

**Agreement No. CE 11/2002 (DS)  
Drainage Improvement in Sai Kung – Design and Construction**

**Final Executive Summary for the Environmental Impact Assessment Report**

**TABLE OF CONTENTS**

<b>1</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	Project Background .....	1
1.2	Purpose of the Environmental Impact Assessment .....	1
1.3	Project Location and Scope.....	1
<b>2</b>	<b>PROJECT DESCRIPTION .....</b>	<b>2</b>
2.1	Project Details and Design Consideration.....	2
2.2	Do-nothing Scenario .....	4
2.3	Project Programme.....	4
2.4	Interaction with Other Projects .....	4
<b>3</b>	<b>SUMMARY OF THE EIA.....</b>	<b>5</b>
3.1	Air Quality Impacts.....	5
3.2	Noise Impacts.....	5
3.3	Water Quality Impacts.....	5
3.4	Waste Management .....	6
3.5	Land Contamination Impacts .....	6
3.6	Ecological Impacts .....	6
3.7	Landscape and Visual Impacts .....	7
3.8	Impacts on Cultural Heritage .....	8
3.9	Environmental Monitoring and Audit Requirements.....	9
<b>4</b>	<b>OVERALL CONCLUSIONS.....</b>	<b>9</b>

**List of Figures**

Figure 1	Location Plan of Sai Kung River & Sha Ha Stream, Pak Kong River and Ho Chung Channel
Figure 2	General Layout of Sai Kung River
Figure 3	General Layout of Pak Kong River
Figure 4	General Layout of Ho Chung Channel
Figure 5	General Cross Sections
Figure 6	Typical Sections
Figure 7	Retaining Walls for Gabion Channel

## **1 INTRODUCTION**

### **1.1 Project Background**

- 1.1.1 Sai Kung River, Ho Chung River and Pak Kong River are the watercourses causing flooding problems in Sai Kung town centre, Ho Chung and Pak Kong. These watercourses remain natural with irregular cross sections along most of their lengths. Although engineering works have been locally carried out in some parts of the watercourses, flooding persists due to inadequate flow capacities of these rivers exacerbated by the development strain in Sai Kung.
- 1.1.2 Drainage Services Department (DSD) completed the “*Stormwater Drainage Master Plan in Sai Kung, East Kowloon and Southern Lantau*” (DMP Study) and “Preliminary Project Feasibility Study Report” for the drainage improvement in Sai Kung in September 2000 and October 2001 respectively.
- 1.1.3 The DMP Study identified deficiencies and flooding problems in the existing drainage systems within the study area. This proposed drainage improvement works in Sai Kung River, Pak Kong River and Ho Chung Channel are part of the recommendations in the DMP Study for upgrading three existing drainage capacity.

### **1.2 Purpose of the Environmental Impact Assessment**

- 1.2.1 The proposed project is a Designated Project under Schedule 2 Part I of the EIAO and requires an environmental permit under the EIAO for its construction and operation. An application for an Environmental Impact Assessment (EIA) study brief under section 5(1) of the Environmental Impact Assessment Ordinance (EIAO) was submitted by the Applicant on 1 November 2001 with a Project Profile (No. PP-149/2001) for the captioned proposed project.
- 1.2.2 The purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed project and related activities taking place concurrently, and to contribute to decisions on the overall environmental acceptability of the Project.
- 1.2.3 The EIA provided an assessment of the potential environmental impacts associated with the Project, in relation to the issues specified in the EIA Study Brief No. ESB-088/2001 including noise, air quality, water quality, waste management, land contamination, ecology, cultural heritage and landscape & visual resources.

### **1.3 Project Location and Scope**

- 1.3.1 The proposed site of the Project is located in Sai Kung, which is bounded by the high ground of Ma On Shan, Buffalo Hill and Kowloon Peak. Surface runoff drains across the area into Port Shelter to the East via several watercourses.

- 1.3.2 The project includes drainage improvement works at three of the watercourses, namely Sai Kung River, Pak Kong River and Ho Chung Channel. The Sai Kung River flows through box culvert in the Sai Kung town centre before entering the Sai Kung Hoi. The Pak Kong River runs alongside Hiram's Highway before entering a road crossing to Pak Sha Wan. The Ho Chung River runs alongside Ho Chung Road before passing under Hiram's Highway to Pak Sha Wan in the south.
- 1.3.3 The location plan for the three rivers in Sai Kung is presented in **Figure 1** and the individual layout plans for the improvement works at Sai Kung River, Pak Kong River and Ho Chung Channel are given in **Figures 2 – 4**. The improvement works cover only a limited length at the downstream side of three rivers while the rest of the rivers will remain at the present conditions. A cross section and schematic sections of the proposed rivers are presented in **Figures 5 - 7**.

## 2 PROJECT DESCRIPTION

### 2.1 Project Details and Design Consideration

- 2.1.1 Improvement works at the three rivers were recommended in the “*Stormwater Drainage Master Plan Study in Sai Kung, East Kowloon and Southern Lantau*” (DMP Study). The total length of Sai Kung River is approximately 1.3km from upstream grassland flowing through Sai Kung town centre before entering into the Inner Port Shelter (Sai Kung Hoi). The concerned section is 150m long which is located at the mid section of the Sai Kung River. The proposed Sha Ha Diversion Box Culvert will connect the Sai Kung River at upstream and the box culvert constructed by Civil Engineering and Development Department (CEDD) at downstream.
- 2.1.2 The Pak Kong River runs alongside the Hiram's Highway before entering a road crossing under the Hiram's Highway to Pak Sha Wan. The total length is approximately 1.32km and the concerned section is 600m long located at the downstream end of the river as stated in the Project Brief. During the public consultation, the local residents in Pak Kong objected the drainage improvement works in Pak Kong because of the need for resumption of village houses along both sides of the river bank. The local residents requested during the public consultation to minimise the extent of works as far as possible and they would accept a higher flooding risk instead of resumption of houses. As agreed with the local residents, this project will only re-construct two bottlenecks in Pak Kong River and stabilise an existing channel slope adjacent to Hiram's Highway.
- 2.1.3 The Ho Chung Channel runs alongside Ho Chung Road before passing under the Hiram's Highway to Pak Sha Wan in the south. The total length is approximately 1.6km and the concerned section is 650m long located at the downstream area.
- 2.1.4 The major items of the drainage improvement works are summarised in **Table 2.1** below.

**Table 2.1 Summary of Project Elements**

<b>Works Programme</b>	<i>Dec 2005 to April 2008</i>	
<b><u>Major Elements in Sai Kung River and Sha Ha Diversion Culvert</u></b>		
(a) Open Trapezoidal Channel	<i>Length = 150m</i>	<i>Depth = 3m – 3.5m</i>
	<i>Bank width = 16m – 24m</i>	<i>Bed width = 5m</i>
	<i>Gabion walls with rip-rap bases and natural substrates</i>	
(b) Diversion Box Culverts	<i>Length = 280m</i>	<i>3 cells 3m(W) x 3m(H)</i>
(c) Low Flow Pipes	<i>Length = 12m</i>	<i>3 x 600mm diameter</i>
<b><u>Major Elements in Pak Kong River</u></b>		
(a) Channel Widening	<i>Length = 100m</i>	<i>Depth = 3m (approx.)</i>
	<i>Bank width = 13m – 18m</i>	<i>Bed width = 7m – 18m</i>
	<i>To be reinstated by gabion blocks and concrete retaining wall</i>	
(b) Reprovision of crossings	<i>2 numbers (1 vehicular crossing and 1 pedestrian crossing)</i>	
<b><u>Major Elements in Ho Chung Channel</u></b>		
(a) Open Trapezoidal Channel	<i>Length = 300m</i>	<i>Depth = 3.8m – 5m</i>
	<i>Bank width = 17m – 42m</i>	<i>Bed Width = 17m – 34m</i>
	<i>Gabion walls with rip-rap bases and natural substrates</i>	
(b) Rectangular Channel	<i>Length = 350m</i>	<i>Depth = 5m</i>
		<i>Width = 17m – 25m</i>
(c) Reprovision of crossings	<i>4 numbers (1 vehicular crossing and 3 pedestrian crossings)</i>	
(d) Floodwall	<i>Length = 300m</i>	<i>Height = 1m</i>

2.1.5 It is noted that natural lowland and estuarine river habitats are relatively rare habitats in Hong Kong, and are known to provide habitats for a diversity of aquatic organisms. The detailed design of the drainage improvements should reflect the potential ecological value of the existing rivers, and natural features of the rivers should be retained wherever possible. The following ecological-friendly design has been incorporated as basic principles:

- (a) Riverbeds should not be lined with concrete: the natural stream bed and substrate should be retained.
- (b) Riverbanks should not be lined with concrete: soft engineering materials should be utilised as far as possible.

- (c) Natural features of the rivers (such as pool/riffle sequences) should be retained and incorporated wherever possible.
- (d) Compensatory planting should be provided to mitigate the loss of natural riparian vegetation.

2.1.6 Environmental benefits and dis-benefits, alternative drainage options, considerations and constraints for the proposed drainage improvement works at each river were evaluated. Public consultation was also undertaken with local residents, village representatives, the Rural Committee Members, the District Council and green groups. Comments from relevant parties have been addressed and incorporated into the design of the three layouts for the drainage improvement works.

## **2.2 Do-nothing Scenario**

2.2.1 With the existing drainage system at its current capacity level, there is a risk of flooding during heavy rainstorms in Sai Kung. The potential consequences of such flooding include:

- (i) Flooding will persist in Sai Kung Town Centre, downstream area of Ho Chung and Pak Kong River.
- (ii) Development in Sai Kung, Pak Kong and Ho Chung will be hindered. The existing drainage system will not provide the flood protection standard required for future development. Further development will increase the frequency, severity and extent of flooding.
- (iii) Damage to properties, blockage of roads and accesses, nuisance to the public and risk to lives will remain.

2.2.2 If the Project does not proceed, these risks to the community in Sai Kung and Ho Chung will continue and some future development may need to be compromised. There are no simple, small-scale works that can be implemented to reduce these risks. The only effective solution to provide adequate flood relief is to implement the drainage improvement works identified in this Project. For Pak Kong, due to the reduction in scope of the works, the flooding risk will remain.

## **2.3 Project Programme**

2.3.1 The construction programme of the Project will commence in December 2005 and is expected to complete by April 2008.

## **2.4 Interaction with Other Projects**

2.4.1 Concurrent projects with likely interaction with this Project are identified. The potential cumulative impacts have been addressed in the relevant sections of the EIA Report. The construction programmes of the concurrent projects are based on the available information at the time of the submission of this Report.

### **3 SUMMARY OF THE EIA**

#### **3.1 Air Quality Impacts**

- 3.1.1 The main source of air quality impacts would be from the construction works. With the implementation of the recommended mitigation measures i.e. extensive watering of the haul roads, the air modelling results showed that the total suspended particulates level at all air sensitive receivers (ASRs) would be within the dust criteria. Odour nuisance from the excavated materials are considered to be minimal and mitigation measures are recommended to limit its emission.
- 3.1.2 A cumulative dust impact assessment from this Project and the “Improvement work of Ho Chung Road” was carried out. Assessment results indicated that the cumulative dust levels at all ASRs would comply with relevant dust criteria.

#### **3.2 Noise Impacts**

- 3.2.1 Construction of the proposed drainage improvement works is likely, if unmitigated, to generate high noise levels exceeding 75 dB(A) Leq(30-min) at the Noise Sensitive Receivers (NSRs) identified in close proximity to the proposed work sites. The predicted noise levels at the representative NSRs range from 65 dB(A) to 97 dB(A). Adverse noise impacts due to the use of powered mechanical equipment would occur at these sensitive receivers if noise control measures were not implemented.
- 3.2.2 The most effective mitigation measure is to control the noise emissions from the powered mechanical equipment used on site. This would involve either selecting silenced equipment, or reducing the transmission of noise using mufflers, silencers, or acoustic enclosures. Receiver-specific measures that include the use of movable noise barriers and temporary noise barrier will further alleviate the potential construction noise impacts. In this Study, with adoption of silenced equipment, movable noise barriers and temporary noise barrier, the mitigated noise levels at all NSRs due to this Project would comply with the daytime construction noise standard as set out in the EIAO-TM.
- 3.2.3 An indicative assessment was undertaken for cumulative noise impact arising from this Project and the “Improvement work of Ho Chung Road”. Assessment results indicated that the cumulative noise levels at NSRs would comply with noise criteria of 75dB(A) stipulated in the EIAO-TM.

#### **3.3 Water Quality Impacts**

- 3.3.1 The key issue in terms of water quality would be related to excavation works for the drainage improvement works during the construction stage. Working method controls have been recommended to minimise potential water quality impacts during excavation of the earth channel. In particular, excavation works for the earth channel at each river would be carried out in dry condition by diverting the stream flow from upstream of the site and containment measures would be used within the channel to prevent water from entering the excavation area. Other mitigation measures include control measures on runoff and drainage from the

works areas to minimise construction runoff, proper site management and good housekeeping practices to ensure construction wastes not entering the adjacent watercourses. With the implementation of these recommended mitigation measures, unacceptable impacts on water quality would not be anticipated.

### **3.4 Waste Management**

- 3.4.1 The main waste arising would be excavated material from the drainage improvements works for the three river channels, and would comprise soil, sand, gravel and small rocks. Other wastes generated by the construction activities are likely to include general refuse from the workforce, chemical wastes from plant and vehicle maintenance, and construction & demolition (C&D) material from the demolition of existing structures and site clearance.
- 3.4.2 Excavated material with suitable characteristics should be reused on-site as far as practicable. Surplus public fill generated from the Project is proposed to be disposed of to the fill bank at Tseung Kwan O Area 137, and C&D waste is proposed to be disposed of to the South East New Territories Landfill Site. Provided that these identified waste arisings are to be handled, transported and disposed of using the recommended methods and good site practices are to be strictly followed, adverse environmental impacts would not be expected.

### **3.5 Land Contamination Impacts**

- 3.5.1 An account of the present and historical land uses along the proposed drainage improvement areas of the three river channels indicated that activities related to land contamination impact was not identified in or near to Sai Kung River and Ho Chung Channel. However, two workshops associated with contaminating uses were noted to be present near Pak Kong River, and the main type of activities was related to vehicle repairing works.
- 3.5.2 A preliminary Contamination Assessment Plan (CAP) has been prepared which proposed further investigation on the workshop areas falling within the project boundary of Pak Kong River. Due to the possible changes of land use and site conditions, a review of the CAP would be required by the future Environmental Team at a later stage after land resumption.
- 3.5.3 It is considered that the potential residual impacts would not be significant provided that any identified contaminated land would be remediated to the acceptable standards prior to the site clearance/excavation works, and the mitigation measures recommended would be properly implemented during the construction stage of the Project.

### **3.6 Ecological Impacts**

- 3.6.1 Nine-month ecological surveys covering the wet and dry seasons were undertaken to establish the ecological profile of the Sai Kung & Sha Ha, Pak Kong and Ho Chung Assessment Areas. The Assessment Areas included several areas (Conservation Areas, Coastal Protection Areas, Country Park/Special Area) of recognised conservation interest.
- 3.6.2 Seven major habitat types were identified within the Assessment Areas, comprising Rivers/Streams, Cultivation Land, Woodland and *Fung Shui* Woodland, Shrubland,

Developed and Village Areas, Mangrove, and Marine Habitat. Several plant species of conservation interest were found in the Assessment Areas, including one rare tree species (*Ehretia acuminata*) recorded inside the proposed Ho Chung Works Area.

- 3.6.3 A total of 64 bird species were recorded in the Assessment Areas during recent surveys, 12 of which are considered of conservation interest. One fish, one snake, one butterfly and three mammal species of conservation interest were also recorded from the Assessment Areas during recent surveys.
- 3.6.4 The primary direct ecological impact resulting from the Project would be the loss of small sections of moderate ecological value lowland rivers. The proposed works are also anticipated to directly affect several individuals of the rare tree *Ehretia acuminata*.
- 3.6.5 Other direct impacts would include the loss of 0.83ha low-moderate value cultivation land and 0.91ha low ecological value village and developed area habitats. Because of the low ecological value of the affected habitats, these impacts are considered relatively minor.
- 3.6.6 Indirect impacts would be expected to include increased sedimentation in aquatic habitats during the construction phase, and disturbance to wildlife caused by increased human activity and noisy construction phase activities. Sedimentation is predicted to have only temporary and localised impacts to aquatic habitats, and is considered a minor ecological impact. Construction phase disturbance would be temporary, and would largely affect only low and low-moderate ecological value habitats. As such, it is considered a minor ecological impact.
- 3.6.7 Operation phase impacts are expected to be relatively minor.
- 3.6.8 Measures to avoid, minimise and compensate for identified ecological impacts have been recommended. These include measures to reduce minor construction phase impacts to aquatic communities resulting from increased sedimentation and disturbance. Additionally, individuals of the rare tree species *Ehretia acuminata* affected by the proposed works are recommended to be transplanted.
- 3.6.9 The design of drainage channels proposed to replace Sai Kung and Ho Chung Rivers includes the use of natural substrates for lining newly formed channel beds, recreation of natural riffle/pool sequences, use of rock filled gabion to line newly constructed river banks, and extensive compensatory planting along the channel banks. With these measures in place, it is expected that aquatic communities found in the rivers would re-colonise the newly constructed drainage channels. No major long-term residual impacts to the rivers are anticipated.
- 3.6.10 With the implementation of the recommended mitigation measures, ecological impacts resulting from the proposed drainage improvement works are expected to be relatively minor and environmentally acceptable.

### **3.7 Landscape and Visual Impacts**

- 3.7.1 Landscape impacts on the landscape resources and character are assessed without mitigation measures in place. The impacts on the assessed Landscape Character Areas (LCAs) are

predicted to be negligible except lowland valleys where moderate adverse impacts are predicted due mainly to the loss of approximately 442 existing trees. However, this loss of trees would be significantly offset by tree planting and greening of slopes and channel edges. Additionally existing trees which are in conflict with the Project would wherever possible be transplanted to a location within the Project works or adjacent to the works. The transplanting locations will be finalised with Leisure and Cultural Services Department or Agricultural, Fisheries & Conservation Department during the detailed design phase of this Project.

- 3.7.2 The unmitigated visual impact of the Project on the visual sensitive receivers (VSRs) are predicted to be slight-moderate adverse except at Hiram's Highway near Tai Chung Hau Road where moderate-significant adverse impact are expected owing to the intrusion of the new works into existing views. Through the incorporation of mitigation measures such as planting within the channel, textured concrete walling and compensatory tree planting, the predicted visual impacts can be reduced to slight adverse except for VSR3 where moderate adverse residual visual impact would be expected.
- 3.7.3 Overall, the landscape and visual impacts of the Project are considered to be acceptable with mitigation measures. A low level of loss of landscape and visual resources is predicted and is not considered excessive so as to constitute unacceptable impacts. However, a key landscape design issue during detailed design will be the need for a high level of co-ordination and liaison between Government and the design consultant to ensure that all recommended mitigation measures are effectively incorporated into the Project. The proposed works would not be acceptable if these mitigation measures are not incorporated.

### **3.8 Impacts on Cultural Heritage**

- 3.8.1 The Cultural Heritage Impact Assessment consists of two sections, an Archaeological Impact Assessment and a Built Heritage Impact Assessment.
- 3.8.2 For the Archaeological Impact Assessment, the desk-based review identified no archaeological potential in the Ho Chung and Pak Kong works areas. For the work areas at Sai Kung River, the desk-based review identified there was a potential for archaeological deposits at the works areas at Sha Ha. However, the field survey results indicate that no *in-situ* archaeological deposits remain within the Sha Ha works area and no mitigation is recommended.
- 3.8.3 For the Built Heritage Impact Assessment, the proposed drainage works will have minor effects on the majority of built heritage features recorded in the survey. The mitigation measures required for the construction phase of the Project include:
- The higher earth god shrine should be provided with protective covering if works come within 1m of the structure. Safe public access should be maintained throughout the construction period;
  - For the Che Kung Temple and second earth god shrine, a vehicle parking area should be maintained or alternative parking facilities should be made available. Clear signage for directions to the Temple should be provided from Hiram's Highway;

- Felling of mature trees along all three rivers should be avoided. If it is unavoidable, any trees that are removed from the area should be replaced by trees of the same species.
- The channel design should also include proposals for designs that would minimise any change in character to the environmental setting, such as the incorporation of building materials for the construction activities, that are compatible to the existing environment, such as cobbles and gravel and the incorporation of features that will encourage vegetation growth along the banks, such as grass concrete and natural verges.

### **3.9 Environmental Monitoring and Audit Requirements**

3.9.1 An Environmental Monitoring and Audit (EM&A) programme will be setup and implemented by the project proponent to ensure compliance with the recommendations in the EIA Report, to assess the effectiveness of the recommended mitigation measures, and to identify any further need for additional mitigation measures or remedial action. Details of the recommended mitigation measures, monitoring procedures and locations are presented in a stand-alone EM&A Manual. This will enable the Contractor to have early warning and provide necessary action to reduce impacts at specific areas if the assessment criteria are approached. The effectiveness of on-site control measures could also be evaluated through a monitoring exercise. All the recommended mitigation measures should be incorporated into the EM&A programme for implementation.

## **4 OVERALL CONCLUSIONS**

- 4.1.1 Over the last 10 years, rapid development in Sai Kung has resulted in a higher surface runoff and the existing drainage systems that have been designed with lower flood protection level are no longer adequate to provide the flood protection standards required for developed areas. This Project purposes to improve the lower sections of the three river channels and aims to relief the potential flooding risk which may cause danger to human life, damage to properties and to a lesser extent nuisance to the public.
- 4.1.2 The overall environmental acceptability of the Project has been carefully considered and balanced in the EIA Study and the engineering design work. Possible alternatives alignments and construction options have been evaluated to minimise environmental impacts.
- 4.1.3 The detailed design of the drainage improvements has reflected the potential ecological value of the existing rivers, and natural features of the rivers will be retained wherever possible. Ecologically friendly designed river channels have been applied instead of the conventional concrete bed channel so as to restore and enhance the ecological habitats in the original river channel. Compensatory planting has been incorporated to mitigate the loss of natural riparian vegetation.
- 4.1.4 During the construction phase, the potential impacts particularly the air, noise and water quality impacts would be mitigated to acceptable levels through the proposed specific measures.

- 4.1.5 The potential environmental impacts during both construction and operational stages are addressed with suitable design and mitigation measures. The results of various assessments indicate that the environmental impacts identified are generally within acceptable environmental standards and no adverse residual impacts are identified.