



# UCL

## PROJECT PROFILE

### Hong Kong

### West Harbour Crossing

omega centre

**Centre for Mega Projects in Transport and Development**

A global Centre of Excellence in Future Urban Transport  
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This project profile has been compiled by the Hong Kong OMEGA Team, University of Hong Kong, Hong Kong.

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## Abbreviations

ACABAS	Advisory Committee on the Appearance of Bridges and Associated Structures
ACP	Airport Core Program
BOT	Built-Operate-Transfer
CHT	Cross Harbour Tunnel
CTS-2	Second Comprehensive Transport Study
EPCOM	Environmental Pollution Advisory Committee
FINSCOM	Financial and Institutional Coordinating Committee
HK	Hong Kong
HKLII	Hong Kong Legal Information Institute
IRR	Internal Rate of Return
KMB	Kowloon Motor Bus Company Limited
LegCo	Legislative Council
MAPB	Maunsell-Acer-Parsons Brinckerhoff Joint Venture
MTRC	Mass Transit Railway Corporation
MOU	Memorandum of Understanding
NAPCO	New Airport Projects Co-ordination Office
NKJV	Nishimatsu Kumagai Joint Venture
SHRUG	Study on Harbour Reclamations and Urban Growth
SWK	Scott Wilson Kirkpatrick
TAM	Toll Adjustment Mechanism
WHC	Western Harbour Crossing
WHCC	Western Harbour Crossing Consultants
WHTCL	Western Harbour Tunnel Company Limited

## A INTRODUCTION

Hong Kong, with some seven million inhabitants, is one of the most densely developed and prosperous territories in Asia (for the general geographical context of Hong Kong, see Figure 1). It has one of the best natural deep sea harbours in the world, and for some thirty years it has been one of the three busiest ports in the world. Victoria Harbour, as it is known, practically separates the urban geography of Hong Kong into two functional areas, the Kowloon Peninsula and the New Territories, and Hong Kong Island (see Figure 1). The Kowloon Peninsula itself and the northern part of Hong Kong Island collectively represent the centre of gravity of the Hong Kong urban economy, and collectively is widely accepted to be the most densely developed urban area in the world. Integrating these two districts, separated by some 500+metres of Victoria Harbour, as well as numerous secondary islands and bays, has been and continues to be a transportation challenge. Over the years this challenge has been met with passenger ferries, vehicle ferries, and over the last forty years with three road tunnels.

Figure 1: Map of the Hong Kong Special Administrative Region of China (HKSAR)



Source: Google Map Hong Kong, 2008; Centamap, 2008

### Type of project

Western Harbour Crossing (WHC) is the third cross-harbour road tunnel in Hong Kong. It was also Southeast Asia's first dual three-lane immersed tunnel. The HKD 7.5bn project incorporates a 2km long immersed tube tunnel and tunnel structures, and as a principal arterial it includes 10km of associated roads (40km of lanes) and 17 bridges (SCMP, 30 April 1997a; Davis, 30 April 1997e).

WHC was part of the Airport Core Program (ACP) which formed the framework for the development of the new Hong Kong International Airport, but it was also considered as a self-sustaining mega transport infrastructure even without the new airport (Wong, 5 October 1992). ACP was set up by the Hong Kong Government, and was designed to construct ten supporting infrastructure projects that would serve the new Hong Kong International Airport at Chek Lap Kok. This included road works, bridges, and tunnel links (WHTCL, 2007b).

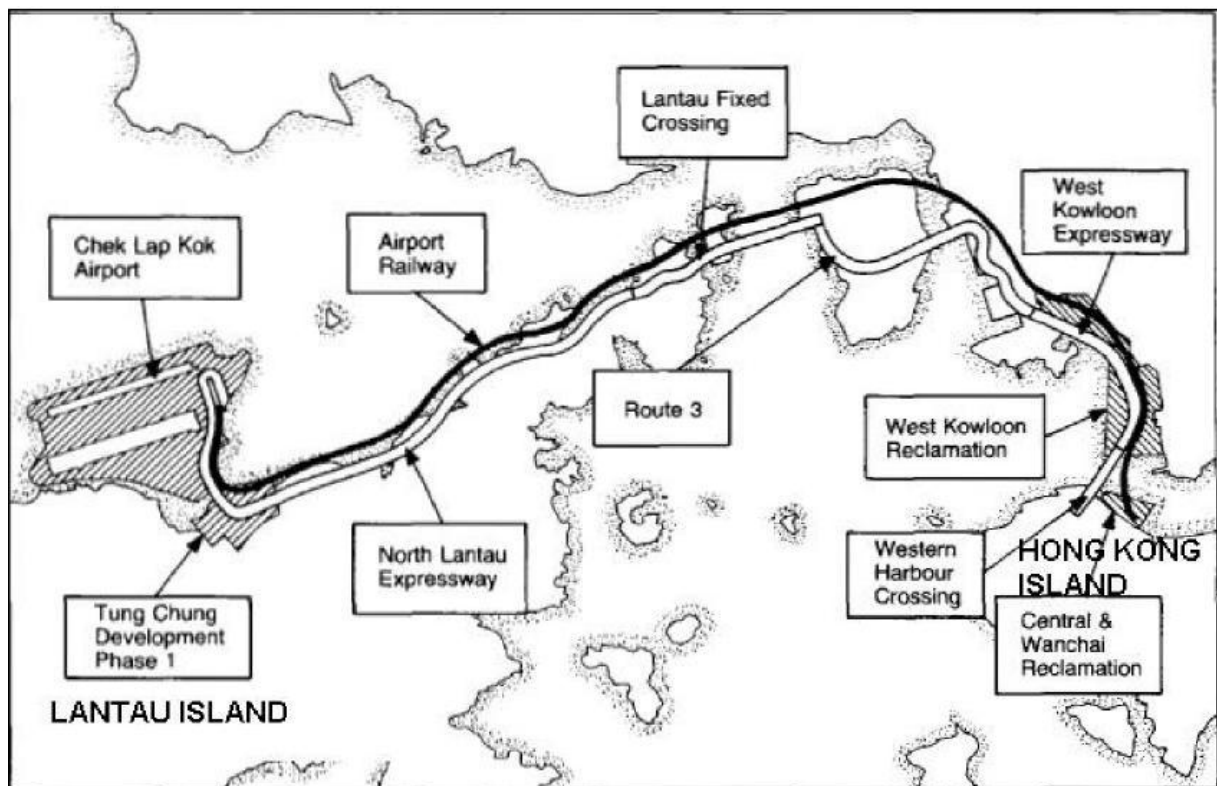
Distinct from the other nine ACP infrastructure projects, WHC is a franchised build-operate-transfer (BOT) project. The project was completed in 1997 (WHTCL, 2007b).

### Location of WHC

WHC is built on the western side of Victoria Harbour, connecting Sai Ying Pun on Hong Kong Island with the West Kowloon Reclamation. It connects directly with Route 3 which runs all the way to the Chinese border at Lok Ma Chau. The tunnel's adjoining roads offer easy access to Kwai Chung container port and to Chek Lap Kok airport.

Figures 2-6 show the location of WHC and the other ACP projects.

**Figure 2: Projects of ACP**



Source: Blake, 1994



**Figure 3: Map of WHC**



Source: Google Map Hong Kong, 2008

**Figure 4: Aerial photo of the southern entrance at Sai Ying Pun**

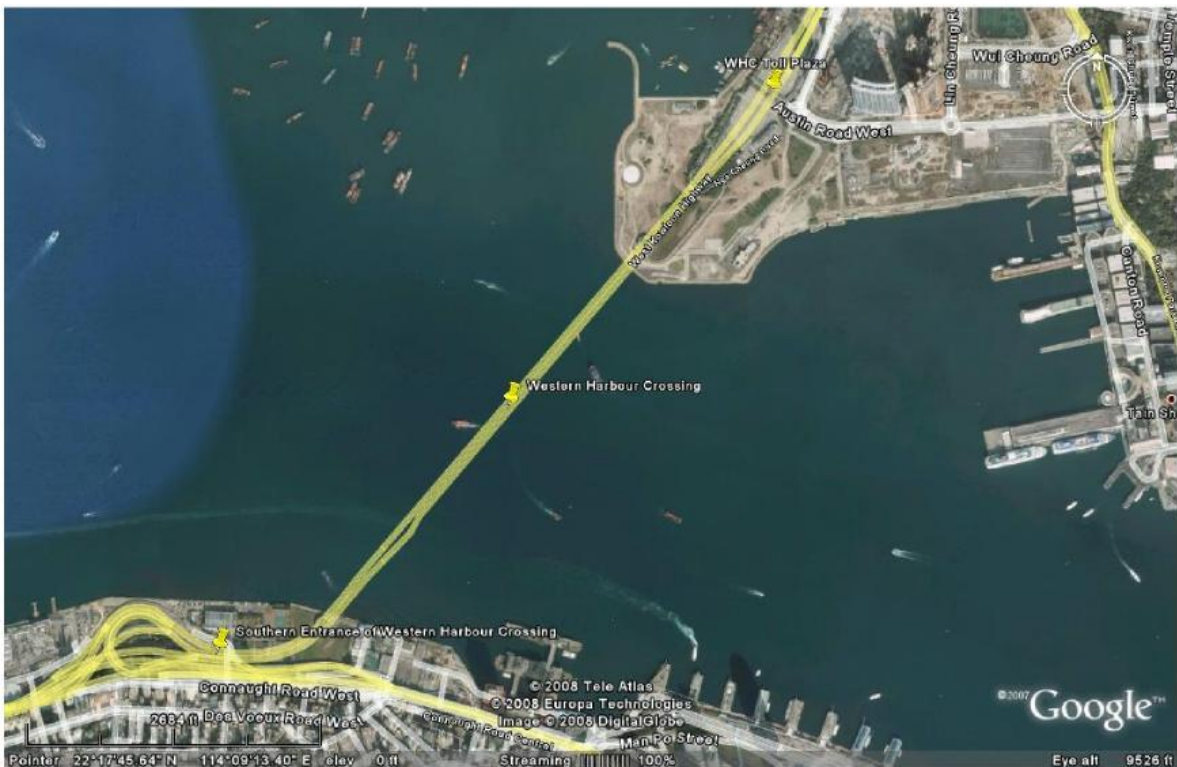




Figure 5: Aerial photo of the northern entrance at West Kowloon



Figure 6: Aerial photo of the WHC





## **B BACKGROUND TO PROJECT**

### **The need for a third harbour crossing**

In the late 1980s, the Second Comprehensive Transport Study (CTS-2) forecast population growth and growing numbers of vehicles in Hong Kong. The population was expected to increase from 5.125m in 1981 to 6.34m in 2001, whilst the total number of vehicles would increase from 261,000 in 1986 to 610,000 in 2001 (Transport Department, 1989).

The growth in the number of cross-harbour trips was one of the reasons contributing to the initiation of WHC. CTS-2 also forecast that the number of daily cross-harbour person trips would increase by 86% from 1.4m to 2.6m, and goods vehicle trips by 129% from 34,000 to 78,000 over the same period. For instance, by the early 1980s, the Cross Harbour Tunnel (CHT) was carrying over 120,000 vehicles per day, exceeding its design capacity of 80,000. Therefore, CTS-2 recommended that building of the Western Harbour Crossing was vital. WHC was expected to provide sufficient additional capacity to meet the cross-harbour road traffic demand until the 21<sup>st</sup> century (Transport Department, 1989).

### **Principal project objectives**

Government objectives:

- To provide much needed relief for the two existing cross-harbour tunnels;
- To meet the cross-harbour traffic demand for the 21<sup>st</sup> century;
- To form part of the key strategic networks to the Chek Lap Kok Airport (Transport Department, 1989).

Western Harbour Tunnel Company objectives:

- To link HK Island with the Hong Kong International Airport (HKIA) and the container port in Kwai Chung;
- To alleviate cross-harbour traffic congestion;
- To open up the western side of HK to development (WHTCL, 2007b).

### **Key enabling mechanisms and decision to proceed**

The construction of WHC resulted from the decision by Hong Kong Government to meet the future cross-harbour traffic demand. The Western Harbour Crossing Ordinance (Cap. 436) was enacted in 1993 to govern the construction and operation of WHC. The subsequent Western Harbour Crossing Bill was introduced to the Legislative Council in 1993 to provide for the award of a franchise to the Western Harbour Tunnel Company to build and operate WHC (Transport Department, 1989; LegCo, 2008; HKLII, 1993).

From an early stage, the Government took the view that the Tunnel should be funded by the private sector. In 1991, the Western Harbour Crossing Study, undertaken by the Western Harbour Crossing Consultants, determined WHC as a feasible build-operate-transfer (BOT) project. Following the invitation of tenders, the Western Harbour Tunnel Company (WHTCL) was appointed to finance, design, build, maintain and operate WHC for a period of 30 years, until August 2023.

(SCMP, 4 March 1989; Robertson, 1998).

An overview of the timeline associated with the key enabling mechanisms is presented as follows:

1981	<i>'Additional Cross Harbour Facilities – Study of Long Term Options 1981'</i> short-listed three options for the alignment of the western harbour tunnel. It runs between Central and Kwai Chung via Stonecutters Island (Wilbur Smith and Associates, 1981; Parnell, 13 Jan 1982).
1984	<i>'Study on Harbour Reclamations and Urban Growth'</i> (SHRUG) recommended a western harbour tunnel from Kennedy Town via West Kowloon to Kwai Chung should be built (Highways Department & WHCC, 1991; Lands Department, 1983; HK Standard, 7 Mar 1984)
May 1989	<i>'Second Comprehensive Transport Study'</i> (CTS-2) confirmed the need to construct WHC and it had the highest priority for investment. It was proposed as one section of Route 3. This recognised the need for the third crossing to meet the increased cross harbour traffic demand (Transport Department, 1989)
April 1991	WHC Final Report was released. This Report included a detailed feasibility study of the project, and indicated that the project was feasible and capable of attracting private sector investment (Morris, 1999; Highways Department & WHCC, 1991; Morris and Hill, 1996).
Sept 1991	The British and Chinese Governments signed the Memorandum of Understanding. Both sides agreed to give their firm support to the construction of a new airport at Chek Lap Kok and its connecting road and rail systems (HK Government, 1991)
Feb 1992	Invitation of tenders to bid for WHC (Robertson, 1997)
June 1993	The WHTCL was awarded the franchisee to build and operate WHC for 30 years (Robertson, 1998)
July 1993	The WHC Ordinance (Cap 436) was enacted (HKLII, 1993)

Prior to the construction of WHC, a series of feasibility studies was undertaken:

- The first site investigation was undertaken between 1989 and 1990. The Western Harbour Crossing Final Report was issued in 1991. Funds were allocated by the Finance Committee for a HKD 25m feasibility study on the third harbour crossing in Western Harbour. Western Harbour Crossing Consultants (WHCC), a joint venture led by Hyder Consulting, was appointed by the Government to study the feasibility of constructing WHC.
- This series of feasibility studies comprised five main reports. The Engineering Feasibility report selected and examined various proposed alignment options. It also assessed traffic requirements and interchange networks at each landfall;
- The Drawings Report contained engineering drawings which defined the proposed alignment and form of the crossing;
- The Site Investigations Report described the background to, and the planning and results of, the land and marine based site investigations;
- The Financial Analysis Report reviewed the financial aspects of the project with particular reference to its viability as a public or private sector project;
- The Environmental Impact Assessment described the probable effects on the environment and the monitoring and mitigation measures which would be implemented to minimise these effects (SCMP, 05 Oct 1988; SCMP, 09 March 1989; Lloyd, 1996).

- The second site investigation was carried out in 1992. This was to provide adequate information for the tenderers (De Silva et.al, 1997);
- The third site investigations, which included the detailed design, were carried out by Maunsell-Acer-Parsons Brinkerhoff (De Silva et.al, 1997).

## **Main organisations involved**

This section shows the major players involved in the preparation, implementation and operation of the WHC project.

### Government bodies and departments

The following describes the main public sector organisations and departments involved in WHC project planning, delivery and operation.

#### *Joint Liaison Group's Airport Committee*

The Committee included representatives of the British Government and the Chinese Government. The Committee discussed any issues related to Chek Kap Kok Airport and its associated infrastructure, particularly on financial matters. These projects had to be approved by both Governments before any construction works started.

#### *Hong Kong Legislative Council (LegCo)*

Legislators, including Legco's Panel on Transport, were responsible for passing the WHC Ordinance and the WHC Bill. They were also responsible for deciding the toll adjustment mechanism.

#### *Highways Department*

The Highways Department is the ultimate owner of the project and was responsible for the day-to-day administration of the project agreement placed by the Hong Kong Government. It received reports from the contractor for approval, relating to design criteria and principles. These were circulated to all Government departments, utility companies and other parties involved or with an interest in the project. It was responsible for the work on adjoining highway contracts which were under construction. (Robertson, 1998).

#### *Transport Department*

The Transport Department prepared long-term transport strategies, and identified the need for a third harbour crossing tunnel. It forecasted the traffic volume of WHC and placed more than 300 road signs on the approach roads (SCMP, 30 April 1997a).

#### *Consultative Committee*

The Committee was set up by the Hong Kong Government, and was responsible for discussing any matters relevant to the new airport and related projects, but has no decision-making power. It should not delay the progress of the projects. (HK Government, 1991).

#### *New Airport Projects Co-ordination Office (NAPCO)*

The Office was responsible for the day-to-day coordination of the implementation of the ten Airport Core Program (ACP) projects. However, it did not exercise control over WHC's

project cost management (Yates & McKinnell, 1995).

#### *Financial and Institutional Coordinating Committee (FINSCOM)*

This was a Government group overseeing the financial aspects of ACP. It was chaired by Financial Secretary Hamish Macleod, and also included Secretary for Treasury K. Y. Yeung, Secretary for Monetary Affairs David Nendick, Secretary for Transport Michael Leung, Secretary for Economic Services Anson Chan and Secretary for Works James Blake (SCMP, 24 Jan 1992).

#### *Environmental Protection Department*

##### *Environmental Pollution Advisory Committee (EPCOM)*

Currently known as the Advisory Council on the Environment (ACE), the committee is the Government's principal advisory body on issues related to pollution control and environmental sustainability. (IAQ). The WHC EIA Report in 1991 was consulted by EPCOM. The environmental measures had to be approved by EPCOM before any construction works began.

##### *Transport Advisory Committee*

The Committee advises the Administration on issues of transport policy and major transport-related proposals. It has neither statutory authority nor executive functions (LegCo, 2005b).

#### *Planning Department*

##### *Local Government (District Councils, with limited local government functions)*

The two local government bodies involved were Central and Western District Council's Traffic and Transport Committee and Yau Tsim Mong District Council's Traffic and Transport Committee.

##### *Mass Transit Railway Corporation (MTRC)*

MTRC was involved in relation to the construction of the railway tunnel. During the tunnel construction, contractors needed to coordinate works with those of the Airport Railway tunnel, which runs close to the road tunnel. (Poon, 1995).

#### *Marine Department*

In order to gain access to the full length of the tunnel trench, it was necessary to coordinate dredging activities, the unit placing operations and subsequent backfilling works with the Central Shipping Fairway. Extensive discussions took place with Marine Department (Ogura et.al., 1997). Several diversions of the shipping fairway through the harbour were necessary, to allow dredging and sinking of the units. (Poon, 1995).

#### *Agricultural and Fisheries Department*

The Department was involved in relation to the relocation of the temporary poultry market.

#### *Architectural Services Department*

The Department was involved in relation to the relocation of the temporary poultry market and the Indoor Games Hall and Park.

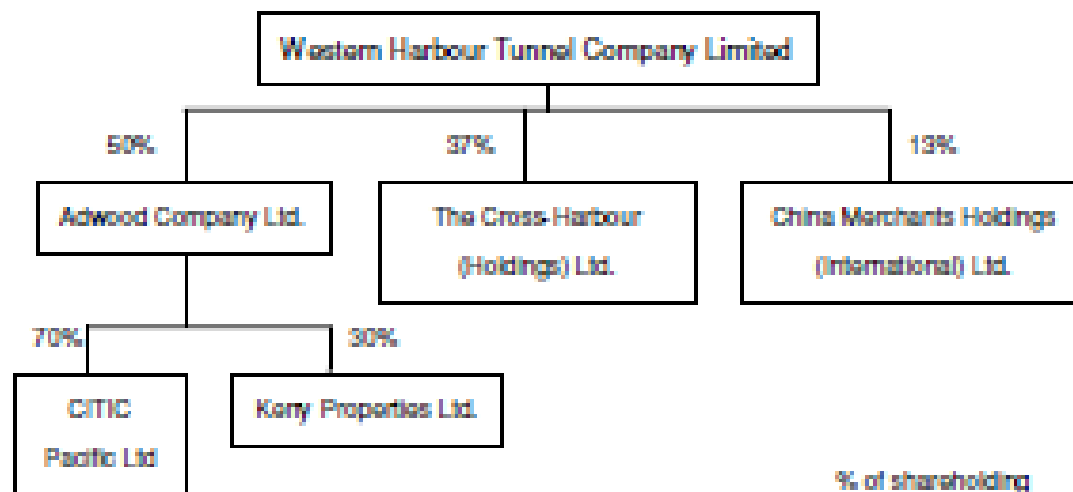


## The consortium: Western Harbour Tunnel Company Limited

### *Company Structure*

Western Harbour Tunnel Company Limited (WHTCL) was established in 1992 as a competitor in the tender process. It was appointed in 1993 to design, build, finance and operate WHC. It is on a 30-year, franchised, build-operate-transfer (BOT) model (WHTCL, 2007b). Figure 7 shows the shareholding structure of WHTCL.

**Figure 7: The shareholding structure of WHC**



Cross Harbour Tunnel holds 37% of the consortium, and China Merchants (Hong Kong) owns 13%. The rest is held by the Adwood Consortium, with CITIC Pacific and CITIC Hong Kong holding 10% and 25% respectively; and the Kerry Group the remaining 15% (SCMP, 22 July 1993b). Under the general management agreement, the Cross Harbour Tunnel Company acted as an equity shareholder as well as the general manager of the WHC project for the duration of the concession (Pretorius, 2007).

### *Responsibilities*

WHTCL is required to arrange the financing of the project within the balance between equity from the franchisee shareholder companies and that borrowed from the financial institutions (Robertson, 1998).

It also participated in the Government's overall reporting system and provided the project information (including programs, program updates and progress reports) required by NAPCO for monitoring purposes (Yates & McKinnell, 1995).

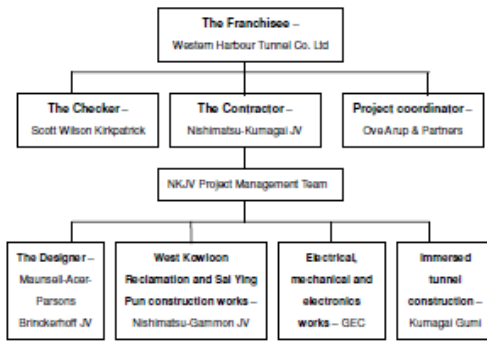
During construction, a framework was set up for the operation and maintenance of the tunnel, involving establishing job descriptions, employment policy, recruitment and training. This ensured the company was prepared to operate the facilities once work was completed (Robertson, 1998).

### The contractors

The organisational arrangements associated with the construction of WHC are set out in Figure 8.



**Figure 8: Main civil engineering contracts**



Source: Robertson, 1998

A more detailed description of the activities of each WHC contractor WHC is given below.

#### *Nishimatsu Kumagai Joint Venture (NKJV)*

The Contractor, a joint venture of Nishimatsu Construction Company Ltd. and Kumagai Gumi Company Ltd.

NKJV awarded a sub-contract to *Gammon Construction Ltd*, to carry out the civil works on the Sai Yin Pun landfall (De Silva, 1997).

Another sub-contract was awarded to *GEC Hong Kong Ltd.*, for design, manufacture, installation and commissioning of the electrical and mechanical works (De Silva, 1997).

NKJV was obliged to put in place a project management team under the leadership of the project manager.

It had responsibilities both in the project agreement and under the construction contract. These were all solely for the design, construction, and normal maintenance of works for the 12 months following completion of construction.

Designers were employed by NKJV and the construction was sub-contracted (Robertson, 1998).

#### *Maunsell-Acer-Parsons Brinckerhoff Joint Venture (MAPB)*

NKJV entered into a design agreement with MAPB Joint Venture, which consisted of Maunsell Consultants Asia Ltd, Acer Consultants (Far East) Ltd, Parsons Brinckerhoff (Asia) Ltd.

The Designers' Agreement was signed in September 1993.

MAPB acted as the designers.

The full design contract covered the immersed tube works, the road works and interchanges at Sai Ying Pun, which included part of the Route 7 highway, the administration and toll plaza sections, associated highway works on the West Kowloon reclamation site and the two ventilation buildings.

Within the MAPB joint venture, the contract was divided into separate areas of responsibility. Acer Consultants designed the immersed tube in close liaison with Kumagai Gumi. Parsons

Brinckerhoff dealt with electrical and mechanical systems design, with input from Acer. Maunsell and Acer separated the task of designing the bridges.

Finally, MAPB prepared a set of drawings which were checked internally before being passed to the independent inspector, Scott Wilson Kirkpatrick. NKJV and the Government would then give their approval before final versions were made and any construction went ahead.

MAPB also took responsibility for the system design of the mechanical and electrical installation.

Nearly 2,500 detailed drawings were produced for the design of WHC, about 1,800 civil and structural drawings, and 700 mechanical and engineering drawings were produced by the MAPB joint venture (Davis, 30 April 1997b).

MAPB employed a number of design sub-contractors to work on specialised areas of the contract. These included:

- RMJM Hong Kong Ltd, as the architects for the design of the two ventilation buildings and the administration building;
- Brian Clouston & Partners, as the landscape architect;
- Taywood Engineering Ltd, as the durability specialist to devise special measures of protecting the facility;
- Consultants in Environmental Services (Asia) Ltd, as the environmental specialist to assess the environmental impact of the tunnel design; and
- MVA Consultancy, responsible for designing the toll collection system for WHC.

(Davis, 30 April 1997b; Ma, 1996; Tam, 1997; Robertson, 1998)

#### *Scott Wilson Kirkpatrick (SWK)*

SWK was employed as an independent design and work checker, and also contracted as the engineer. Its endorsement was required before these were issued as project records.

- Design checker – responsible for checking that submitted designs and operating and maintenance manuals were in compliance with the project requirements within the project agreement.
- Worker checker – responsible for monitoring that the contractor had carried out the works in accordance with the certified drawings and Government's requirements and standards. They were also required to check quality and environmental issues by routine auditing of environmental trigger levels before any construction work began. The environmental aspects included monitoring dust, disturbance in the harbour and water quality at Shek O. These environmental control measures had to meet the contractors' own standards and those of the Environment Protection Department.

SWK sub-contracted the checking of the mechanical and electrical works to Kennedy and Donkin International and the environmental checking to ERM Hong Kong.

The checking process began with submission of an outline design by the constructor to the Government for approval in principle. After the reports were checked and certified by the checker, and acknowledged by the director's representative, construction was undertaken. The checking process continued throughout the construction stage.

More than 1,000 detailed designs were checked during the construction stage.

- Engineer – responsible for the certification and contractual administration between the WHTCL and the NKJV. Also responsible for certifying interim monthly payments to the contractor.

(Robertson, 1998; SCMP, 30 April 1997b)

#### *Ove Arup & Partners*

Ove Arup & Partners acted as the project coordinator, preparing reports for submission to the Government and the board of WHCC. These included aspects of the project covering design and construction issues, quality and environmental aspects, and cost and progress (Robertson, 1998).

They also represented the Company in technical and contractual matters, tending all principal project meetings with Government, the contractor, and the engineer/checker.

They were responsible for liaison with the Company's Business Manager and the General Manager of the Cross Harbour Tunnel Company, to assist in the establishment of commercial, operating, maintenance and public relations policies and procedures.

They ensured the operations and maintenance requirements of the Tunnel Company were adequately covered in the design (Poon, 1995).

#### *Hyder Consulting Ltd*

Western Harbour Crossing Consultants was a joint venture led by Hyder Consulting, to undertake a feasibility study for WHC in 1989. The Study was issued in April 1991.

The main consultants participating in this report were:

- Acer Consultants (Far East) Ltd.;
- Maunsell Consultants Asia Ltd.;
- Parsons Brinckerhoff (Asia) Ltd.;
- Pypun-Howard Humphreys Ltd.

The sub-consultants were:

- CES Consultants in Environmental Sciences (Asia) Ltd.;
- Coopers & Lybrand Associates Ltd.;
- Llewelyn-Davies Weeks HK Ltd.

#### *GEC (HK) Limited*

GEC was awarded the contract for the design, manufacture, installation and commissioning of the electrical and mechanical work to meet the design standards (Mackie, 1996; Davis, 30 April 1997b).

#### *Pioneer Internationals*

This company provided 180,000m<sup>3</sup> of a special concrete mix to Kumagai Gumi for the casting basin at Shek O Quarry (SCMP, 30 April 1997d).

They supplied 200,000m<sup>3</sup> of concrete to Gammon for the construction of the approach roads, the cut and cover tunnels and ventilation building at Sai Ying Pun.

They also provided Nishimatsu Construction with 70,000m<sup>3</sup> for the construction of the northern entrance to WHC.

They were awarded the sub-contract to surface the roads within WHC (Mackie, 1996; SCMP, 30 April 1997d).

#### *Barclays de Zoete Wedd*

The investment banking division of Barclays Bank Plc, Barclays de Zoete Wedd was appointed as financial adviser to the HK Government for WHC (Shan, 22 Sept 1995).

#### *Jardine Construction Insurance Services*

This company worked in association with the WHTCL, compiling an underwriting presentation to provide potential insurers in the international market with full details of the project (SCMP, 30 April 1997c).

#### *Allianz Group of Germany and SCOR of France*

These companies were appointed leading insurers for the contractors 'all risks' and third-party insurance, supported by other insurers in Europe, Hong Kong and Japan (SCMP, 30 April 1997c).

## **Planning and environmental regime**

### Outline of planning regime

The Western Harbour Crossing Ordinance (Chapter 436) stipulates WHTCL's responsibility for the construction, operation and maintenance of WHC. It also provides for a specified toll adjusted mechanism in respect of WHC (HKLI, 1993; LegCo, 2008).

According to district board electoral boundaries, the immediate landfall of WHC on the Western District roughly covers the constituencies of Sheung Wan [M-03] and Sai Ying Pun West (Kong, 1993).

For land use impact in Western District, the Outline Zoning Plan was revised when WHC was planned. The entrance/exit area of the Crossing was also planned on the newly reclaimed site on Sai Ying Pun. No immediate amendment was made on the zoning of Western District on that newly revised plan. The implication of the Western Harbour Crossing on the development of the district was not seriously taken into consideration when the Crossing was proposed (Kong, 1993).

The Project Brief, issued by the Hong Kong Government, was used as a basis for inviting tenders for the franchise. The document identified WHC as a key project in the Airport Core Program. It also defined the WHC project as extending from an interface with the West Kowloon Expressway to the Route 7 connections at Sai Ying Pun on HK Island. The tunnel links to Route 7 and terminates at Rumsey Street Flyover in the east and the Belcher Bay link in the west (Morris and Hill, 1996).

## Environmental issues and ecological mitigation

The Environmental Impact Assessment Study (the Study), undertaken by Western Harbour Crossing Consultants, provided information on the nature and extent of potential environmental impacts associated with WHC. It reviewed both the construction and operational impacts of the tunnel, including an assessment of the noise, air and water quality, visual and land use impacts (Highways Department & WHCC, 1991).

These environmental measures were detailed in the Project Agreement. The franchisee was responsible for financing and completing these measures (Griffin & Yue, 18 Feb 1992).

The Study aimed to mitigate as far as possible any adverse environmental effects caused by the construction and operation of the crossing (Highways Department & WHCC, 1991). This assessment was considered and reviewed by the Environmental Pollution Advisory Committee (EPCOM) (Griffin, 26 Nov 1991).

### *Air quality impacts*

The assessment of air quality was guided by the Air Pollution Control Ordinance. The major air quality impact on sensitive receivers during the construction phase would arise from dust generation. It was identified that the predicted total suspended particulates (TSP) at the sensitive receivers at Sai Ying Pun would range from 4769 – 5541  $\mu\text{gm}^{-3}$ , which exceed the 500  $\mu\text{gm}^{-3}$  guideline limit. This would require strict mitigation measures to be adopted and enforced (Highways Department & WHCC, 1991).

During the operation of WHC, the main sources of pollutants would be traffic emissions from the surrounding road network, the tunnel portals and Ventilation Buildings. The preliminary calculations indicated that the portal emissions would lead to unacceptably high pollutant levels. Thus, a low portal emission ventilation system was adopted (Highways Department & WHCC, 1991).

### *Noise impacts*

Sai Ying Pun was expected to experience the highest noise levels at the nearest sensitive receivers on Connaught Road West. It was identified that noise levels would reach 87dB(A) in the worst case. Although there were no legislative requirements for limits on daytime construction noise then, the Environmental Protection Department suggested a guideline of 5dB(A) above the background noise level (Highways Department & WHCC, 1991).

The measurements recommended in the Study were initially rejected by EPCOM due to insufficient mitigation to reduce noise pollution (Griffin, 26 Nov 1991). It obtained environmental approval by EPCOM in 1992 (Griffin & Yue, 18 Feb 1992). Later, the Government and EPCOM agreed to compensate the residents of 2,200 flats, who were affected by excessive traffic noise, with double-glazed windows and air-conditioning, in a package expected to cost up to HKD 120m (Griffin & Yue, 18 Feb 1992).

### *Water quality impacts*

The major impact on water quality was the increased turbidity which was caused both by dredging and infilling of the tunnel trench, and from construction site runoff. The Study recommended that pollutants from the construction site runoff be diverted through sediment traps. Any water used for dust suppression at concrete batching plants would need to be discharged to settlement tanks and reused (Highways Department & WHCC, 1991).

### *Visual impact and landscaping*

The visual impact of the landfall works on existing possible future developments had been assessed. The visual impact mainly resulted from the elevated road structures of Sai Ying Pun Interchange. The introduction of green areas was seen to soften the landscape to a certain extent. However, other mitigation measures such as setting back of roads were difficult due to limitation of space (Highways Department & WHCC, 1991).

Further, the Study supported the objectives of the Metroplan Urban Design Statement, to enhance the visual and physical accessibility of the waterfront. In particular, the importance of retaining the ridge line of the Victoria Peak had been mentioned in Metroplan. Therefore, the building height of all new developments likely to be built along Connaught Road West was expected to avoid undesirable visual problems to the overall urban landscape of the western part of Hong Kong (Highways Department & WHCC, 1991; Kong, 1993).

### Regeneration

The Green Island and Western District had been identified in the Territory Development Strategy review as one of the main population growth centres. Property analysts argued that WHC was the key to massive redevelopment of Western District, which would catalyse rapid commercial development. Many companies had planned to redevelop land into commercial buildings or hotels. However, long-term growth still depended on making the district more accessible and on other future infrastructure projects, such as the Green Island reclamation and extension of the Island MTR line (SCMP, 28 July 1996).

When the tunnel was first opened, WHC employed over 250 people, with about 60% of the workforce engaged in providing or supporting operations (Davis, 30 April 1997a). With the opening of WHC and the Airport Railway, the development of a new urban centre on the West Kowloon Reclamation site commenced at the Kowloon Station site. In 1997, it consisted of 11.7m sq ft of fully integrated facilities, including 5,126 residential units, three office towers totaling 2.8m sq ft of floor space (including the 88-storey landmark office), 860,800 sq ft of retail space, four hotels offering 2,400 rooms and parking for 6,000 vehicles (SCMP, 30 April 1997e; SCMP, 21 Jan 1998).

Today, the land immediately next to the WHC toll plaza on West Kowloon Reclamation has developed into a mixed-used development. Residential projects include The Waterfront, The Arch, The Harbour Side, The Cullinan, and the Sorrento. The International Commerce Centre, which is under construction, will accommodate offices and hotels. A shopping mall, Elements, started operation in late 2007 (Sun Hung Kai, 2008; Centamap Co. Ltd., 2008). A cultural district located east of the Harbour tunnel exit on the Kowloon side is on the drawing board.

### **Land acquisition**

Both landfalls at Sai Ying Pun and Western Kowloon are constructed on areas of reclamation (Robertson, 1998). All land was made available by Government as part of its agreement with the franchisee (Highways Department & WHCC, 1991). No land resumption was required for WHC although a small number of short term tenancies had to be terminated at no cost (Lloyd, 1996).

## **C      PRINCIPAL PROJECT CHARACTERISTICS**

### **Route description**

The WHC project is split into two sections – Hong Kong Island and Kowloon. On the Hong Kong side, the new Smithfield link at Pokfulam connects Belcher Bay with Kennedy Town, which is part of Route 7, and runs to Sai Ying Pun and the tunnel entrance. It then reaches Sai Ying Pun tunnel approach. After passing the 1.36km immersed tube of WHC, it arrives at West Kowloon Toll Plaza (SCMP, 30 April 1997a).

On the Kowloon side, the tunnel leads directly on the Western Kowloon Expressway, which further links to Chek Lap Kok Airport and to the border at Lok Ma Chau. The tunnel also provides access to some local streets including Canton Road, Jordan Road, Kansu Street, Waterloo Road, Argyle Street, Cherry Street, Nam Cheong Street, Yan Chau Street, Tong King Street and Hing Wah Street (SCMP, 30 April 1997a).

The project comprises the immersed tube road tunnel, associated approach roads, a major interchange and a new section of the elevated road along Connaught Road West, and a toll plaza with 20 toll lanes at the tunnel entrance on the Kowloon side.

#### *The approach roads*

The highway works at Sai Ying Pun stretch 2km from the end of the Rumsey Street Flyover to Belcher Bay, where land was still being reclaimed and would not be available to the contractor until mid-1995.

Connaught Road West is a heavily populated residential area.

(Poon, 1995).

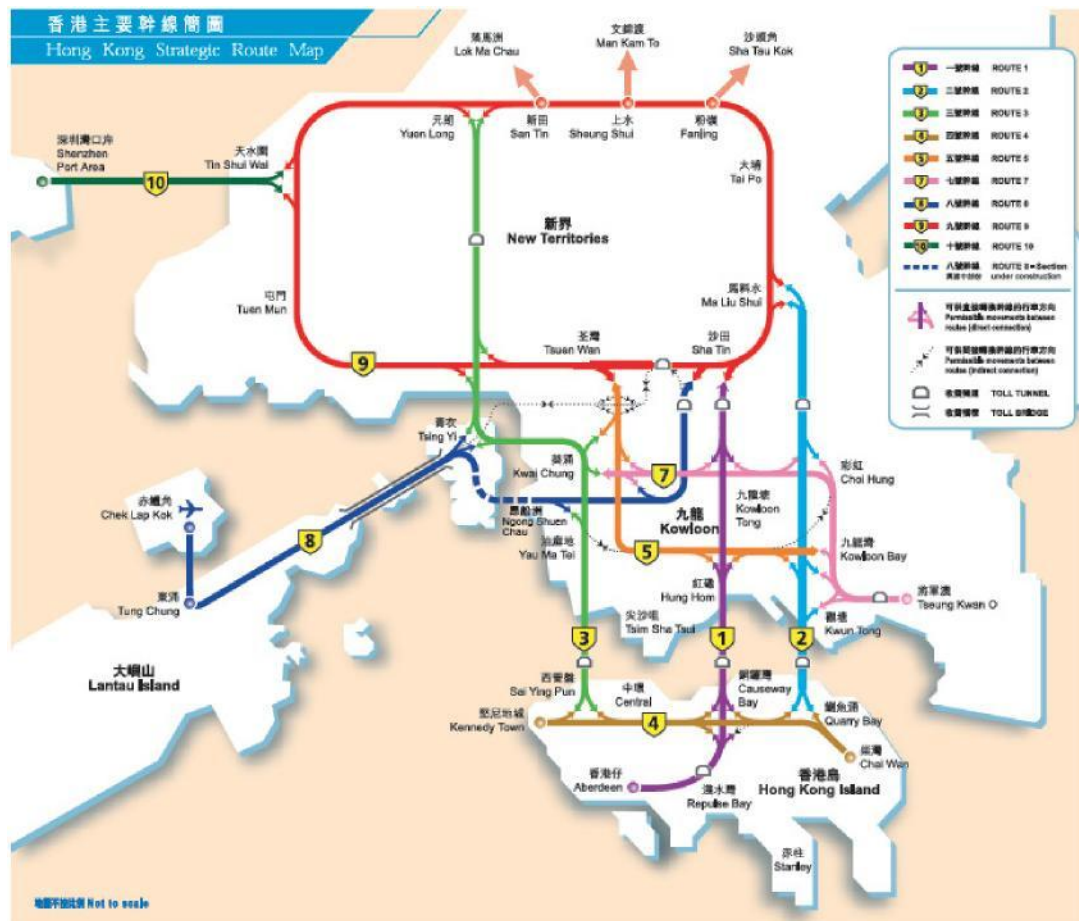
Route 7 connects Sai Ying Pun and Aberdeen, while the Central-Wanchai Bypass is to be built as part of the Wan Chai reclamation (Lau, 12 June 1990).

#### *Bus routes*

When WHC was opened to traffic in 1997, Kowloon Motor Bus Company (KMB) and Citybus Group Ltd operated eight service routes and two bus routes through WHC respectively (Reuters, 17 Apr 1997; Davis, 30 April 1997f).

To date, over 40 bus routes run through WHC (Citybus, 2008; KMB, 2008).

**Figure 9: Hong Kong Strategic Route Map**



Source: Transport Department, 2008

## Project costs

Over the years, the project costs have been adjusted several times. However, as the project was arranged as a BOT, the increases in costs over estimates were finally borne by the contractors and thus were budget-neutral to the government.

In February 1992, the construction cost was estimated to be HKD 4bn at February 1992 prices (Yue, 19 Feb 1992).

The actual construction cost is HKD 5.7bn contract (WHTCL, 2007b; Lang, 1998).

The initial estimation of the total cost of the WHC project was HKD 4bn at 1990 prices (Wong, 12 Dec 1990).

In April 1992, the whole project estimated cost was HKD 4.15bn at March 1991 prices (Cheung & Yue, 2 April 1992).

In 1992, the whole project estimated cost is HKD 6.5bn at 1997 prices (Wong, 1995).

The estimated total cost to the project (including financing charges and other costs) is HKD 7.5bn (SCMP, 22 July 1993b).

The actual whole project cost is HKD 7bn (WHTCL, 2007b; LegCo, 2008).



**Table 1: Project costs of WHC**

	Estimated price (in HKD)	Actual price (in HKD)
Construction cost	• HKD 4bn	• HKD 6.5bn
Whole project cost	<ul style="list-style-type: none"> <li>• HKD 4bn at 1990 prices</li> <li>• HKD 4.15bn at Mar 1991 prices</li> <li>• HKD 6.5bn in money of the day terms</li> <li>• HKD 7.5bn (including financing charges)</li> </ul>	• HKD 7bn

In order to prepare for the opening of the crossing, the Government spent about HKD 2.8bn on road improvements and traffic management schemes to facilitate the smooth flow of traffic to and from the tunnel (Yue, 19 Feb 1992).

### Project program

Since the WHC franchise straddled the transfer of Hong Kong's sovereignty on 1 July 1997, agreement had to be obtained from China through the Joint Liaison Group, prior to the bill's passage through the Legislative Council (Lloyd, 1996).

Despite the fact that there were difficulties in acquiring approval from the Legislative Council and in securing agreement on the funding method between British and Chinese Governments, the tunnel was open for public use three months earlier than planned at the start of construction. Table 2 below summarises the project delivery.

**Table 2: Principal project dates**

	Forecast	Actual
Construction start	Mid-1993 (Reuters News, 18 Feb 1992)	August 1993 (WHTCL, 2007b)
Construction completion	By 1996 (Fitzpatrick, 30 Aug 1990) 30 June 1997 (Poon, 1995)	April 1997 (WHTCL, 2007b)

### Main engineering features

#### Engineering

Both the Sai Ying Pun ventilation building and West Kowloon ventilation building were built on reclaimed land.

The tunnel, including both the cut-and-cover sections and the immersed tube, is 2km long. The immersed tube section is 1.3km long.

At West Kowloon landfall, the alignment had been fixed. This enabled a smooth alignment to be connected directly to the West Kowloon Expressway, where the toll plaza and the administration areas were built.

At the Sai Ying Pun landfall, the connection to the east-west corridor on the north shore of HK Island was more constrained. The main constraints were the existing developments on Connaught Road, the new Wholesale Market complex, and other committed development in this area (Morris, 1999).

## Construction

### *Tunnel construction*

The 12 precast units comprising the tunnel were fabricated in three batches of four in a casting basin at Shek O, excavated below the floor of a partially worked out quarry close to the sea.

The casting basin allowed the fabrication of three separate batches of four units per batch together in an L-shaped layout. Each unit required 12,400m<sup>3</sup> of concrete and 2,500 tonnes of reinforcing steel (Ogura et.al., 1997).

When each batch was completed, the basin was flooded and the units were towed to a temporary mooring for final fitting-out and thence to the harbour.

Four units were cast at a time (Ogura et.al., 1997).

The entrance channel to the casting basin was then closed with a floating caisson gate to allow the basin to be pumped out for fabrication of the second batch. The units were sunk into a prepared trench dredged from the harbour bed, from which marine mud was removed and replaced with sand up to the tunnel founding level to limit settlement.

Once the casting basins were completed, they were floated out to a temporary anchorage at Tseung Kwan O (Ogura et.al., 1997).

The logistics of the marine works were considerable, as it was necessary to make several diversions of the shipping fairway through the harbour to allow dredging and sinking of the units (Poon, 1995).

### *The approach roads to WHC*

There were a total of 17 bridges and approach roads (Davis, 30 April 1997c).

Connaught Road West is a heavily populated residential area. Complex traffic and utilities diversions were required to allow sections of the jigsaw to be pieced together, whilst keeping construction noise and dust to tolerable levels. The problems included constructing some 17 separate bridge structures. The land upon which much of the work is being done was reclaimed around 1985 (Poon, 1995).

### *Ventilation buildings*

RMJM was the architect of the two identical ventilation buildings. It required appropriate designs to meet the high standards set by Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS), a Government-run body which advises on highway projects and associated buildings (Davis, 30 April 1997d).

Environmental concerns had been incorporated into the design, which included sunscreens and cladding to reduce heat absorption. Non-reflective glazing was used to reduce the glare effect for the approaching motorist (Davis, 30 April 1997d).

## Main contracts and contractors

Note: Data not found in the public realm.

## Major civil engineering components

Details are shown in Table 3 (below).

**Table 3: WHC Key Facts and Figures**

The Tunnel	No. of traffic lanes	Six lanes (dual three-lane tunnel)
	Traffic capacity	Maximum 180,000 vehicles per day
	Tunnel length	1.97km between West Kowloon and Sai 'ling Pun
	Speed limit	80 km/h
	Design life of tunnel structure	120 years
Toll Plaza at West Kowloon	No. of toll lanes	20 lanes (four reversible to provide 12 toll lanes for traffic in one direction at peak hours)
	Speed limit	50 km/h
	Administration building	three storey with total gross floor area of 4,280m <sup>2</sup>
	Number of bus interchanges	two units on both sides of the Toll Plaza
Immersed Tube Tunnel	Total length	1.363km
	No. of units	12 units
	Size of each unit	113.5m (length) x 33.4m (width) x 8.57m (height), weighing 35,000 tonnes on average
Tunnel Approach	Number of ventilation building	two units (each 45m diameter)
	Length of cut & cover tunnel	251.5m at West Kowloon, 355.5m at Sai 'ling Pun
	Length of open ramp	164m at West Kowloon, 134m at Sai 'ling Pun
Sai 'ling Pun Interchange	Length of ground level roads	3km
Route 4 (Sheung Wan to Belcher Bay)	Number of bridges	17 units
	Elevated length	3.23km
	Paved deck area	43,000m <sup>2</sup>

Source: WHTCL, 2007b

## D PROJECT TIMELINE

### Project timeline

The following summarises the key decisions/events of the WHC project in relation to its planning, implementation and operation.

Year	Month	Type of Decision/Event	Key Decision/Event
1976		Project Initiation	<ul style="list-style-type: none"> <li>Initial Consideration – A western harbour crossing from Kennedy Town to Lai Chi Kok was considered in 'Comprehensive Transport Study 1976'. However it was rejected due to its excessive cost and traffic problems at each landfall (Wilbur Smith and Associates, 1976)</li> </ul>
1981		Project Initiation	<ul style="list-style-type: none"> <li>The report 'Additional Cross Harbour Facilities – Study of Long Term Options 1981' recommended a tunnel linking Central and Kwai Chung via Stonecutters Island. (Wilbur Smith and Associates, 1981)</li> </ul>
1984		Project Initiation	<ul style="list-style-type: none"> <li>WHC had always been seen as a more direct link between major population centres in Hong Kong and Kowloon, but difficulties with landfalls precluded a crossing in this area (Morris, 1997).</li> <li>The Government identified a pattern of reclamation in 'Study on Harbour Reclamations and Urban Growth 1983' (SHRUG) which would allow a suitable Kowloon landfall on the Western Reclamation (Highways Department &amp; WHCC, 1991).</li> <li>SHRUG recommended a dual four-lane WHC from Sai Ying Pun via West Kowloon to Kwai Chung in both airport-retained and airport-relocated strategies (Lands Department, 1983).</li> <li>The 1984 report 'Additional Cross-Harbour Facilities – Study of Long Term Options', prepared by the Highways and Transport Department, identified an alignment connecting Sai Ying Pun with the West Kowloon Reclamation at Yau Ma Tei. This alignment was regarded by them as the preferred alignment (Highways Department &amp; WHCC, 1991).</li> </ul>
1989	May	Project Initiation	<ul style="list-style-type: none"> <li>As a result of the Government's Port and Airport Development Strategy, a decision was taken to relocate HK's international airport to Chek Lap Kok. The provision of a third harbour crossing was essential (Lands and Works Branch, 1989).</li> <li>Chapter 6 of the 'Second Comprehensive Transport Study 1989' (CTS-2) proposed WHC as one section of Route 3, and this was identified as one of the candidate highway projects (Transport Department, 1989).</li> <li>The Green Paper 'Moving into the 21st Century' was drafted based on CTS-2. WHC was given the highest priority among the HKD 20bn road projects (SCMP, 01 Jun 1989; Transport Branch, 1989).</li> </ul>
1989	July	Project Initiation	<ul style="list-style-type: none"> <li>Terms of Reference for Western Harbour Crossing Study were issued (Highways Department &amp; Highways Department &amp; WHCC, 1991).</li> </ul>
	Nov	Feasibility Study Initiation	<ul style="list-style-type: none"> <li>Western Harbour Crossing Consultants (WHCC) was appointed by the Government to study the feasibility of constructing WHC. The Study commenced in November 1989 (Highways Department &amp; WHCC, 1991).</li> </ul>

Year	Month	Type of Decision/Event	Key Decision/Event
	April	Project Initiation	<ul style="list-style-type: none"> <li>The White Paper 'Moving into the 21st Century' was released. It outlined the plans for the construction of Route 7, Central-Wanchai Bypass and WHC (Transport Branch, 1990). The Central-Wanchai Bypass would link the Island Eastern Corridor and Route 7 to provide a continuous expressway along the north shore of HK Island (Transport Branch, 1990).</li> </ul>
1990	Aug	Project Initiation	<ul style="list-style-type: none"> <li>A financial adviser for WHC would be appointed in early 1991, followed by a franchise operation to be assembled in early 1992 (Becker, 8 Aug 1990).</li> </ul>
	Sept	Project Initiation	<ul style="list-style-type: none"> <li>In 1990, the bidding exercise was initially planned, and was scheduled to be called in April 1991. WHC was scheduled to be completed by 1996 (Fitzpatrick, 30 Aug 1990).</li> </ul>
1991	April	Feasibility Study	<ul style="list-style-type: none"> <li>The Western Harbour Crossing Study Final Report was issued. It examined various alignment options for a dual three-lane tunnel, and carried out engineering, financial and environmental feasibility studies. It also determined that WHC would be feasible as a build-operate-transfer (BOT) project. (Highways Department &amp; WHCC, 1991)</li> </ul>
1991	June	Project Initiation	<ul style="list-style-type: none"> <li>The representatives of the British Government and Chinese Government discussed ACP-related questions and signed the Memorandum of Understanding. Both sides agreed to give their firm support to construction of a new airport at Chek Lap Kok and its connecting road and rail systems (HK Government, 1991) (also stated signed on 3 Sept 1991 - Yates and McKinnell, 1995)</li> </ul>
	Aug	Project Initiation	<ul style="list-style-type: none"> <li>Wharf Holdings formed a consortium to bid for the WHC (Thompson, 3 Aug 1991)</li> </ul>
	Nov	Project Initiation	<ul style="list-style-type: none"> <li>Environmental Pollution Advisory Committee (EPCOM) rejected the EIA report, due to insufficient mitigation to reduce traffic noise, which could affect residents in Connaught Road West (SCMP, 26 Nov, 1991)</li> </ul>
		Project Initiation	<ul style="list-style-type: none"> <li>The West Kowloon reclamation was placed, using pumped sand, and was completed in 1992 (Robertson, 1998).</li> </ul>
1992	Jan	Project Initiation	<ul style="list-style-type: none"> <li>To date only two groups had emerged as leading contenders for the BOT contract. One was led by the Cross Harbour Tunnel Company, with Wharf Holdings as its major shareholder; the other was a joint venture between Kumagai Gumi and Nishimatsu Construction (SCMP, 23 Jan 1992)</li> </ul>
	Feb	Project Initiation	<ul style="list-style-type: none"> <li>Wharf Holdings was seeking partners to tender for WHC, but was yet to decide whether it would form a joint venture for the tender (Ho, 8 Feb 1992)</li> <li>The Government proposed compensation measures to which EPCOM agreed, that residents affected by excessive traffic noise would be compensated with double-glazed windows and air conditioning in a package expected to cost up to HKD 120m (Griffin &amp; Yue, 18 Feb 1992).</li> <li>It was planned that by February 1993, the Government would draw up a shortlist of bidders and submit it to the Chinese Government before the contract was granted (Griffin &amp; Yue, 18 Feb 1992)</li> <li>The winning bid would be selected in early 1993 (Reuters News, 18 Feb 1992)</li> </ul>

Year	Month	Type of Decision/Event	Key Decision/Event
1992	Feb	Project Initiation	<ul style="list-style-type: none"> <li>The Government announced that the winning franchisee of WHC would be required to construct a section of Route 7 as part of the project. This section would run from Rumsey Street Flyover to Belcher Bay at Kennedy Town, and would cost over HKD 700m. After construction, the Highways Department would take over management of the road (Yue, 19 Feb 1992)</li> <li>The total WHC project cost had risen from HKD 3bn to HKD 4bn at 1992 prices because the original plan did not include part of Route 7 (Yue, 19 Feb 1992).</li> </ul>
	March	Project Initiation	<ul style="list-style-type: none"> <li>The invitation of tenders to bid for WHC was announced on 3 March 1992. A tender deposit of HKD 1m was required, to be refunded one month after the tender closed (Yue, 19 Feb 1992).</li> <li>CITIC Pacific said it would form a consortium, led by itself, to bid for the project (Sito, 3 March 1992).</li> <li>The Cross Harbour Tunnel Company, with Wharf Holdings as its major shareholder, and Nishimatsu Construction were at the head of the queue for the project (Yue, 10 March 1992).</li> </ul>
	April	Financing and Implementation	<ul style="list-style-type: none"> <li>Western Harbour Tunnel Company Ltd was established to build and operate WHC (WHTCL, 2007b).</li> </ul>
	May	Financing and Implementation	<ul style="list-style-type: none"> <li>Informal meetings about funding plans for the new airport and related projects were held over the past few weeks by the Joint Liaison Group's Airport Committee, but no formal meetings were planned as of May 1992 (Free, 21 May 1992).</li> </ul>
	June	Financing and Implementation	<ul style="list-style-type: none"> <li>The draft bill and franchise documents were submitted to Executive Council for formal approval</li> <li>The CHT and CITIC consortia decided to join forces and became the only bidder (SCMP, 29 June 1992)</li> </ul>
	July	Financing and Implementation	<ul style="list-style-type: none"> <li>The deadline for tenders was 3 July. Western Harbour Tunnel Company (WHTCL) was the only company to bid (Yue, 2 July 1992; Yue, 19 Feb 1992).</li> </ul>
	July	Financing and Implementation	<ul style="list-style-type: none"> <li>Negotiation between the Government and the franchisee for the project was expected to begin by the end of August 1992, and an award was expected in February 1993 (SCMP, 31 July 1992).</li> </ul>
	Nov	Implementation	<ul style="list-style-type: none"> <li>The draft Western Harbour Crossing Bill, project agreement and associated agreements were being prepared by the Government for discussion with the franchisee tunnel company. The Government had also gazetted WHC under the roads ordinance. (SCMP, 25 Nov 1992)</li> </ul>
1993	March	Financing and Implementation	<ul style="list-style-type: none"> <li>The construction of WHC was still hoped to begin in August or September 1993, but doubts were caused by the Sino-British tensions (SCMP, 26 March 1993).</li> </ul>
	June	Financing and Implementation	<ul style="list-style-type: none"> <li>Both Governments agreed to hold a second round of talks on the airport under the Joint Liaison Group (JLG). The Chinese Government would decide whether it approved the construction of WHC in this meeting (Holberton, 12 June 1993).</li> </ul>

Year	Month	Type of Decision/Event	Key Decision/Event
	June	Financing and Implementation	<ul style="list-style-type: none"> <li>On 18 June 1993, the British and Chinese Governments reached an agreement in the Sino-British Airport Committee Meeting. The agreement included the financing method for WHC and the Chinese Government approval for the project, as its franchise period passes beyond 1997 when the sovereignty of HK would be returned to China (Stamp, 18 June 1993; Ma, 1996).</li> <li>An award was made to the WHTCL as the franchisee at a meeting of the Joint Liaison Group. The franchise period was from 1993 to 2023 (Robertson, 1998)</li> <li>The Administration introduced the Western Harbour Crossing Bill (WHCB) into the Legislative Council. A Bills Committee was formed to study the Bill (LegCo, 2008)</li> <li>The consortium reached an agreement with the Government on the toll and its future adjustment. The next stage was to wait for the Legislative Council to pass the Bill. (Wong, 23 June 1993)</li> <li>The details of the franchise and the WHC Bill were made public on 25 June 1993 (Wong, 24 June 1993).</li> <li>Debates began over the internal rate of return and toll charges (LegCo, 1993a and LegCo, 1993b).</li> <li>On 30 June 1993, the Joint Liaison Group (JLG) Airport Committee had the meeting in accordance with the Memorandum of Understanding covering the massive airport project. (Wong, 30 June 1993).</li> </ul>
1993	July	Financing and Implementation	<ul style="list-style-type: none"> <li>Debates on the toll adjustment mechanism and toll charges continued.</li> <li>The Project Agreement between HK Government and Western Harbour Tunnel Company Limited was signed. The Project Agreement awarded the franchise to finance, design, build, operate and maintain WHC for a period of 30 years. It also set the procedures and technical requirements for the crossing (Robertson, 1997; LegCo, 1995).</li> <li>The Project Agreement required the insurance program to cover all risks undertaken by contractors. Such risks covered loss or damage to works at all stages of construction, third-party liability insurance with a limit of HKD 700m; a marine liability insurance; project employees' compensation policies covering all personnel engaged on the project, and a professional indemnity insurance to cover design and construction obligations (SCMP, 30 April 1997c).</li> <li>WHC Ordinance (Cap 436) was enacted (HKLII, 1993).</li> <li>On 21 July 1993, legislative councilors voted 35 to 19 to approve the amended arrangements suggested by the Liberal Party (SCMP, 22 July 1993a).</li> <li>The consortium announced the final arrangement and shareholders' structure following the approval of the WHC project by the Legislative Council (SCMP, 22 July 1993b).</li> </ul>
	Aug	Implementation	<ul style="list-style-type: none"> <li>The 47-month construction program began on 2 August 1993. Senior staffs were appointed (WHTCL, 2007b; SCMP, 19 Aug 1993)</li> </ul>

Year	Month	Type of Decision/Event	Key Decision/Event
	Sept	Implementation	<ul style="list-style-type: none"> <li>The HK Government signed the formal Franchise Agreement with WHTCL, including the Designers Agreement and construction contract on 2 September 1993. After the consortium was awarded the franchise, it signed a HKD 5.7bn contract with Nishimatsu Kumagai Joint Venture. (Ma, 1996; Manuel, 3 Sept 1993)</li> <li>Establishment of a Project Co-ordination Team and the selection of Ove Arup &amp; Partners (Poon, 1995)</li> </ul>
1993	Nov	Financing	<ul style="list-style-type: none"> <li>WHTCL signed a syndicated loan agreement of HKD 5.2bn with the 22 banks (Ma, 1996; Reuters, 9 Sept 1993).</li> </ul>
	Dec	Financing	<ul style="list-style-type: none"> <li>The HKD 5.2bn syndicated loan from 22 banks was available to WHTCL by the end of December 1993, in which 60-70% of the loan was to come from Japanese banks (SCMP, 16 Dec 1993; Sender, 13 Jan 1994).</li> </ul>
	Feb	Implementation	<ul style="list-style-type: none"> <li>The 2km central fairway from Sheung Wan to Admiralty was trimmed from 380m to 300m by the Marine Department in order to allow for the construction of WHC and the Airport Railway Tunnel (Wan, 13 Dec 1996).</li> </ul>
1994	June	Implementation	<ul style="list-style-type: none"> <li>Construction of the first batch of four units started (WHTCL, 2007b).</li> </ul>
	Nov	Implementation	<ul style="list-style-type: none"> <li>The project was ahead of program (SCMP, 5 Nov 1994)</li> </ul>
	Dec	Implementation	<ul style="list-style-type: none"> <li>The first batch of tunnel tubes was completed and towed to a temporary preparation yard at Junk Bay prior to their sinking (Wong, 1998)</li> </ul>
	Jan	Implementation	<ul style="list-style-type: none"> <li>The first batch of immersed tunnel units was floated out from Shek O casting yard and left the casting basin (WHTCL, 2007b, Poon, 1995).</li> <li>The four tube segments were towed through the Tathong Channel to a mooring area at Junk Bay (Wallis, 18 Jan 1995).</li> </ul>
1995	March	Implementation	<ul style="list-style-type: none"> <li>The first 33,000 tonne tube segment (the first of 12 immersed tube units) was sank on the seabed off at Sai Ying Pun after a 16-hour operation. A satellite global-positioning system was used to ensure the unit was precisely located on the seabed (WHTCL, 2007b, Poon, 1995; Wallis, 16 Mar 1995; Wallis, 18 Mar 1995).</li> <li>Marine fairway diversions in Victoria Harbour started towards the end of 1995 when massive tube units for WHC and the Airport Railway tunnel were sunk in the middle of the channel near western HK Island (Wallis, 18 Mar 1995)</li> </ul>
	June	Implementation	<ul style="list-style-type: none"> <li>The British reaffirmed that WHC would be completed by 30 June 1997 (Reuters, 30 June 1995)</li> </ul>
	Sept	Implementation	<ul style="list-style-type: none"> <li>WHC was 48% complete, with the first four sections of immersed tube in position (Bunoan, 5 Sept 1995).</li> </ul>
	Nov	Implementation	<ul style="list-style-type: none"> <li>WHC was 63% complete. Work was proceeding on foundations, the ventilation building and approach tunnels on each side of the harbour (SCMP, 30 Nov 1995).</li> </ul>
1996	April	Implementation	<ul style="list-style-type: none"> <li>The final unit was sunk into position at the end of April (WHTCL, 2007b).</li> <li>WHC was 71% complete (Patanne, 16 April 1996).</li> </ul>



Year	Month	Type of Decision/Event	Key Decision/Event
	July	Implementation	<ul style="list-style-type: none"> <li>New approach roads were under construction, including the Smithfield link at Pokfulam connecting with Belcher Bay and Sai Ying Pun. This was the first section of Route 7, a highway linking north HK Island with Aberdeen (SCMP, 28 July 1996).</li> </ul>
	Sept Sept 18	Implementation	<ul style="list-style-type: none"> <li>All 12 units of WHC were linked up (NAPCO, 1998).</li> <li>The joint venture held a breakthrough ceremony to celebrate the completion of the immersed tunnel section (Mackie, 1996)</li> </ul>
	Oct	Operation	<ul style="list-style-type: none"> <li>The Transport Advisory Committee approved a HKD 40 surcharge for taxis using WHC, which means taxi drivers only receive an additional HKD 10, over the flat HKD 30 fare, for their return trip. TAC said this was derived from the taxi vacancy rate. Taxi drivers claimed they were treated unfairly and they proposed a HKD 60 surcharge for taking passengers through WHC. The union also said they were not consulted prior to endorsing the proposal. If the negotiations failed, it was believed it would cause more congestion on CHT and EHT as their fees were lower (Delfino &amp; Szeto, 30 Oct 1996; Delfino &amp; Lo, 16 Nov 1996).</li> <li>The tunnel was due to open in March 1997, but contractors believed it could be delayed until August 1997 because of slow progress on contracting approach roads (Delfino &amp; Szeto, 30 Oct 1996).</li> </ul>
	Nov	Operation	<ul style="list-style-type: none"> <li>In order to soothe drivers angry over tunnel surcharges, the Transport Advisory Committee planned to build five or six taxi stands for WHC (Delfino &amp; Lee, 5 Nov 1996).</li> </ul>
	Dec	Implementation	<ul style="list-style-type: none"> <li>The Marine Department set a speed limit at 10 knots for all vessels in Victoria Harbour. Also, the central fairway from Sheung Wan to Admiralty reverted to its original width of 380m (SCMP, 13 Dec, 1996)</li> <li>China Motor Bus submitted plans to the Government for the 12 routes proposed for WHC. The tender result would be due in February 1997 (Chan, 14 Dec 1996).</li> <li>The overall project was 95% completed at the end of December (Reuters, 10 Jan 1997).</li> </ul>
	Jan	Implementation	<ul style="list-style-type: none"> <li>It was expected that WHC would be open to traffic in April 1997 (HK iMail, 6 Jan 1997).</li> <li>The Executive Council approved a HKD 40 taxi toll which comprised HKD 30 for the tunnel toll and an additional HKD 10 for the return fee through the CHT or EHT (SCMP, 29 Jan, 1997).</li> </ul>
1997	Feb	Implementation	<ul style="list-style-type: none"> <li>The Sai Ying Pun section of Route 7 between Sheung Wan and Belcher Bay opened on 26 February (Cheung, 14 Feb 1997).</li> </ul>
	April	Implementation	<ul style="list-style-type: none"> <li>It was confirmed that WHC would open for traffic on April 30 (Reuters, 11 Apr 1997).</li> <li>Citybus Group Ltd announced that it would operate two bus routes through WHC (Reuters, 17 Apr 1997).</li> <li>The tunnel was open to traffic on 30 April 1997 (Davis, 30 April 1997d).</li> </ul>
	June	Operation	<ul style="list-style-type: none"> <li>Commuters said several peak hour bus services through WHC should be extended (Delfino, 4 June 1997).</li> </ul>

Year	Month	Type of Decision/Event	Key Decision/Event
	Sept	Operation	<ul style="list-style-type: none"> <li>The daily throughput of the crossing was 20,000 vehicles. It was expected the throughput would increase substantially when Route 3 and the new airport opened in 1998 (Regulatory News Service, 2 Sept 1997).</li> <li>The Transport Department announced that they had misinformed the Transport Advisory Committee over the numbers of vacant cross-harbour taxis last October, and urged a correction (Delfino, 6 Sept 1997).</li> </ul>
	Oct	Operation	<ul style="list-style-type: none"> <li>Given the low traffic volume, legislators questioned whether the Government should cut the toll to attract more motorists. However, the Secretary for Transport stressed that the reduction of car tolls was purely a commercial decision for the tunnel company and it was up to the company to decide. Another suggestion was to equalise tolls in the three cross-harbour tunnels, to HKD 16 (SCMP, 16 Oct 1997)</li> </ul>
	Nov	Operation	<ul style="list-style-type: none"> <li>Following the controversial taxi surcharge, Executive Council approved an additional HKD 15 surcharge for passengers using the tunnels from 1 January 1998 (Delfino, 5 Nov 1997).</li> </ul>
1998	March	Operation	<ul style="list-style-type: none"> <li>The daily throughput had steadily increased to about 30,000 vehicles a day (Leung, 18 Mar 1998).</li> </ul>
	May	Operation	<ul style="list-style-type: none"> <li>Throughput was growing at a rate of 1-2% per month, accounting for about 15% of total cross-harbour traffic (Chan, 8 May 1998).</li> </ul>
1999	Mar	Operation	<ul style="list-style-type: none"> <li>The tunnel company planned to defer its right to increase tolls on WHC until the impact of the Government's decision to increase tolls on the CHT, from HKD 10 to HKD 20 in September (Oldfield, 11 Mar 1999).</li> </ul>
	Aug	Operation	<ul style="list-style-type: none"> <li>WHC reduced tolls for cars and motorcycles from HKD 30 and HKD 15 to HKD 20 and HKD 8 respectively between 10pm and 8am. The concessions would last three months (Lo, 31 Aug 1999).</li> </ul>
	Sept	Operation	<ul style="list-style-type: none"> <li>Although tolls for cars and motorcycles doubled in CHT, the usage rate at WHC remained unchanged at about 3,300 vehicles (So, 2 Sept 1999).</li> </ul>
	Oct	Operation	<ul style="list-style-type: none"> <li>WHC's operators applied to the Transport Department to increase car tolls from HKD 30 to HKD 40 (So, 14 Oct 1999)</li> </ul>
2001	Dec	Operation	<ul style="list-style-type: none"> <li>Since December 2000, the increased tolls at WHC led to a steep fall in traffic in WHC; for every percentage point increase in revenue there has been an equivalent drop in traffic volume. This also resulted in longer queues at the other two cross-harbour tunnels (SCMP, 17 Dec 2001).</li> </ul>

## Project key issues

This section describes some key issues that emerge from the Project Timeline.

### Project initiation

In the report 'Additional Cross Harbour Facilities – Study of Long Term Options 1981', three out of 16 options were short-listed as the most feasible means of easing cross-harbour traffic

flow (HK Standard, 13 Jan 1982).

The relocation airport plan and new port facilities suggested in PADS could drain as much as three quarters of HK's fiscal reserves. Even if the private sector agreed to share 60% of the final costs, it was estimated the works would still drain between 10% and 20% of HK's reserves (Wong, 4 Jan 1990). Also, the operation of these facilities would extend beyond the transfer of HK's sovereignty on 1 July 1997. Therefore, it required agreement from the Chinese Government.

#### Confirmation of the project's necessity

The Government conducted a comprehensive review to assess what could be salvaged from the *Ports and Airport Development Strategy* (PADS) if the Chek Lap Kok airport plan was shelved. WHC, West Kowloon Expressway and the West Kowloon Reclamation were expected to go ahead even if the airport plan was abandoned. This was because West Kowloon Reclamation was needed to relieve the pressure on the overcrowded district, whereas WHC would be required to alleviate heavy traffic in the Cross Harbour Tunnel (SCMP, 22 April 1991).

While it was still uncertain whether the new airport and its associated railway would be built, Mr James Blake, the Secretary for Works, gave assurances that WHC was a self-sustaining project even without the new airport. It would go ahead (Wong, 5 Oct 1992).

#### Environmental issues

EPCOM rejected the EIA report on WHC in November 1991, as it did not contain sufficient measures to mitigate noise impacts. This was a rare rejection. Residents affected by excessive traffic noise would be compensated with double-glazed windows and air conditioning in a package expected to cost up to HKD 120m. But the measures were unlikely to satisfy the residents of 2,200 flats on Connaught Road West, who lived about 30m from the crossing. Some would also be compensated for electricity bills. In other words the amount could vary according to the needs of each flat. The measures would be written into the tender application requirements and funded by the franchisee.

Originally, a proposed five-storey noise barrier wall would have had to be built and the road area covered, costing HKD 240m; but this option was rejected due to its high cost and ineffectiveness (Griffin & Yue, 18 Feb 1992).

#### Tender issues

By January 1992, two groups had emerged as leading contenders for the BOT contract. One was led by the Cross Harbour Tunnel Company, with Wharf Holdings as its major shareholder. It consisted of Mott McDonald as the main consultant, Schroders as financial adviser, and Wilbur Smith Associates as traffic engineering consultant. Tunnel Engineering Consultants, immersed-tube experts from the Netherlands, also joined the group (SCMP, 23 Jan 1992). The contractors were a consortium consisting of Aoki, Costain, Tarmac and Christiani Nielson (SCMP, 26 March 1992). Wharf's decision to bid for the WHC franchise was part of the company's diversification program (SCMP, 23 Jan 1992). The other group was a joint venture between Kumagai Gumi and Nishimatsu Construction from Japan. This group was assisted by Ferrigno and Associates. However, a team was yet to be formed and named (SCMP, 23 Jan 1992).

During the preparation of the bidding exercise, a member of the consultative committee asked whether a 30 year franchise would be too long as WHC, linked to the Chek Lap Kok airport, would be profitable (Griffin & Yue, 18 Feb 1992).

In March 1992, Nishimatsu Construction was yet to team up with partners to form a consortium. CITIC Pacific was also interested in the project and yet to form a consortium, as was part of the French Bouygues group, Dragages Et Travaux Publics (Yue, 10 March 1992).

About ten days after the bid opened, CITIC Pacific formed a consortium with Nishimatsu Construction and Kumagai Gumi. The consortium also included Kerry Properties and American International Assurance (SCMP, 20 March 1992). As of 6 March 1992, only Wharf and CITIC had put down the required HKD 1m deposit (SCMP, 26 March 1992).

At the same time as the WHC project was opened for tenders, the Government was planning to raise the CHT tunnel tax from HKD 5 to HKD 15. But the CHT Company believed this would frighten away potential investors (SCMP, 7 May 1992).

American International Assurance had withdrawn its interest in joining CITIC Pacific's consortium two weeks before the tender deadline. Its departure was expected to take a stake of about 20% (To, 21 June 1992).

Just a week before the tenders for the project closed, CHT and CITIC decided to join together to put in one bid. It was likely that CHT dissolved its own consortium in favour of joining the CITIC group. In other words, the contractors of the CHT team were dropped (SCMP, 29 June 1992).

As only one bidder had responded when the tender closed, the Government's bargaining power was weakened. Given this disappointing response, two new consortia, led by Leighton Contractors (Asia) and Aoki Corp respectively, emerged and proposed to build the project for the Government if the Government called the tender off and instead moved to operate the project itself (SCMP, 5 July 1992).

The Government estimated the project cost at HKD 4.2bn in 1991, or HKD 6.5bn in money of the day terms (i.e. in 1997 prices) (SCMP, 31 July 1992). But the CITIC group believed it could cost HKD 800m more (Yue, 4 July 1992). If the project cost included financing charges, it could increase to between HKD 7.5bn and HKD 8bn (SCMP, 31 July 1992). Due to the lack of competition in the bid, the consortium (led by Wharf and CITIC Pacific) planned to set a HKD 30 toll per trip for private cars when the tunnel opened in 1997, so as to pay for high construction and financing costs (SCMP, 5 July 1992).

#### Debates surrounding the Toll Adjustment Mechanism and toll levels

In June 1993, the consortium had reached a consensus with the Government on the toll and its future adjustment. An automatic adjustment mechanism would be introduced so that the tunnel company could maintain the target rate of return, ranging from 15% to 18.5%, whilst the toll was proposed to be at HKD 30 for private cars. In addition, the operator could increase the tunnel toll by HKD 10 whenever its IRR fell below 15%. This resulted in a great deal of criticism from legislators. If legislators did not approve the draft legislation before the legislative session recess on 21 July and if the tunnel franchise was not awarded in August, the consortium would bear substantial cost increases and delay in the opening of the project (Wong, 23 June 1993).

In general, legislators argued that there was not enough control over toll increases. Legislators representing both the United Democrat Party and Liberal Party argued that the targeted IRR of 16.5% was unreasonably high and that the Government was forcing them to approve (or rubber stamp) the controversial franchise term.

Similarly, the Association of Democracy and People's Livelihood argued that the IRR should be reduced to between 10% and 12% range (Ng, 26 June 1993).

However, Government officers responded that the WHC Bill was a package. Re-opening negotiations with the consortium and any changes to the package would make the project less attractive. These would jeopardise a very important project and the consortium would withdraw from the project. Also it would compromise the attraction of the project to the bankers providing funding (Lee & Chan, 2 July 1993; SCMP, 7 July 1993).

Legislators were warned not to make any real amendments or to reject the toll mechanism. The Government warned that to do so would mean tearing up an agreement that had already been approved by the Chinese Government. It would also mean starting all over again, and having to seek China's consent once more (Gittings, 11 July 1993).

About a week before the legislators voted for the final decision, the Liberal Party proposed an amendment and both the Government and the consortium agreed to accept the compromise. The party's amendment sought to preserve the HKD 30 opening toll, but addressed legislators' concerns about excessive profits for the operator. Therefore, the party proposed that for the first three years after the tunnel opened in mid-1997, profits would be kept to a maximum of 16.5% of its investment instead of the original 18.5%. Any amount above that would be kept in the toll stability fund to help suppress the need for future toll rises.

Most independent legislators were expected to support the bill. However, the United Democrats declared they would not support the Liberal Party's amendment. They insisted that the toll should be reduced to HKD 25 and the minimum IRR reduced from 15% to 14% (Ng & Law, 14 July 1993).

On 21 July 1993, legislative councilors voted 35 to 19 to approve the amended arrangements suggested earlier by the Liberal Party (SCMP, 22 July 1993a).

Following approval by the Legislative Council, the consortium announced the final arrangement and shareholders' structure (SCMP, 22 July 1993b).

### Finance

It was believed that the Bank of China would support CITIC's effort to raise its portion of debt for the WHC franchise (SCMP, 24 June 1993).

According to Government estimates, the consortium was expected to earn total net revenue ranging from HKD 60bn to HKD 83.7bn during its 30-year franchise (Ng, 8 July 1993).

The consortium was expected to fund the project through equity worth HKD 2.4bn, and to borrow the remaining HKD 5.1bn (Ng, 8 July 1993).

### Criticism

Overall, the key elements of the arguments appeared to be the operators' financial return as defined in the Bill. Critics of WHC seemed intent on concentrating on the alleged rewards to the operators rather than the risks carried by them. Another criticism was the level of the proposed tolls. However, this fails to consider that toll levels are in money of the day terms. Also, people forgot to take into account the potential benefits to Hong Kong, both on a domestic level (such as better traffic movement and less congestion) and in its international attractiveness as a business centre (SCMP, 27 June 1993).

Furthermore, the negotiation process between the consortium and the Government was not transparent to either the legislators or the public (Ng, 9 July 1993).

### Implementation

Contractors and team members were appointed for the construction of WHC. Eighty senior staffs were hired for the joint venture team:

- John Mundy as project manager;
- Nishimatsu's John Porter as project director;
- Kumagai Gumi's Kazutoshi Torakai as technical director;
- K.C. Tsui as the Joint Venture construction manager for the mechanical and electrical works;
- Sandy Hone as the Joint Venture's deputy project manager and construction manager for the civil works;
- Knud Poulsen, a specialist in immersed tube construction, as engineering manager;
- Alex Peling as commercial manager;
- Robert Lloyd, Eric Granville and Don Ramanaynke, as the Government's Highways Department Western Harbour Link Office's engineers.

(SCMP, 19 Aug 1993)

## **E PROJECT FUNDING/ FINANCE**

### **Introduction**

The WHC project is a build-operate-transfer (BOT) model. It is privately financed, owned, operated and maintained by the franchisee. The total cost of WHC was HKD 7bn (WHTCL, 2007a).

It is important to note that the planning and construction phases of WHC occurred before 1997, whilst its franchise period passed beyond 1997, when the sovereignty of Hong Kong would be returned to China. Therefore, the financing method had to be agreed by both Chinese and British Governments (Ma, 1996).

The project was financed from shareholders' equity and a syndicated loan. WHTCL had to maintain a debt:equity ratio of 69:31 on the operating date (Pretorius, 2007). The debt:equity ratio just after the completion of the construction of the project was estimated to be about HKD 5.2bn:HKD 2.4bn (Ma, 1996).

By inviting the private sector to raise the finance for the project, the Government saved sufficient money to finance 150 standard-sized primary schools, 28,000 public housing units or 125 secondary schools (Davis, 30 April 1997c).

### **Background to funding/financing**

At an early stage when the Government appointed consultants to assess the feasibility of the WHC project, the Government knew that it would be commercially viable and was confident that many local and international developers would be interested in co-operating with the Government (Wong *et. al*, 12 Oct, 1989).

Under this BOT mechanism, the tunnel company has been granted the concession for the design, construction, operation and maintenance of WHC for a concession period of 30 years from the start of construction. WHC will be transferred to the Government at no cost at the end of the concession period (Lang, 1998).

### **Overview of key stages in funding/financing approach**

The launch – in 1990, the Government announced that the WHC project would be privately financed, and a bidding exercise was initially scheduled to be called in April 1991 (Fitzpatrick, 30 Aug 1990). Since mid-1991, private sector companies interested in bidding for the project began to look for partners to form consortia (Thompson, 3 Aug 1991).

The competition – The bidding exercise was launched in March 1992 and ended in early July 1992 (Yue, 2 July 1992; Yue, 19 Feb 1992).

Award of franchise – in July 1993, the Government and Western Harbour Tunnel Company Limited (WHTCL) signed the Project Agreement. Later that year the WHC Ordinance was enacted (LegCo, 1995; HKLII, 1993).

Financing arrangement – in November 1993, WHTCL signed the syndicated loan agreement of HKD 5.2bn with the 22 banks (Ma, 1996; Reuters, 9 Sept 1993).

## Funding sources

WHTCL signed the syndicated loan agreement of HKD 5.2bn with the 22 banks in November 1993 (Reuters News, 9 Sept 1993). The total lending from the Japanese banks was HKD 3.475bn (66.8% of the loan facilities). The two banks in Hong Kong provided 19.7% of the loan facilities. In particular, HSBC was the advisor and arranger for the private sector consortium financing. The consortium has to repay the HKD 5.2bn in a 15-year non-recourse loan. This syndicated loan was used to fund various costs including contract costs, operating costs and interest during construction (Ma, 1996; Lang, 1998; Pretorius, 2007; SCMP, 21 July 1993).

Table 4 (below) shows the major financial institutions:

**Table 4: Major financial institutions**

	Loan (HKD m)
Hong Kong & Shanghai Banking Corporation Ltd.	512.5
Heng Seng Bank Ltd.	512.5
Fuji Bank	512.5
Industrial Bank of Japan Ltd	512.5
The Long Term Credit Bank of Japan Ltd	350.0
The Dai-Ichi Kangyo Bank Ltd	350.0
The Sakura Bank Ltd	350.0
The Sumitomo Bank Ltd	350.0
The Mitsubishi Bank Ltd	350.0
Sanwa International Finance	350.0
The Bank of Tokyo Ltd	350.0
Bayerische Hypotheken – und Wechsel – Bank AG	350.0
ABN AMRO Bank NV	350.0
Total:	5,200.0

Source: Ma, 1996; Reuters, 9 Sept 1993

### Other participants

- Dresdner Bank AG (Hong Kong Branch)
- Credit Suisse;
- Societe Generale Asia Ltd;
- Asahi Bank Ltd;
- Daiwa Overseas Finance Ltd;
- De Nationale Investeringsbanken N.V.;
- Mitsubishi Trust and Banking Corporation;
- Chuo Trust and Banking Co. Ltd (HK Branch);
- Tokai Bank Ltd (HK Branch).

Tranche A was used to finance project costs, while Tranche B was arranged with a swap panel to hedge the interest rate of 50% of the loan facilities from the operation date in 1997 for a period up to five years. The entire facility, excluding sub-tranche A, was available up to the final maturity, which was 15 years from the signing of the facility agreement. As for sub-tranche A, it had to be fully drawn before the operation date. Prepayment was only allowed for sub-tranche A. Cancellation of Tranche A in whole or in part was allowed, whilst cancellation of tranche B was only allowed after the repayment or cancellation of tranche A (Lang, 1998).



As of 31 July 2007, the outstanding bank loan of WHTCL is HKD 3.126bn (WHTCL, 2007a). Table 8 lists the details.

## **Main elements and structure of financing package**

### Equity

The total equity from the shareholders was around HKD 2.4bn, which accounts for 32% of total financing (Pretorius, 2007). The equity of each shareholder is listed below:

**Table 5: The equity share between shareholders**

Shareholders	HKD m
The Cross Harbour Tunnel Co. Ltd.	900
Adwood *	1,216
China Merchants Holdings (Hong Kong) Co. Ltd.	316
	Total: 2,432

Source: Lang, 1998

\*Adwood includes CITIC Hong Kong (Holdings) Ltd., CITIC Pacific Ltd., and Kerry Holdings Ltd.

### Debt

In addition to finance from shareholders' equity, the remaining 68% of the total financing was raised through debt financing (Lang, 1998).

According to Patrick Ho, the tunnel company's finance manager, at least 50% of the loans were hedged into fixed interest rate loans for between two and five years. This means the impact of interest rate movements and fluctuations was reduced (Davis, 30 April 1997c).

### Revenue

The project revenue comes mostly from tolls, which are governed by the Western Harbour Crossing Ordinance (Cap. 436) (the Ordinance). Table 6 presents WHC's actual revenue, and Table 7 shows its after-tax profit revenue.

As shown in Table 6, the actual revenue of the tunnel was HKD 658m in 2007 (WHTCL, 2007a). Although there is a gradual increase in both the actual revenue and the after-tax profit revenue over years, the Company was still unable to meet the targeted Minimum Net Revenue.

According to Government estimates, the consortium was expected to earn total net revenue in the range of HKD 60bn to HKD 83.7bn during its 30-year franchise (Ng, 8 July 1993).

### Toll Adjustment Mechanism

The Ordinance provides for a specified toll adjustment mechanism (TAM) in respect of WHC. According to the proceedings in the Legislative Council (1995), the purpose of the mechanism is to provide WHTCL with a reasonable but not excessive return for shareholders, whilst maintaining a stable toll regime for road users. It also aims to ensure that the Company will earn sufficient revenue to service its debts (LegCo, 1995). From the perspective of the Government, the mechanism was an alternative to controlling the pricing

of the tunnel. From the perspective of investors, the mechanism provided better control to cover cost inflation or decline in patronage, thus reducing the uncertainty of the income stream and return (Pretorius, 2007).

During the franchise period, the Company may give effect to a toll increase on six anticipated specified dates, depending on its net revenue in a particular year. The Company is entitled to ask the Government to gazette a toll increase if the actual net revenue generated is less than the upper estimated net revenue. If the net revenue exceeds the upper estimated net revenue but is less than the maximum estimated net revenue, the Company is entitled to the upper estimated net revenue plus 50% of the excess and the balance, and the remaining 50% of the excess will go to the Toll Stability Fund. In the third case, if the actual net revenue is greater than the maximum estimated net revenue, the Company is entitled to the upper estimated net revenue plus 50% of the excess between upper estimated net revenue and maximum estimated net revenue, and all surplus will go to the Toll Stability Fund (HKLII, 1993).

If traffic levels and revenue fall below the forecast volume, TAM will allow the operator to advance the date of a toll increase. Conversely, if the amount of revenue received by the operator is above the forecast, resulting in a rate of return over the range specified, the toll increase will be deferred (Tam, 1997).

Over 30 years, the internal rate of return (IRR) was expected to be between 15% and 18% (SCMP, 21 July 1993; Tam, 1997).

### Tolls

As stated in the Ordinance, the Company has the right to raise its tolls in accordance with the Toll Adjustment Mechanism. It has raised its gazetted toll several times and offered concessionary rates on each occasion to keep the actual toll levels down (Pretorius, 2007). Table 7 illustrates the WHC toll levels. To have a better picture of the events in relation to tolls, Table 6 presents a summary of the timeline of toll events.

**Table 6: Timeline of toll events**

Year	Month	Events
1997	Apr 30	<ul style="list-style-type: none"> <li>The opening toll is HKD 30 as specified in the Ordinance and Project Agreement (Lang, 1998).</li> </ul>
2000	Dec 3	<ul style="list-style-type: none"> <li>The first tolls were raised (The Cross-Harbour (Holdings) Ltd, 2008). Taxi passengers are required to pay a total surcharge of HKD 50 (i.e. HKD 35 for the tunnel toll and HKD 15 for the return toll) (IS Department, 2000).</li> <li>The tolls were increased by between HKD 5 and HKD 15, eg. Private car from HKD 30 to HKD 35 (Kwok &amp; Cheung, 5 Dec 2000).</li> </ul>
2002	Mar	<ul style="list-style-type: none"> <li>WHTCL launched the first Midnight Empty Taxi Promotion to encourage taxi drivers to use the WHC (WHTCL, 2007b), and extends the validation when necessary. The latest promotion validates until 31 January 2009 (WHTCL, 2008b).</li> </ul>
2003	Feb 16	<ul style="list-style-type: none"> <li>Second tolls were raised by between HKD 2 and HKD 15 for all vehicle categories except taxis and good vehicles. Eg. private cars from HKD 35 to HKD 37 (Lee, 14 Feb 2003).</li> </ul>
2004	Feb 24	<ul style="list-style-type: none"> <li>A third toll gazettal took effect on 24 February 2004 in order to increase toll revenue (WHTCL, 2004).</li> </ul>

Year	Month	Events
	Jun	<ul style="list-style-type: none"> <li>WHTCL launched its first Midnight Goods Vehicle Promotion in gratitude to the support of goods vehicle drivers (WHTCL, 2007b). The latest promotion validates until 31 January 2009 (WHTCL, 2008a).</li> </ul>
	Jul 4	<ul style="list-style-type: none"> <li>Third tolls were increased, ranging from HKD 2 to HKD 15, on all vehicle categories except taxis and additional axles (WHTCL, 2004).</li> </ul>
2005	Jul 28	<ul style="list-style-type: none"> <li>WHTCL announced that it had no intention to adjust its current tolls (WHTCL, 2005b).</li> </ul>
	Jul 31	<ul style="list-style-type: none"> <li>The fourth toll gazettal took effect on 31 July 2005, due to the performance of the tunnel being below the target set in the WHC Ordinance (WHTCL, 2005a).</li> </ul>
2006	Jul 31	<ul style="list-style-type: none"> <li>The fifth toll gazettal took effect on 31 July 2006, due to the performance of the tunnel being below the target set in the WHC Ordinance. But the actual tolls remain unchanged for the time being (WHTCL, 2006).</li> </ul>
2007	Jul 31	<ul style="list-style-type: none"> <li>The sixth toll gazettal took effect on 31 July 2007, due to the performance of the tunnel being below the target set in the WHC Ordinance. But the actual tolls remain unchanged for the time being (WHTCL, 2007a).</li> </ul>
2008	Jan 4	<ul style="list-style-type: none"> <li>WHTCL announced an increase in its fourth tolls for a number of vehicle categories (except motorcycles, goods vehicles and additional axles) with effect from 6 January 2008, ranging from HKD 5 to HKD 15 (WHTCL, 2008c) eg. Private Cars: HKD 40 to HKD 45, Taxi: HKD 35 to HKD 40, Light Buses: HKD 50 to HKD 55.</li> </ul>

### Role of traffic forecasts

As mentioned above, the revenue from WHC's operations has continued to be disappointing. The traffic forecast in January 1997, just three months before the tunnel opened, was between 50,000 and 70,000 vehicles a day during the first year of operation (Tabakoff, 11 Jan 1997). However, the actual number of vehicles was not more than 47,000 vehicles per day (WHTCL, 2007a).

One comment made was that WHC's traffic forecasts were too optimistic and consequently set an over-estimate of net revenue in the WHC Ordinance.

**Table 7: Actual revenue (year ending 31 July)**

HKD m	Y/E Jul-07	Y/E Jul-06	Y/E Jul-05	Y/E Jul-04	Y/E Jul-03	Y/E Jul-02	Y/E Jul-01	Y/E Jul-00	Y/E Jul-99	Y/E Jul-98
Minimum estimated net revenue in the Ordinance	1,549	1,455	1,190	880	794	713	506	253	201	154
Upper estimated net revenue in the Ordinance	1,983	1,881	1,570	1,202	1,106	1,016	768	461	399	336
Maximum estimated net revenue in the Ordinance	2,143	2,039	1,711	1,321	1,221	1,128	865	538	471	403
Actual net revenue/ (deficit)	658	567	492	400	325	299	172	59	(52)	(208)
Shortfall	891	888	698	480	469	414	334	194	253	362
Internal Rate of Return (IRR)	- 4.52%	- 32.48%	- 45.7%							

Source: WHTCL, 2007a; WHTCL, 2005a; HKLII, 1993

**Table 8: Other financial details**

Date (as at../ for the year ended..)	After-tax profit (HKD m)	Outstanding bank loan (HKD m)	Remaining unused banking facilities (HKD m)	Toll Revenue (HKD m)	Turnover (HKD m)	Operating & administrative expenses (HKD m)
31 July 2004	184	2,666	556	719	636	(328)
31 July 2005	251	2,320	560	666	705	(262)
31 July 2006	299	1,908	629	716	767	(256)
31 July 2007	273	3,126	374	774	810	(257)

Source: WHTCL, 2004; WHTCL, 2005a; WHTCL, 2006; WHTCL, 2007a

**Table 9: Toll Levels of WHC (in HKD)**

Category	Vehicle	Effective from 6 January 2008		4 July 2004 – 5 January 2008		16 Feb 2003 – 3 July 2004		3 Dec 2000 – 15 Feb 2003		1 May 1997 – 2 Dec 2000	
		Gazetted Toll	Actual Toll	Gazetted Toll	Actual Toll	Gazetted Toll	Actual Toll	Gazetted Toll	Actual Toll	Gazetted Toll	Actual Toll
1	Motorcycles, motor tricycles	45	22	30-40	22	25-30	20	20-25	20	15	15
2	Private cars	90	45	60-80	40	50-60	37	40-50	35	30	30
2	Taxis	90	40	60-80	35	50-60	35	40-50	35	30	30
3	Public and private light buses	100	55	70-90	50	60-70	47	50-60	45	40	40
4	Light goods vehicles	135	55	90-120	55	75-90	50	60-75	50	45	45
5	Medium goods vehicles	185	80	125-165	80	105-125	70	85-105	70	65	65
6	Heavy goods vehicles	275	110	185-245	70	155-185	100	125-155	100	95	95
2	Public and private single- decked buses	100	80	70-90	60	60-70	60	50-60	50	40	40
8	Public and private double-decked buses	145	115	100-130	85	85-100	85	70-85	70	55	55

Source: WHTCL, 2007b; LegCo, 2008

## **F OPERATIONS**

### **Traffic forecasts**

Traffic forecasts played a key role in determining the overall approach to funding and the level of tolls required at the commencement of WHC in 1997. Over the years, the estimated traffic volume was inconstant.

#### Traffic capacity

As set out in the engineering feasibility study, the designed capacity assumption was 165,000 vehicles per day, whilst the practical capacity was assumed to be 142,000 vehicles per day (Highways Department & WHCC, 1991).

Later, as in the newspaper and the official announced forecasts by the tunnel operator, the traffic capacity of WHC was increased to a maximum of 180,000 vehicles per day (WHTCL, 2007b).

#### Expected traffic volume

WHC was expected to handle about 75,000 vehicles per day soon after its opening in 1997 (Robertson, 1997).

Traffic volume was expected to grow to 120,000 vehicles per day a few years after its opening (Reuters News, 18 Feb 1992).

By 2010, the tunnel would be at full capacity, with 180,000 vehicles per day (Yue, 19 Feb 1992).

The tunnel was expected to account for an average cross harbour flow of 69,000 vehicles per day, increasing to 160,000 by the year 2023 (Lucas, 19 April 1994).

Robert Adams, Chairman of WHTCL, predicted the crossing would be used by between 50,000 and 70,000 vehicles a day during the first year of operation (Tabakoff, 11 Jan 1997).

WHC was expected to capture 28% of cross harbour traffic, rising to 35% in 2011. Based on this forecast, the TAM provides for four-yearly toll increases of HKD 10 for private vehicles for the first 13 years of its operation and HKD 15 for the subsequent 13 years, assuming concessions will be given to buses (Tam, 1997).

#### Reported traffic volume

The recorded traffic volume has been lower than the designed capacity since operation of WHC commenced. In particular, the traffic volume was around 20,000 vehicles a day during the year of commencement. This was less than half the original estimate of 59,000 vehicles by the Transport Department (SCMP, 16 Oct 1997). A possible reason for the low traffic levels was that Route 3 and the airport were not opened until mid-2008.

Table 10 presents the actual traffic volumes in WHC and Table 11 lists the daily traffic in WHC by vehicle category. The tables also show WHC's shares of cross-harbour traffic.

During the year ended 31 July 2007, a total of 17,149,183 vehicles and a daily average of 46,984 vehicles were recorded.

Overall, the actual traffic volume in WHC is gradually increasing. The increases in WHC's traffic throughput have also resulted in increases in the share for cross-harbour traffic. The increase in traffic throughput and the market share were mainly due to the recovery of the Hong Kong economy, an increase in the total market, and the development of West Kowloon (WHTCL, 2007a).

In 2007, private cars had the largest share of total daily traffic flow, accounting for 51.45%; but they only account for 23.82% in the total daily traffic flow of cross-harbour traffic (WHTCL, 2007a).

**Table 10: The actual traffic throughput of WHC**

Year	Yearly Vehicle Traffic Volume (Year ended in Dec)	Daily Average Vehicle Volume	WHC's shares for Cross-Harbour Traffic (Daily Throughput)	Source
1997 <sup>1</sup>	5,497,637	22,348	9.78	TD, 2007
1998	12,081,454	33,100	14.77	TD, 2007
1999	14,313,392	39,215	17.37	TD, 2007
2000	15,663,569	42,797	18.18	TD, 2007
2001	14,491,343	39,702	16.91	TD, 2007
2002	14,613,689	40,038	17.15	TD, 2007
2003	13,600,352	37,261	16.32	TD, 2007
2004	14,342,787	39,188	16.72	TD, 2007
2005	15,033,790	41,188	18.07	TD, 2007
2006	16,195,988	44,373	19.36	TD, 2007
2007 <sup>2</sup>	17,149,183 <sup>2</sup>	46,984 <sup>2</sup>	/	WHTCL, 2007a

<sup>1</sup> started from 30 April 1997

<sup>2</sup> Year ended in July (1 August 2006 – 31 July 2007)

**Table 11: Daily traffic volume by vehicle category**

Year	Private Cars (PC)	% of PC using WHC of Cross Harbour Traffic	Taxis	% of Taxis using WHC of Cross Harbour Traffic	Goods Vehicles (GV)	% of GV using WHC of Cross Harbour Traffic	Buses	% of Buses using WHC of Cross Harbour Traffic	Source
1997 <sup>1</sup>	17,198 2	10.39 2	/	/	2,882	6.10	1,971	12.23	WHTCL, 2004
1998	24,196 2	15.59 2	/	/	4,542	10.26	3,948	21.81	WHTCL, 2004
1999	27,198 2	17.81 2	/	/	5,870	12.87	5,604	27.09	WHTCL, 2004
2000	25,576	22.49	5,321	11.36	5,090	11.14	6,158	27.85	WHTCL, 2004
2001	23,562	20.78	4,825	10.36	4,635	10.35	6,169	27.47	WHTCL, 2004
2002	23,517	21.03	4,922	10.75	4,605	10.27	6,492	28.14	WHTCL, 2004
2003	21,285	19.60	5,039	11.16	4,067	9.32	6,413	28.43	WHTCL, 2004
2004	21,436	19.86	6,438	13.05	4,133	9.31	6,738	27.98	WHTCL, 2004
2005	21,232	20.22	7,044	14.13	4,169	9.39	6,710	27.92	WHTCL, 2007a
2006	22,522	22.57	8,522	16.67	4,722	10.74	6,817	28.26	WHTCL, 2007a
2007	24,175	23.82	10,359	18.89	5,122	11.49	6,869	28.50	WHTCL, 2007a

<sup>1</sup> started from 30 April 1997

<sup>2</sup> Taxi was grouped under Private Cars

Remarks: 1997-2004 figures are recorded on year ended in December, while 2005-2007 figures are recorded on year ended in July



## **G EMERGING ISSUES**

### **Emerging issues**

#### Incomplete road network

In general, the main comment about WHC was that it did provide good connectivity with other ACP projects such as Route 3 and West Kowloon Expressway, and thus was an integral and well-functioning part of the infrastructure serving the Hong Kong International Airport. However, beyond that, it is considered to be poorly integrated with the road infrastructure in HK, and is considered also to be somewhat of a lost opportunity to influence the nature and direction of urban development in Hong Kong (particularly Western District), and Western Kowloon.

According to the CTS-2 (1989), Central-Wanchai-Bypass and Route 7 (Kennedy Town to Aberdeen) were also identified as major highway projects, and were proposed to form part of the strategic road networking connecting WHC and to relieve traffic congestion. However, due to various reasons, neither project was completed (or even started) after the opening of WHC in 1997. As a result of this incomplete road network, WHC is not well-connected with the rest of Hong Kong's road infrastructure and hence its role in relieving cross-harbour traffic congestion is minimised.

On the Kowloon side, the approach roads connecting to Tsim Sha Tsui and other parts of Kowloon are incomplete (neither comprehensive nor well-integrated). This again causes traffic congestion especially during peak hours.

#### Differential tunnel tolls

The issue of differential tunnel tolls among the three cross-harbour tunnels has been debated since the construction stage of WHC. Today, CHT, EHT and WHC charge HKD 20, HKD 25 and HKD 45 for private cars respectively (Transport Department, 2007). In particular, the high toll at WHC is said to be one of the main reasons for low traffic throughput. Also, the high toll at WHC has been criticised because it is not seen to help to alleviate traffic congestion at CHT, which was the main purpose of its construction. Consequently, the toll differences result in imbalance of traffic flow amongst the three tunnels and traffic congestion in CHT.

As a result, legislators have been exploring how to utilise WHC as well as to enhance the distribution of traffic at the three cross-harbour tunnels. According to a paper in Legco (2005a), measures include enhancing the accessibility of WHC, such as constructing new road links leading to it; amending the toll-related issues such as increasing the toll of CHT; and revising the franchise-related issues such as buying out the franchises of WHC. Yet, not much progress has been made with this matter, with criticism including that there was a lack of political will and government reluctance to take action on this matter.

#### Bus network

District councilors point out that there are no WHC bus services, particularly airport buses, running along the upper-level streets in Western District such as Bonham Road and Robinson Road. Residents in the mid-levels have no access other than by foot if they want to take an airport bus, which is very inconvenient.

### Land use and transport planning

The land on the northern entrance of WHC in West Kowloon Reclamation was not developed when the tunnel was opened to traffic in 1997, following the onset of the Asian Financial Crisis in 1997-98. This severely curtailed the expected residential population of the area, and thus directly influenced the number of toll trips WHC had expected to materialize over the early years of the tunnel's operation. The Western Kowloon Reclamation is presently still developing, ten years after commencement. Further, there is also no certainty about the timing and scale of the controversial West Kowloon Cultural District, which provides a further negative overall perspective on demand for WHC services. Government has been criticised that there is no integration between land use and transport planning, with the WHC case prominent in this debate.

In conclusion, there seems to be a consensus amongst interviewees that WHC is an excellent infrastructure asset for Hong Kong from an engineering and technical perspective. However, it is not considered quite successful in terms of its financial performance and operation in terms of relieving traffic congestion and facilitating land development, which has been delayed due to a variety of economic and political reasons since Hong Kong's handover to the Chinese sovereign rule.

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