8.1	6.2	7.0
Turbidity in NTU	4.2	4.7	3.0	3.5	1.8	3.0	4.1	4.6

Note:

1. The action levels for SS and turbidity can be 95%-ile of baseline data as mentioned above or 120% of upstream control station at the same tide of the same day according to the EM&A Manual.
2. The limit levels for SS and turbidity can be 99%-ile of baseline data as mentioned above or 130% of upstream control station at the same tide of the same day according to the EM&A Manual.
3. As mentioned in **table 5.4**, the limit levels of DO(mg/L) can be 4mg/L or 1%-ile of baseline data. However, since 1%-ile of baseline data for all measurements are above 4mg/L, 1%-ile of baseline data will be used as the limit levels for all monitoring stations for both tides.

6. HYDROLOGICAL CHARACTERISTICS MONITORING

6.1 Monitoring Methodology and Parameters

Monitoring was undertaken to establish hydrological characteristics baseline levels of sections of Wai Ha River adjacent to Drainage Improvement Works in Shuen Wan, Tai Po, and to provide data to establish action and limit levels in comparison to baseline levels and control point data.

The hydrological characteristics of sections of Wai Ha River were measured by water flow rate and depth. Measurements for each monitoring station were performed at mid-flood and mid-ebb tides for once per week for 4 weeks (7th of January, 2011 – 2nd of February 2011).

Table 6.1 summarizes the monitoring parameters, frequency and measurement methods.

Table 6.1 – Hydrological Characteristics Monitoring Parameters, Frequency and Measurement Methods

Parameter	Frequency	Measurement Method
Water Depth (m)	Mid-Flood and Mid-Ebb tides per day, once per week	<i>in-situ</i>
Water Flow Rate (m ³ /s)		

6.2 Monitoring Stations

In accordance with the EM&A Manual (revision 3), monitoring stations were established at 4 locations, which are summarized in **Table 6.2** and depicted in **Appendix L**:

Table 6.2 – Hydrological Characteristics Monitoring Stations

Monitoring Station	Location	Coordinates
H1	Between the Shuen Wan Marsh and ECA	E:839301 N:836386
H2	Route to Sam Kung Temple	E:839163 N:836433
H3	Upstream of Tung Tze Shan Road	E:838760 N:836714
H4	Wai Ha Village 29D	E:838865 N:836621

6.3 Monitoring Equipment

Baseline monitoring for *in-situ* measurements was performed by a portable echo-sounder, model Greyline Stingray. The equipment was calibrated and verified by certified laboratory or manufacturer every year to ensure they perform to the same level of accuracy as stated in the manufacturer's specification. Calibration Certificate of the multi-meter is given in **Appendix M**.

6.4 Monitoring Results and Observations

The monitoring results are summarized in **Table 6.3**. All monitoring data are given in **Appendix N**.

Table 6.3 Summary of Water Quality Monitoring Results

	Average of Monitoring Results	
	Water Depth (m)*	Water Flow Rate (m ³ /s)**
H1 (Flood)	0.1	-0.375
H1 (Ebb)	0.1	2.277
H2 (Flood)	0.5	1.696
H2 (Ebb)	0.5	2.394
H3 (Flood)	0.5	0.375
H3 (Ebb)	0.5	3.203
H4 (Flood)	0.3	3.768
H4 (Ebb)	0.3	3.261

*: Since the water levels were too low for the depth detector to determine, a tape measure was used for estimation.

** : Negative values mean the water flowed upstream.

The weather conditions during the monitoring period were mostly fine. No water quality monitoring was conducted under increment weather condition such as in the presence of rain.

Since the hydrological characteristics baseline monitoring was carried out in the dry season, the water depth and flow rate were both very low and in many occasions undetectable. As a result the action and limit levels will be relied on the control stations' data instead of the baseline monitoring results.

6.5 Revisions for Inclusion in the EM&A Manual

The baseline monitoring was conducted according to the EM&A Manual

(revision 3) for water quality.

The monitoring methodology, parameters monitored and monitoring locations are in line with the EM&A Manual (revision 3).

6.6 Action and Limit Levels

The Action and Limit levels for all monitoring stations are summarized in **Table 6.4**, which would be applied for compliance assessment of hydrological characteristics for this project.

Table 6.4 Action and Limit Levels for Hydrological Characteristics at All Monitoring Stations

Parameters	Action	Limit
Water Depth (m)	80% of baseline water depth	60% of baseline water depth
Water Flow Rate (m ³ /s)	120% of control station's water flow rate on the same day of measurement	140% of control station's water flow rate on the same day of measurement

The Action and Limit levels for water flow rate are set based on the assumption that the construction works will not halt or redirect any water flow.

Since this baseline monitoring was performed in the dry season, the E.T. advises to use the first month of hydrological characteristics monitoring data as a review to determine if wet season specific action and limit levels are necessary.

6.7 Conclusions

Baseline monitoring was conducted at all monitoring locations (H1, H2, H3 and H4, as listed in **table 6.2**) from 7th of January, 2011 to 2nd of February, 2011.

Average values for parameters per location per tide are displayed in **table 6.3**, however there were a lot of fluctuations in the measurements collected and the water flow of Wai Ha River were very low or undetectable in the dry season. As a result, the action and limit levels will be determined by the upstream control stations on the same day of measurement.