



Agreement No. LD 01/2012
Eco-hydraulics Study on Green Channels –
Stage 1

Executive Summary

February 2015
Drainage Services Department

**Agreement No. LD 01/2012
Eco-hydraulics Study on Green Channels
– Stage 1**

Executive Summary

February 2015

Drainage Services Department

Land Drainage Division, 11/F, Kowloon Government Offices, 405 Nathan Road, Kowloon.

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	20 Oct 2014	Various	Julia Chan	Anne F Kerr	First Draft
B	23 Dec 2014	Various	Julia Chan	Anne F Kerr	Second Draft
C	14 Jan 2014	Various	Julia Chan	Anne F Kerr	Third Draft
D	02 Feb 2014	Various	Julia Chan	Anne F Kerr	Final

This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned project only. It should not be relied upon by any other party or used for any other purpose.

We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties

This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

Content

Chapter	Title	Page
1.	Executive Summary	2
1.1	Background	2
1.2	Findings of the Working Papers	2
1.3	Recommendations for Stage 2 Study	6

Table

Table 1-1 Summary of RSE assessment criteria	4
Table 1-2 Summary of scores for the selected green channels	4

1. Executive Summary

1.1 Background

Drainage Services Department (DSD) has implemented a wide range of green channels in the Territory to enhance the environment for channelization of natural streams and rivers, but the ecological values of the green channels have not been assessed after completion of the works. Further, the information on percentage of the lowland rivers (defined as reaches below 200 m) that remain in natural state or channelized is not available. Collection of such information, including the extent to which various green channels beds, embankment and substrate designs of the green channels enrich ecological habitats and support species biodiversity, is required for assessment on the enhancements to the environment by the green channels.

In response to the need of the above assessment, the study of eco-hydraulics of green channels was conducted to provide important insights into the advantages and disadvantages of different green channel design in terms of habitat enhancements as well as the hydraulic resistance, and allowed all implemented designs in various catchments to be ranked systematically in order to give more information for consideration in implementing eco-hydraulic channel/river projects in the future. Guidelines for green channels/ rivers design for enhancing the ecological values of the drainage systems without jeopardizing the hydraulic requirements were prepared taking into account the findings of the study.

This Study forms the Stage 1 Study which comprises six working papers and includes recommendations for the next phase of works (the Stage 2 Study).

1.2 Findings of the Working Papers

Working Paper No.1 – Inventory of Green Channels Maintained by DSD

An inventory was established for the engineered and green channels / rivers being planned / designed, constructed and operated by DSD, as well as existing rivers with high ecological value not maintained by DSD. The inventory included information on their characteristics, channel designs and ecological value.

Based on a review of available information, a total of 215 river / stream segments were identified and tabulated in the inventory. An analysis of the coverage of rivers / streams in Hong Kong identified that low-lying rivers / streams (with elevations less than 100 m) account for approximately 56.6% in length of all the rivers / streams in Hong Kong. Except for Ngong Ping Stream, the rivers / streams maintained by DSD occur wholly or partly within this low-lying area, and such engineered channels (by DSD and others) account for approximately 9.8% in length of all the low-lying rivers / streams in Hong Kong.

Working Paper No. 2 – Classification and Prioritization of Hydraulic Resistance and Ecological Value for Existing Green Channels

305299/ENL/03/08/D February 2015

P:\Hong Kong\ENL\PROJECTS\305299 Eco-hydraulics Study on Green Channels Stage 1\03 Deliverables\08 Final Study Rpt n
ES\Working\Executive Summary\Executive Summary RevD.doc

A review was conducted of some of the assessment techniques and scoring systems established locally and overseas, which include the *New Nature Conservation Policy* (NNCP) developed in Hong Kong, the *Rapid Stream Assessment Technique* (RSAT) and the *Qualitative Habitat Evaluation Index* (QHEI) developed in the United States, and the *Stream Ecological Valuation* (SEV) from New Zealand. Taking into account the reviewed techniques, local refinements were considered to tailor for the environmental conditions of green channels in Hong Kong, and a preliminary assessment and ranking of ecological conditions and hydraulic resistance for the rivers in the inventory was conducted. Taking into account the data gaps identified in the preliminary assessment, a total of 12 engineered / green channels were selected for further investigation including water quality monitoring, flow measurement and ecological surveys.

Working Paper No. 3 – Classification and Prioritization of Ecological Value for 12 Selected Green Channels

For the 12 engineered / green channels selected from the inventory, further investigation and subsequent classification and prioritization of ecological value was conducted. The assessment criteria include are summarised in **Table 1-1**.

In addition, two channels (Ngau Tam Mei Channel and Yuen Long Bypass Floodway) were also selected for further investigation to review the effect on habitat enhancement as a result of the collapse of an inflatable dam at the Northern New Territories (listed below).

With the results of the further investigation, the rapid stream evaluation (RSE) technique (including the criteria and ranking system) was fine-tuned and applied to the selected channels to produce a ranking of habitat quality and ecological conditions after the implementation of green design elements. Results of the RSE (see **Table 1-2**) indicated that a mixture of substrate types benefits the re-colonization of aquatic fauna, provided that the water quality is good. Preservation of natural substrates which mimic the natural river conditions provides diverse habitats for fish and aquatic invertebrates. Riparian vegetation provides habitats for dragonflies and act as refuges for other aquatic fauna, in which vegetation trimming within channels may cause disturbance to habitat.

The RSE technique will enable quantitative assessment of the effectiveness of proposed green channel designs in mitigating environmental impact associated with future channelization works. The ranking of the channels may also be adopted as a preliminary indicator to relevant authorities of the need for further ecological enhancement works and help prioritize works according to the overall ranking. For the study of the effect on habitat enhancement as a result of the collapse of an inflatable dam at Ngau Tam Mei Channel, the findings suggested that no substantial difference in water quality compared to Yuen Long Bypass Floodway with its inflatable dam in place (due to presence of both upstream pollution sources as well as polluted tidal water from Deep Bay). However, some changes to river bed habitat was observed and the new habitats include mangroves and mudflats that provide feeding and roosting grounds for avifauna species (including endangered species such as the Black-faced Spoonbill) during low tide. Further long

term monitoring of pre- and post-collapse of inflatable dam conditions is recommended to enable more conclusive evaluation to be drawn.

Table 1-1 Summary of RSE assessment criteria

Assessment criteria	
(1) Physical and chemical factors of importance to the biota	
(a) Water quality	(i) pH
	(ii) DO (% saturation)
	(iii) NH ₃ -N
(b) Instream habitat	(i) Substrate
	(ii) Embankment Profile
Categories for physical and chemical factors	
(2) Biological factors	
(a) Species richness	
(b) Species of conservation concern	
(c) Freshwater/estuarine fish species	
(d) Freshwater invertebrates	
(e) Riparian habitat conditions	
(f) Riparian vegetation at water margin & channel embankment	

Table 1-2 Summary of scores for the selected green channels

Criteria / score	Physical and chemical factors		Biological factors		Overall score	
Ping Yuen River	13	Good	11	Average	24	Average
Ng Tung River abandoned meanders	15	Good	9	Fair	24	Average
Ho Chung River	16	Good	14	Average	30	Good
Ngong Ping Stream	16	Good	8	Fair	24	Average
Pak Ngan Heung River	17	Excellent	14	Average	31	Good
Ma Tso Lung Stream	13	Good	8	Fair	21	Average
Ma Wat River	15	Good	11	Average	26	Average
Tong Fuk River	18	Excellent	14	Average	32	Good
Lower Lam Tsuen River	13	Good	4	Poor	17	Fair
Deep Water Bay Stream	17	Excellent	11	Average	28	Good
Ngau Tam Mei	11	Average	11	Average	22	Average
Yuen Long Bypass Floodway	11	Average	11	Average	22	Average

Note: results are based on the rapid stream evaluation technique described in Working Paper No.3.

Working Paper No. 4 – Guidelines for Enhancing Ecological Value for Green Channels

The concept of blue-green infrastructure was introduced to meet the contemporary public aspirations in respect of the natural environment and protection of the local culture and rural lifestyle. Taking into account the information collected as part of the Stage 1 Study, a general review was conducted on the ecological considerations that should be taken into account where practicable, in the design of existing river channels or future river channelization works. The importance of enhancing ecological connectivity has been emphasized. The review includes an overview, experience and evaluation of existing channel designs, opportunities for channels

enhancement, method of riparian vegetation improvement, information on the development of effective revitalization / ecological enhancement plans for channelized rivers / streams, and information on ecological enhancement measures taking into consideration hydraulic resistance inherent in new channel designs. The findings of the review were used to update DSD's *Practice Note No.1/2005 Guidelines on Environmental Considerations for River Channel Design*.

Working Paper No. 5 – Implementation Proposals for Stage 2 Study

Based on the findings of the working papers, detailed proposals for site trials and field assessments for the Stage 2 Study were developed. In the Stage 2 Study, site trials and field assessments are proposed to be designed to enhance ecological value of selected green channels with due consideration of hydraulic resistance. The identified channels may be drainage projects under design or construction, or existing drainage channels under maintenance by DSD.

Working Paper No. 6 – Biodiversity Review for Existing Green Channels

A review was conducted of the ecological conditions of four post-construction green channels (Ho Chung River, Ma Wat River, Pak Ngan Heung River and Ngong Ping Stream), comparing them to pre-construction ecological baseline information.

Generally, it is observed that the number of species of conservation concern decreased after channelization works for Ho Chung River and Ngong Ping Stream, while there were slight improvement for Pak Ngan Heung River and Ma Wat River. The habitats which had been altered by channelization might not have been stable yet for the re-colonization of freshwater fauna. Despite this fact, the following ecological enhancement or channel maintenance measures have contributed to the retention or even increase in the biodiversity of streams during post-construction phases:

- Installation of fish ladders
- Provision of in-stream refugia
- Provision of shallow ponds
- Reuse of topsoil and vegetation
- Provision of riffles and pools
- Retaining and use of natural bed substrates
- Appropriate vegetation maintenance regime

Several limitations were identified which impeded accurate and reliable comparison of species compositions and abundances before and after construction works. Comparable survey methods and survey efforts need to be conducted at times which are closer to the project period, both during pre-construction and post-construction, to be able to directly relate construction works with adverse effects to ecology. Long-term post-construction monitoring covering both wet and dry season are recommended to capture the more ecologically stable conditions after the habitats have been fully established.

1.3 Recommendations for Stage 2 Study

Recommendations for the Stage 2 Study include ecological enhancement works at Ma Wat River and Lower Lam Tsuen River together with further ecological surveys and water quality monitoring at Ping Yuen River, Ng Tung River Abandoned Meanders, Ngong Ping Stream or other suitable streams. Field trials on hydraulic resistance of different vegetation species as well as maintenance and further development of the Eco-channels Database Management System will be carried out in later phases. Depending on the success of the ecological enhancement measures for Ma Wat River and Lower Lam Tsuen River, similar ecological enhancement measures may be utilized for Ping Yuen River, Ng Tung River Abandoned Meanders, Ngong Ping Stream or other suitable streams where appropriate. The results of the Stage 2 Study will also be used to determine long-term management measures to ensure the sustainability of the rivers or streams as ecologically functioning environments.