HONG KONG DRAINAGE SERVICES DEPARTMENT
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洪水橋渠道水文/水力研究報告
研究總結

The Hydrological/hydraulic Investigation of the Hung Shui Kiu Drainage Channel

Executive Summary

HWR Report 145 (Vol. 3)

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Hydraulics and Water Research (Asia) Ltd

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EXECUTIVE SUMMARY

1. General

On 5 November, 1993 and 22 July, 1994 severe flooding occurred from the upper reach of the Hung Shui Kiu Channel causing considerable damage to the surrounding properties. The Drainage Services Department commissioned Hydraulics and Water Research (Asia) Ltd and their associates Wallingford Water, the joint venture between the Institute of Hydrology and H R Wallingford Ltd, to undertake a hydrological and hydraulic modelling study to investigate the causes of the two flood events and recommend short term and long term remedial measures.

Detailed hydrological models, based on the unit hydrograph approach, were constructed of the Hung Shui Kiu Catchment upstream of the Shek Po Tsuen gauging station (see figure A). These models were calibrated against observations taken during and after the two flood events and used to determine the runoff hydrographs expected from the 1 in 2, 10, 50 and 200 year return period design rainstorms.

A one dimensional hydrodynamic model (see figure B) was constructed of the Hung Shui Kiu Channel from the irrigation weir upstream of the Tuen Mun-Yuen Long Highway to the Shek Po Tsuen gauging station. The model was calibrated against the two recent flood events, using the inflow discharges determined from the hydrological models and water level observations taken during and after the events. The model was used to assess the improvement offered by the existing remedial measures implemented by the Hong Kong Drainage Services Department since the flooding occurred and to evaluate potential improvement offered by various options for short term and long term remedial works.

2. Causes of flooding

Three causes of the past flooding incidents were found to be:

(i) higher rainfall than the original channel design capacity;
(ii) greater runoff flows from a given rainfall due to a higher than expected percentage runoff for small steep rural catchments; and
(iii) a lower than expected channel capacity due to unforseen energy losses at the channel bends and access ramps.

The original channel design was reviewed and found to be extremely thorough and consistent with the design guideline prevailing at the time of the design.

研究總結

1. 概述

在1993年11月5日及1994年7月22日於洪水橋上游發生了兩次嚴重的洪水泛濫，對附近資產造成了重大的損壞。為此，渠務署委托水力水研(亞洲)有限公司 (Hydraulics and Water Research (Asia) Ltd) 及由英國 Institute of Hydrology and HR Wallingford Ltd 合營的 Wallingford Water 公司聯合進行一水文與水力研究以探討引起上述兩次泛濫的原因及對短期、長期改善措施作出建議。

石坳村測量站上游之洪水橋集水區(附圖A)的詳細水文數學模型已被建立，此等模型已經根據在93及94年兩次洪水中及其後所測得之數據作校準，並被用於估計由1、2、10、50及200年一遇的暴雨情況下將帶來的流水水道圖。

由屯門--元朗幹線上游的灌溉水壩至石坳村測量站一段的洪水橋渠道之一維水力數學模型已經建立(附圖B)。此模型是經最近兩次洪水中，由上述水文模型所估計之水流量資料及觀測所得之水位數據所校準，並被用於評估自泛濫後由渠務署完成的改善措施的效用，以及不同短、長期改善措施可能帶來的改善。

2. 泛濫成因

研究所得引起以往泛濫的原因有三 :-

(1) 降雨量比原渠道設計所能承受為大；
(2) 鄉村的集水區細小而陡峭引至流水量比預期為高；
(3) 渠道彎曲處及維修入口坡道引至有未能預知之流水能量損耗，因此渠道的容量比原設計為小。

原渠道設計已被重新檢討，而該設計完全附合當時的設計方針。

The table below summarizes the key parameters of the original design as compared to the study results:

Summary of Key Parameters

Parameter	Original design	Study results	
Rainfall return period	1 in 10 yr	Nov 93 event	July 94 event
		max 1 hr avg: 1 in 136 yr	max 1 hr avg: 1 in 14 yr
		max 4 hr avg: 1 in 13 yr	max 4 hr avg: 1 in 13 yr
		total rainfall: 1 in 13 yr	total rainfall: 1 in 40 yr
Runoff coefficient	0.6	0.8 - 0.95	
Design flow rate for 1 in 10 year storm	70 - 76 m^3/s	95 - 104 m^3/s	
Observed maximum flow rate	N/A	Nov 93 event	July 94 event
		120 m^3/s	86 m^3/s
Channel capacity	76 m^3/s	41m^3/s	

3. Short term remedial measures

The existing remedial measures were reviewed and whilst these offer some improvement, additional works are required to obtain an acceptable standard of flood protection.

Short term remedial works included:

(i) removing the access ramp;
(ii) smoothing the channel transitions;
(iii) raising the parapet wall by 1 m to increase channel capacity;
(iv) providing flood storage using siphon pipes at the abandoned upstream irrigation reservoir and irrigation crest, together with stepped up desilting work; and
(v) installing flood warning sirens.

Whilst these measures will not improve the channel performance to the desired standard, they are still recommended as they will provide some improvement and the investment in these options may be preserved when the long term measures are implemented.

以下總結了原設計的主要參數及將此與研究結果作出比較 ：

主要參數的總結

參數	原設計	研究結果	
暴雨回歸期	10年1遇	93年11月泛濫	94年7月泛濫
		最高1小時之平均:136年1遇	最高1小時之平均:14年1遇
		最高4小時之平均: 13年1遇	最高4小時之平均:13年1遇
		總雨量 : 13年1遇	總雨量 :40年1遇
流水量和降雨量比率	0.6	0.8 - 0.95	
設計流水量(10年1遇暴雨)	每秒70-76立方米	每秒95-104立方米	
觀測最高流量	--	93年11月泛濫	94年7月泛濫
		每秒120立方米	每秒86立方米
渠道容量	每秒76立方米	每秒41立方米	

3. 短期改善措施

現有的改善工作已被重新檢討。雖然此等措施可提供一定程度上的改善但仍需要進一步的工作以達至可接受的泛濫安全標準。

短期改善措施包括 ：

(1) 拆除維修入口坡道 ；
(2) 將渠道長方形段及矩形段之接合處修整平滑 ；
(3) 將保護墻加高1米以增加渠道容量 ；
(4) 在渠道上游已棄置之灌溉水塘建設吸虹管及清除淤泥以增加洪水儲存量 ；
(5) 安裝泛濫警報。

雖然此等措施未能將渠道情況改善至理想的標準，但仍可提供一定程度上的改善，故此值得推行。同時，它們亦可納入長期改善工程中，其投資價值將可保存。

4. Long term improvement works

Five options for long term improvement works were investigated:

(i) widening the existing channel along its original alignment to 11.5 m (wide) and completing the replacement of the metal rails with concrete parapet (see figure C) ;
(ii) deepening the channel;
(iii) use of a two stage channel;
(iv) building a new 6.5 m (wide) by 4.6 m (deep) channel (see figure C) to straighten the bends; and
(v) use of the Hung Shui Hang Reservoir for flood storage.

Options (ii), (iii) and (v) were found to be impractical, but options (i) and (iv) provided the required standard of flood protection.

Option (iv) proposes a straightened and considerably shorter new channel and therefore provides better hydraulic performance than the widened channel proposed by option (i). However, the new straightened channel route passes through private lands at higher elevations with existing buildings. Deeper excavation and land resumption will result in higher construction cost and longer implementation time respectively.

Option (i) involves the widening of the existing channel, with parapet wall construction, along its original alignment, and is able to provide a 1 in 50 year flood protection. Government land is available for this option. However, several buildings adjacent to the existing channel have to be cleared in advance. It is anticipated that this required land clearance will take less time than the necessary land resumption under option (iv).

4. 長期改善措施

五項經研究的長期改善方案如下 ：

(1) 加闊渠道至11.5米及利用混凝土保護墻代替原用的鐵欄(附圖C) ；
(2) 加深渠道 ；
(3) 使用兩級渠道 ；
(4) 建造6.5米闊 x 4.6米深的新渠道以拉直現有渠道的彎曲處(附圖C) ；
(5) 利用洪水坑水塘儲洪。

方案(2)、(3)及(5)已被確定為不可行而方案(1)及(4)則可達到所要求的泛濫安全標準。

方案(4) 提議之新渠道比方案(1) 提議之擴闊渠道較直及較短。所以在水力觀點上說，方案(4) 之新渠道是較為有效。然而，該新渠路線會道經地勢較高及盡有建築物之私人土地上。興建該新渠將需要較龐大的挖泥工程，興建成本將會較高，而收購私人土地則會導至興建時間較長。

方案(1) 提議把現有渠面擴闊並在渠道兩旁加建保護墻。此方案將足夠提供50年一遇之洪水保護，政府可在現有渠道兩旁提供官地以實施此方案，然而渠道鄰近的少量建築物將需要被拆卸。但預計拆卸該等建築物將比方案(4) 所要求收回土地所需時間為短。

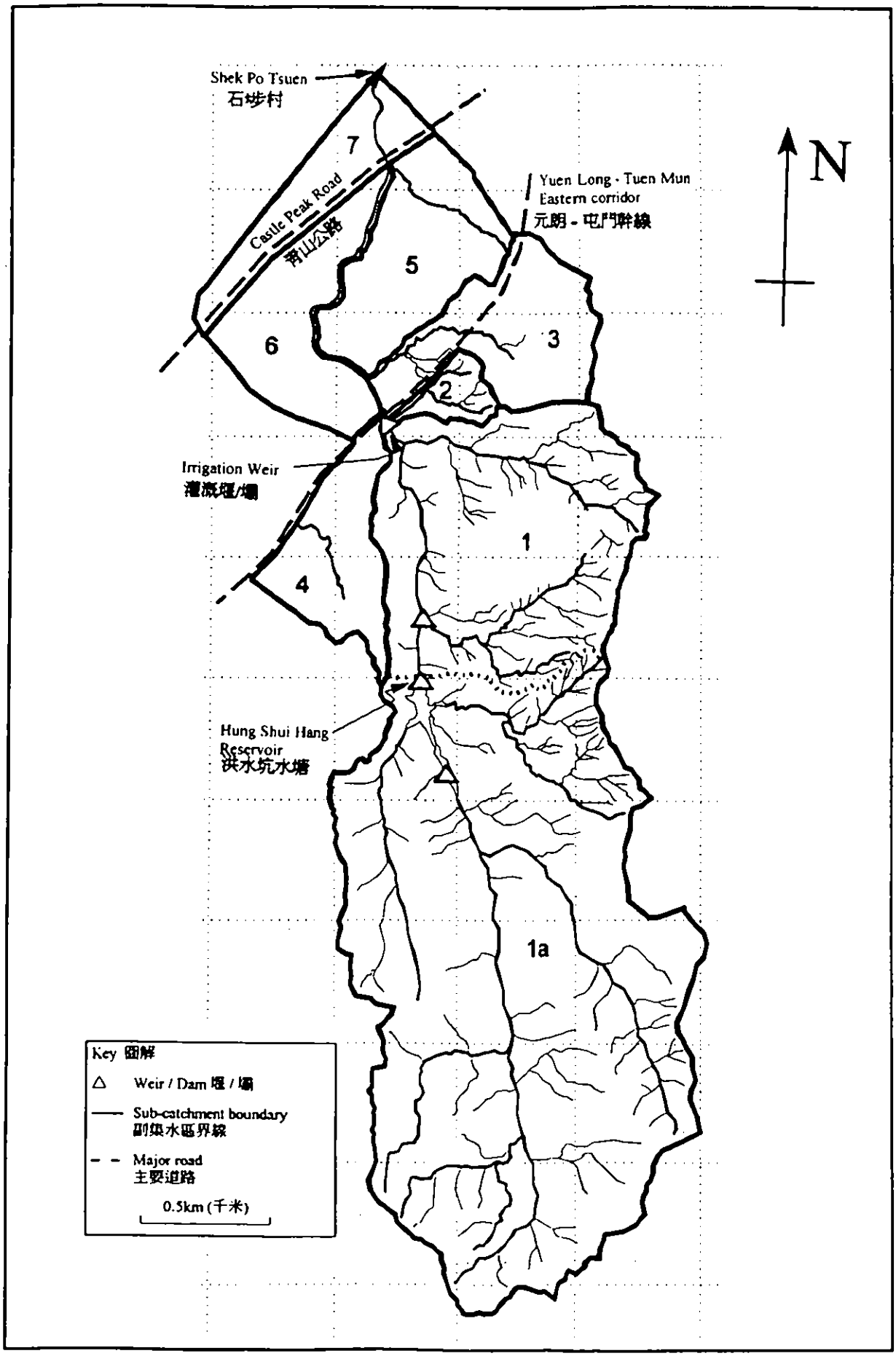

Figure A - The Hung Shui Kiu catchment.
圖 A - 洪水橋集水區

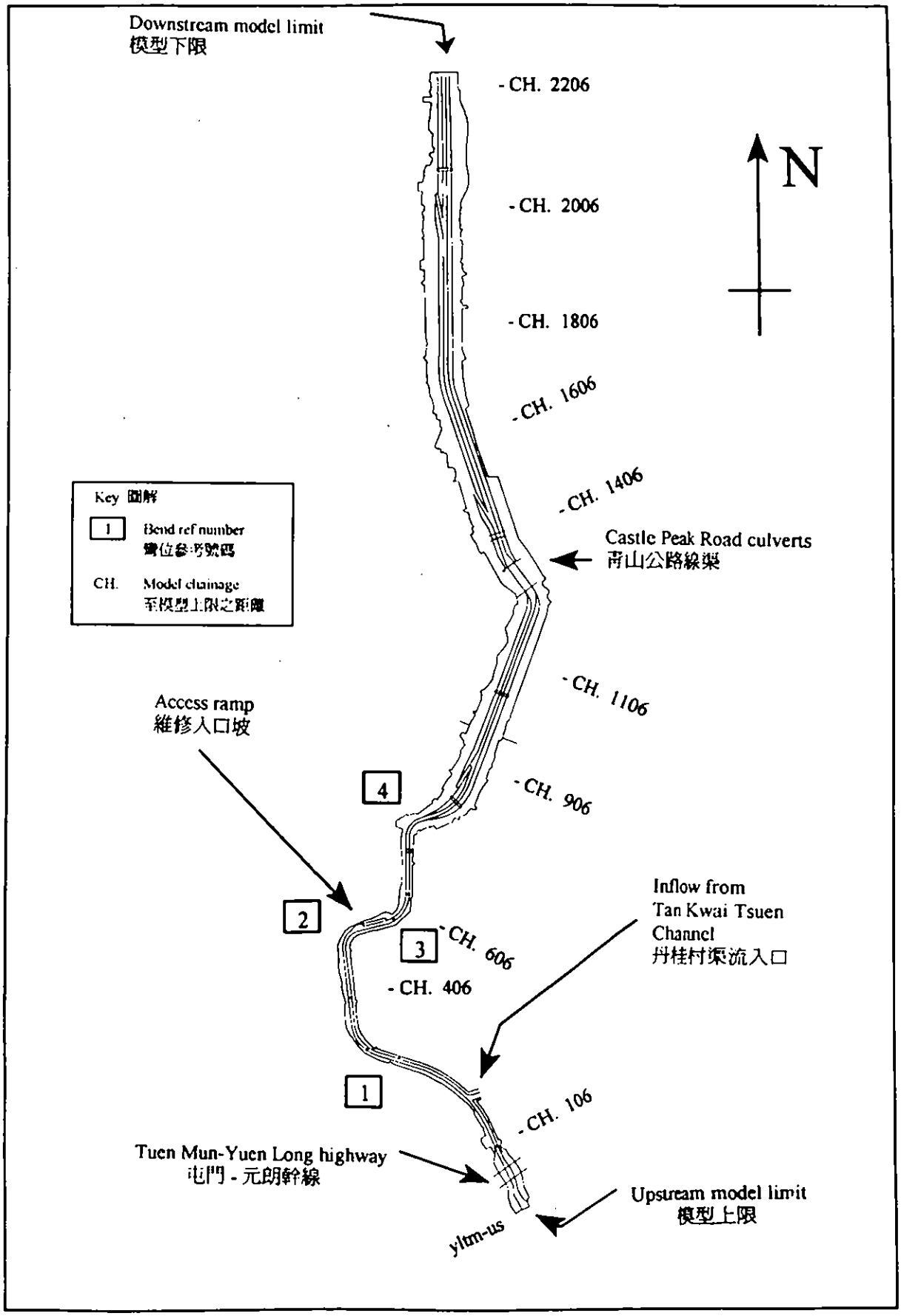

Figure B-Layout of the hydraulic model
圖 B-水力模型平面展示圖

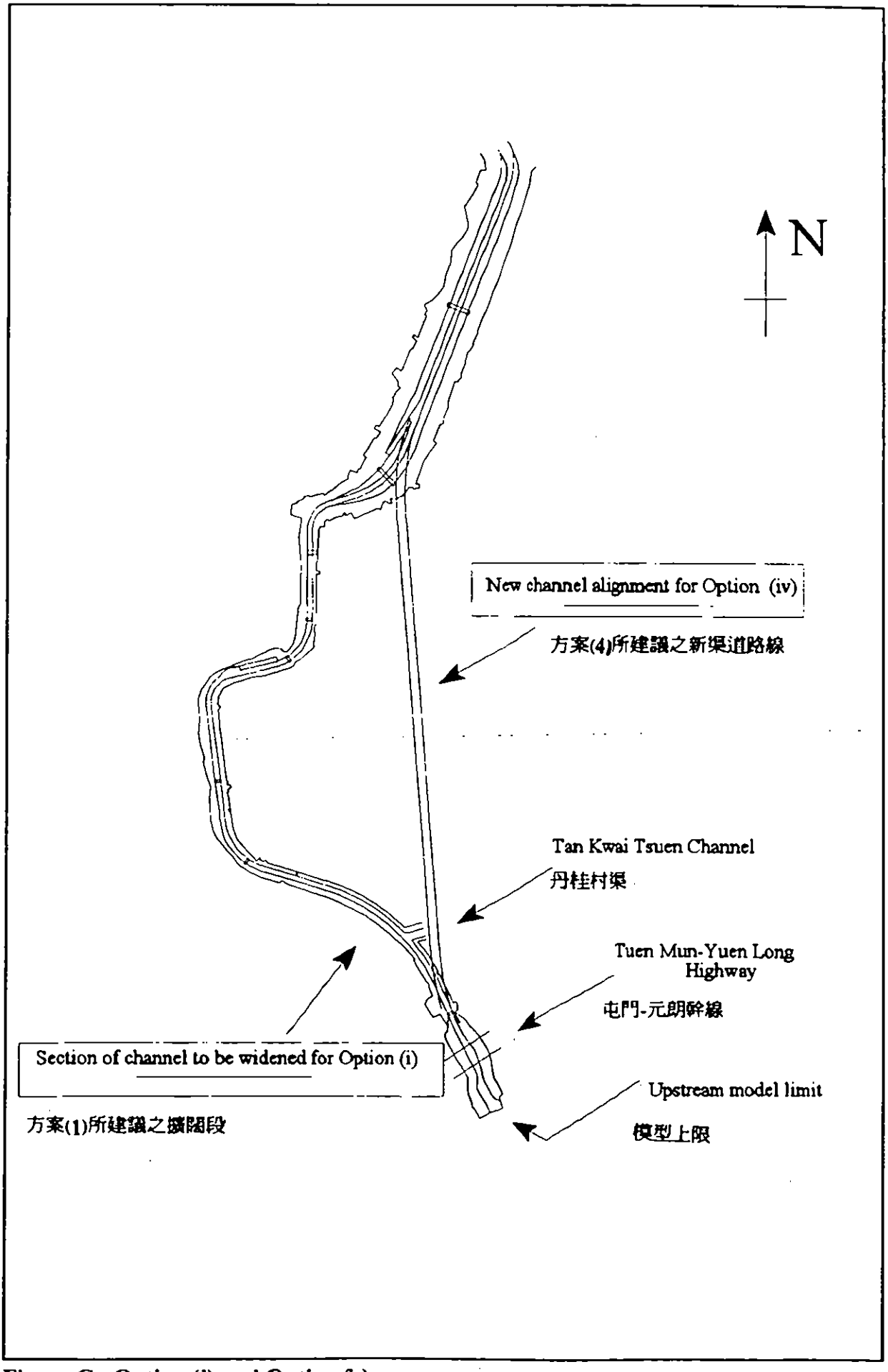

Figure C - Option (i) and Option (iv).

圖 C - 方案(1)及方案(4)

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