

## 2 CONSIDERATION OF ALTERNATIVE ALIGNMENT OPTIONS

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### 2.1 History of Previous Studies

As discussed in **Section 1.1**, the need for increased traffic capacity on the east-west road links across central Kowloon, particularly for coping with the new developments on its western and eastern sides, has been recognized for a number of years.

The feasibility of upgrading existing east-west road links was investigated, but it was found that the environmental, traffic and land resumption impacts would not be desirable. As an alternative, the West Kowloon Reclamation Traffic Study (WKRTS) in 1990 proposed that a route, mainly in tunnel, be developed to link the West Kowloon Highway in West Kowloon Reclamation with the future highway system on the Kai Tak Development (previously known as South East Kowloon Development). This route became known as the Central Kowloon Route (CKR).

The proposed alignment of CKR has evolved through a number of studies, aimed at minimizing the land resumption/clearance and disruption to the public. Previous CKR studies on the alignment options can be dated back to 1991, 1995 and 1999 under the “Central Kowloon Route Study”, “Central Kowloon Route - Study on Alternatives” and engineering review of “Design and Construction Assignment for Central Kowloon Route” respectively. According to the “Legislative Council Panel on Transport Central Kowloon Route Progress Report [LC Paper No. CB(1)1494/07-08(02)] dated 16 May 2008” (<http://www.legco.gov.hk/yr07-08/english/panels/tp/papers/tp0516cb1-1494-2-e.pdf>), there had been more than 40 alignment options considered under the previous studies, including tunnel and flyover options covering most of Kowloon Peninsula as far north as Boundary Street and across the harbour around the southern tip of Tsim Sha Tsui. All these studies had concluded that a tunnel (as opposed to flyover) option across central Kowloon (as opposed to northern or southern Kowloon) would be preferable.

Following a review of the traffic forecasts in early 2002, a dual 3-lane tunnel configuration has now been adopted to meet future traffic demand.

The investigation consultancy CE 58/2006 (HY) had reviewed all the previous studies and affirmed that a tunnel option across central Kowloon would be preferable after considering the geometric design, traffic implications, environmental impacts, land impacts and construction cost. Alternative alignments considered at that study are presented in **Section 2.3**.

CKR is now a proposed a dual 3-lane trunk road, mainly in the form of tunnel, across the Kowloon peninsula linking the West Kowloon Reclamation in the west and the proposed Kai Tak Development in the east. It will connect the West Kowloon Highway at Yau Ma Tei Interchange to the proposed Trunk Road T2 at Kai Tak Development and Tseung Kwan O – Lam Tin Tunnel to form the

strategic highway link Route 6 to serve the existing and planned developments in West Kowloon, East Kowloon and Tseung Kwan O.

With the implementation of CKR, it would relieve the vehicular traffic loading on the existing urban distributor roads across the Kowloon peninsula, including Boundary Street, Prince Edward Road, Argyle Street, Waterloo Road, Chatham Road North and Gascoigne Road Flyover. A summary of the key elements of the proposed alignment is given below.

**Table 2.1: Overview of Key Elements of the Proposed Alignment**

Location	Design	Approximate Length (m) <sup>[1]</sup>
West Portion	Elevated / At-Grade Road	200
	Depressed Road	200
	Cut-and-Cover Tunnel	400
Central Portion	Drill-and-Blast Tunnel	2760
East Portion	Cut-and-Cover Tunnel	210
	Underwater Tunnel	370
	Underpass/Depressed Road	320
	Elevated/At-Grade Road	320

Note:

[1] Only CKR mainline has been measured.

## 2.2 Public Consultation

### 2.2.1 Public Engagement Activities at Investigation Stage

Since 2007, several rounds of public engagement activities have been conducted to collect views on:

- i) Selection of the preferred alignment;
- ii) Yau Ma Tei urban design;
- iii) Conservation and revitalization of Yau Ma Tei Police Station;
- iv) Ma Tau Kok waterfront urban design;
- v) Construction of the CKR section at Kowloon Bay; and
- vi) Reprovisioning facilities and enhancement opportunities as well as construction works in Yau Ma Tei and Kowloon City.

These includes a total of six public forums, two outreach events, briefing sessions for statutory and advisory boards/committees, and focus group meetings with local organizations, concerned groups and professional bodies. A dedicated website [www.ckr-hyd.hk](http://www.ckr-hyd.hk) has been set up by the project proponent to provide information of the project and public consultations that have gone through. A summary of the public events and activities is shown in the following table:

**Table 2.2: Summary of the public events and activities at investigation stage**

District	Public Forums	Outreach Events	Consultation with District Councils	Consultation with Legislative Council Transport Panel
Yau Tsim Mong	4	2	2	2
Kowloon City	2	-	2	
Kwun Tong	-	-	2	

### 2.2.2 Summary of Public Comments Received

As a result of the public engagement activities conducted at Investigation Stage, general consensus was reached on the preferred alignment of CKR. However, some of the consultees concerned that if the operation of CKR would generate additional air and noise pollution. The public opined that mitigation measures should be adopted to remove pollutants/harmful gases from the exhaust from the ventilation buildings and minimize noise resulting from the operation of the CKR itself as well as the ventilation system. In addition, some indicated that the ventilation buildings should locate far away from residential developments to allow a better dispersion of tunnel exhaust and avoid threatening the community health.

Environmental impacts arising from the construction works of CKR are also of public concerns. While most of the consultees realized that possible adverse environmental impacts arising from the construction works were inevitable, they opined that appropriate mitigation measures should be adopted to minimize air and noise pollution resulting from the construction phase. For the temporary reclamation in Kowloon Bay to the north of To Kwa Wan Typhoon Shelter, some consultees showed concern about the adverse environmental impacts on air, noise, water quality and odour, as well as the ecological impacts.

In April 2008, findings of the public engagement activities were presented to the Kwun Tong District Council, Kowloon City District Council and the Yau Tsim Mong District Council. In May 2008, the Legislative Council Panel on Transport was further consulted. They were all supportive of the project and the preferred alignment (see **Section 2.3 and 2.4** on the alternative alignments considered).

## 2.3 Selection of Preferred Alignment Option in West Portion

As discussed in **Section 2.1**, a number of alignment options have been exhaustively considered during the design developments. The general preferred criteria of the alignment options are that, firstly they should connect to West Kowloon Highway at the already constructed connecting points at the Yau Ma Tei Interchange, secondly they should be mainly in the form of a tunnel and thirdly they should avoid affecting private properties or public facilities, such as Yau Ma Tei Police Station, Yau Ma Tei Jockey Club Polyclinic, to the maximum extent, if possible.

### 2.3.1 Evaluation of Options

For the west portion, the previous Investigation Study had consolidated the preliminary findings and developed 14 preliminary alignment options which was then narrowed down to a total of 5 options for evaluation. These 5 alignment options are shown in **Figure 2.1**.

Alignment Option	Description
<i>CKR01</i>	<p>This option enters into a side-by-side cut-and-cover tunnel on the north side of Kansu Street, which affects the old and new wings of the Yau Ma Tei Police Station and the Yau Ma Tei Specialist Clinic Extension. The alignment then enters into a twin-bored tunnel on the west side of Nathan Road, and passes below the MTR lines.</p> <ol style="list-style-type: none"> <li>1. Encroach into old and new wings – need underpinning of old wing and new wing</li> <li>2. Additional time for underpinning: 10 months</li> <li>3. Risk of potential damages to police station old and new wings is higher than CKR03</li> <li>4. No private buildings affected</li> </ol>
<i>CKR02</i>	<p>This option is based on CKR01, except that the alignment has been shifted southwards such that the side-by-side cut-and-cover tunnel avoids the old and new wings of the Police Station, but not the Specialist Clinic Extension building. However, by doing so, the tunnel affects the buildings on the south side of Kansu Street.</p> <ol style="list-style-type: none"> <li>1. Avoid police station old and new wings</li> <li>2. Encroach into CLP Substation, Dickson Building and Tak Cheong Building – infeasible to be underpinned due to their heavy weights</li> <li>3. CLP Substation is to serve the major west Kowloon areas. The relocation of substation requires details planning that may last for long period of time (about 8 to 10 years). Therefore, the relocation of CLP Substation is not practicable.</li> </ol>
<i>CKR03</i>	<p>This option is also based on CKR01, except that the alignment has been shifted less southwards than CKR02 such that the side-by-side cut-and-cover tunnel avoids the old wing of the Police Station and the residential buildings at the south side of Kansu Street. However, this option still affects the new wing of the Police Station and the Specialist Clinic Extension building.</p> <ol style="list-style-type: none"> <li>1. Encroach into 1/3 of new wing – need underpinning</li> </ol>

Alignment Option	Description
	<ol style="list-style-type: none"> <li>2. Avoid CLP Substation and private buildings</li> <li>3. Additional time for underpinning: 7 months</li> </ol>
<i>CKR05</i>	<p>This option comprises a double-deck cut-and-cover tunnel along Kansu Street. This arrangement avoids the buildings on the south side of Kansu Street as well as the old and new wings of the Police Station, but not the Specialist Clinic Extension building, on the north side of Kansu Street. However, this option requires relatively deep excavation and a relatively steep vertical alignment for the bottom deck.</p> <ol style="list-style-type: none"> <li>1. Avoid police station old and new wings</li> <li>2. No private building affected</li> <li>3. Gradient of lower deck is 9%, which is highly undesirable in terms of traffic performance and safety</li> <li>4. Engineering comparatively more difficult for deeper excavation.</li> </ol>
<i>CKR07</i>	<p>This option comprises a side-by-side elevated structure along Waterloo Road, across Nathan Road, with the road entering into twin-bored tunnel on the east side of Nathan Road. The elevated structure would pass very close to numerous private residential buildings, and would impact directly on some of the buildings. It would also need to traverse the West Kowloon Corridor.</p> <ol style="list-style-type: none"> <li>1. Avoid police station and Government buildings at Kansu Street</li> <li>2. Flyover too close to residential buildings where 4.5m clearance for fire rescue requirement cannot be provided</li> <li>3. Affected buildings <ul style="list-style-type: none"> <li>• YMT Ambulance Depot, YMT Fire Station and over 10 nos. of private buildings (total floor area 55,500m<sup>2</sup>) without adequate clearance for fire rescue, including Wah Tak Building, Kam Tong Building, 238-244 Reclamation Street, Ming Sun Mansion, Wai Luen Building, Shun Ho Lau, Wing Tak Building, Bell House, 8 Waterloo Tower 1, Kam Fai Building, Lai Kee Mansion and Jade Mansion etc.</li> <li>• By shifting the alignment northwards to keep 4.5m clearance for YMT Ambulance Depot and YMT Fire Station: around 10 nos. of residential buildings, including Wah Tak Building, Kam</li> </ul> </li> </ol>

**Alignment Option****Description**

Tong Building, 238-244 Reclamation Street, Ming Sun Mansion, Wai Luen Building, Shun Ho Lau, Wing Tak Building and Bell House etc. are required to be demolished

- By shifting the alignment southwards to keep 4.5m clearance for residential buildings: YMT Ambulance Depot, YMT Fire Station and new residential building “Tower 1 of 8 Waterloo Road” etc. are required to be demolished
4. Flyover will be constructed partially above the Fruit Market, previous YMT Cinema and YMT Shelter. Adequate vertical clearance will be provided for fire rescue purpose.
  5. Lutheran Secondary School need demolition

*Environmental considerations for the alignment options in West Portion*

The environmental considerations for the preliminary alignment options have been compared and presented in the table below.

**Table 2.3: Summary of environmental considerations of alignment options at the west portion**

Alignment Options	Design	Environmental Benefits	Environmental Disbenefits
CKR01	C&C Tunnel under Kansu Street	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would have negligible visual impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> <li>• Major parks have been avoided.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• No impacts on electric substation which is a potential source of land contamination.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Some air quality and noise impacts on the residents along Ferry Street and Kansu Street during the cut-and-cover tunnel construction.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Some visual impacts to the residents along Ferry Street and Kansu Street during construction of the cut-and-cover tunnel.</li> <li>• Some landscape impacts to trees and open spaces during construction and operation of west portion.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of excavated materials from cut-and-cover tunnel.</li> <li>• Generation of demolition materials from buildings such as Specialist Clinic Extension buildings, YMT Carpark Building and Kowloon Government Office.</li> </ul> <p><u>Heritage</u></p> <ul style="list-style-type: none"> <li>• Higher risk of potential damages to the old wing of YMT Police Station.</li> </ul>
CKR02	C&C Tunnel under Kansu Street	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would have negligible visual impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> <li>• Major parks have been avoided.</li> </ul> <p><u>Heritage</u></p> <ul style="list-style-type: none"> <li>• Avoid encroachment onto the old wing of YMT Police</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Some air quality and noise impacts on the residents along Ferry Street and Kansu Street during the cut-and-cover tunnel construction.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Some visual impacts to the residents along Ferry Street and Kansu Street during construction of the cut-and-cover tunnel.</li> <li>• Some landscape impacts to trees and open spaces during construction and operation of west portion.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of excavated materials from cut-and-cover tunnel</li> </ul>

Alignment Options	Design	Environmental Benefits	Environmental Disbenefits
		Station.	<p>options.</p> <ul style="list-style-type: none"> <li>• Generation of demolition materials from buildings such as Specialist Clinic Extension buildings, YMT Carpark Building, Kowloon Government Office and 400kV Substation.</li> <li>• Electric substation may be a potential contaminated site.</li> </ul>
CKR03	C&C Tunnel under Kansu Street	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would have negligible visual impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> <li>• Major parks have been avoided.</li> </ul> <p><u>Heritage</u></p> <ul style="list-style-type: none"> <li>• Avoid encroachment onto the old wing of YMT Police Station.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• No impacts on electric substation which is a potential source of land contamination.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Some air quality and noise impacts to the residents along Ferry Street and Kansu Street during construction of the cut-and-cover tunnel.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Some visual impacts to the residents along Ferry Street and Kansu Street during construction of the cut-and-cover tunnel.</li> <li>• Some landscape impacts to trees and open spaces during construction and operation of west portion.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of excavated materials from cut-and-cover tunnel options.</li> <li>• Generation of demolition materials from buildings such as Specialist Clinic Extension buildings, YMT Carpark Building and Kowloon Government Office.</li> </ul>
CKR05	C&C Tunnel under Kansu Street	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would have negligible visual impact during operational stage, especially for the residents along the alignment in Yau Ma Tei.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Some air quality and noise impacts to the residents along Ferry Street and Kansu Street during construction of the cut-and-cover tunnel.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Some visual impacts to the residents along Ferry Street and Kansu Street during construction of the cut-and-cover tunnel.</li> <li>• Some landscape impacts to trees and open spaces during</li> </ul>

Alignment Options	Design	Environmental Benefits	Environmental Disbenefits
		<ul style="list-style-type: none"> <li>• Major parks have been avoided.</li> </ul> <p><u>Heritage</u></p> <ul style="list-style-type: none"> <li>• Avoid encroachment onto the old wing of YMT Police Station.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• No impacts on electric substation which is a potential source of land contamination.</li> </ul>	<p>construction and operation of west portion.</p> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of excavated materials from cut-and-cover tunnel options.</li> <li>• Generation of demolition materials from buildings such as Specialist Clinic Extension buildings, YMT Carpark Building and Kowloon Government Office.</li> </ul>
CKR07	Flyover along Waterloo Road	<p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Major parks have been avoided.</li> </ul> <p><u>Heritage</u></p> <ul style="list-style-type: none"> <li>• Avoid encroachment onto the old wing of YMT Police Station.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• No impacts on electric substation which is a potential source of land contamination.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Noise impact on the residents of the private residential buildings along Waterloo Road during construction.</li> <li>• Higher noise and air quality impacts on the residents of the buildings located on both sides of the elevated structure along Waterloo Road during the operational stage; noise barriers may be required to reduce noise levels.</li> <li>• Air ventilation below the flyover deck is less favourable as the flyover deck will cover most of the Waterloo Road.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Higher visual impact on the residents of the private residential buildings along Waterloo Road during construction.</li> <li>• Flyover induces more significant visual impacts on the environment during operational stage.</li> <li>• Some landscape impacts to trees and open spaces during construction and operation of west portion.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generate more demolition waste due to requiring more demolition works to the affected buildings along Waterloo Road.</li> </ul>

## 2.3.2 Selection of Preferred Alignment

All the key environmental considerations for the alignment options, such as air quality, noise, landscape and visual, cultural heritage and waste, have been considered. None of the alignment option has significant environmental advantages over the others. Hence, the preferred alignment was selected based on other perspectives.

On selecting the preferred alignment option during Investigation Study, due regards have been paid to the views of the public and relevant government departments. All of the alignment options, including Options CKR01, CKR02, CKR03, CKR05 and CKR07, were discussed at a public forum, published in the project newsletters and posted on the dedicate web-site for the project. Through these public engagement activities, a general consensus of the public was reached that Alignment Option CKR03 is the preferred alignment option at the west portion of the route. HyD consulted the Kwun Tong DC's T&TC, Kowloon City DC's T&TC and Yau Tsim Mong DC on 8 April 2008, 10 April 2008 and 24 April 2008 respectively and the Panel on Transport of the Legislative Council on 16 May 2008 . They were supportive of the preferred alignment.

In general, the alignment (i.e. Option CKR03) in the west portion is adopted for the following reasons:

- The alignment will avoid the old wing of the Yau Ma Tei Police Station on the north side of Kansu Street and also avoids the old residential buildings on the south side of Kansu Street.
- The alignment avoids any impact on private land in this area. In addition the vertical alignment is developed so as to pass under the MTRC Tsuen Wan Line and Kwun Tong Line Extension tunnels.
- The side-by-side cut-and-cover tunnel construction is found to be the most engineering feasible of the options considered with a relatively low depth and reasonable construction area.

Detailed assessments of the preferred Alignment Option CKR03 are given in **Chapters 4 - 12**.

The interchange of the CKR with the West Kowloon Highway and the local road network at Yau Ma Tei is arranged to provide the most comprehensive connectivity possible within this confined area. The layout of the slip roads is also configured to avoid existing, under construction and future proposed developments, with only localised modifications of existing roads and other infrastructure.

## 2.4 Selection of Preferred Alignment Option in East Portion

### 2.4.1 Evaluation of Options

A total of 5 alignment options at the east portion of CKR route has been developed and evaluated. 4 of these options included a section of underwater tunnel at To Kwa Wan. The alignment options are shown in **Figure 2.2** (Options A to E). The description of these options is summarised below:

<u>Alignment Option</u>	<u>Description</u>
Option A	<p>This is a land-based option, which avoids the need for temporary reclamation. It comprises a drill-and-blast tunnel section which runs underneath the existing buildings at To Kwa Wan with adequate rock cover until it reaches Sung Wong Toi Road.</p> <p>The cut-and-cover tunnel section can only start after Sung Wong Toi Road in order to avoid affecting a large number of private buildings. However, there are insurmountable problems that make this alignment unfeasible, which are listed as follow:</p> <ul style="list-style-type: none"><li>• Due to the road level of CKR tunnel at Sung Wong Toi Road being very low and the necessity to match with the road level of the road network at Kowloon Bay and Trunk Road T2, the road gradient has to be 18%, which is unacceptable in terms of highway performance and road safety.</li><li>• The depressed road section will conflict with the proposed multi-purpose stadium complex at Kai Tak Development.</li></ul> <p>Alternatively, if the CKR tunnel is designed to acceptable maximum road gradient for highway performance, the cut-and-cover tunnel will start in the To Kwa Wan area near Pak Tai Street, Pau Chung Street or Kowloon City Road depending on the sub-options studied. This alignment requires land resumption of private building as cut-and-cover tunnel will affect at least 60 numbers of buildings in To Kwa Wan area.</p>
Option B	<p>This alignment includes a relatively short section of cut-and-cover tunnel and thus involves the minimal land requirement which requires no resumption of private buildings. However, temporary re-provisioning of the public transport interchange at Kowloon City Ferry Pier is required. This option also requires the temporary re-provisioning of Ma Tau Kok Public Pier as well as the relocation of ferry services at Kowloon City Ferry Pier from the North berth to the South berth (currently unused).</p> <p>Underwater tunnel will start from the existing shoreline near to the Kowloon City Ferry Pier and extend to the Kai Tak Runway. Apart from Option A, Option B has the shortest length of underwater tunnel among other options that pass under Kowloon Bay and thus generates the minimum disruption on marine activity and environmental aspects. Also, this option will not affect any existing buildings.</p>

- Option C** The alignment runs along Chi Kiang Street at the east side. The cut-and-cover tunnel will start from Kowloon City Road and thus conflict with the existing buildings along both side of Chi Kiang Street. Underwater tunnel will start from the existing shoreline near to Hoi Sham Park to the Kai Tak Runway. This alignment requires land resumption of private buildings as the cut-and-cover tunnel will affect about 9 numbers of existing buildings along both sides of Chi Kiang Street. The cut-and-cover tunnel will also affect Hoi Sham Park.
- Option D** This alignment runs along Bailey Street. The cut-and-cover tunnel will start between Ma Tau Wai Road and Sung On Street and conflict with the existing buildings along both sides of Bailey Street. Underwater tunnel will then start from the existing shoreline and extend to the Kai Tak Runway. This alignment requires land resumption of private buildings as the cut-and-cover tunnel will affect about 7 numbers of existing buildings along both sides of Bailey Street.
- Option E** This alignment runs along Fat Kwong Street and Man Yue Street. Although this option allow bored tunnel under the existing buildings along both sides of Man Yue Street, it may still affect Harbour Centre Tower 2 when the bored tunnel connects to the underwater tunnel. This alignment requires land resumption of private buildings as the cut-and-cover tunnel will affect about 1 number of existing building and the pier next to Harbour Centre Tower 2.

Options C, D and E include relatively long sections of cut-and-cover tunnel at Chi Kiang Street, Bailey Street and near Fat Kwong Street respectively which all require significant resumption of private buildings. In addition, these options also require longer lengths of underwater tunnel under Kowloon Bay. The lengths of the underwater tunnel for the five options are listed in the table below for comparison:

**Table 2.4: Length of Underwater Tunnel Section**

Alignment Option	Length of Underwater Tunnel (m)
Option A	No underwater tunnel
Option B	370
Option C	810
Option D	925
Option E	1100

*Environmental considerations for the alignment options in East Portion*

The environmental considerations for the preliminary alignment options have been compared and presented in the table below.

**Table 2.5: Summary of environmental considerations of alignment options at the east portion**

Alignment Options	Design	Environmental Benefits	Environmental Disbenefits
Option A	Drill-and-Blast Tunnel	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce landscape and visual impact during operational stage.</li> </ul> <p><u>Sediment, Water Quality &amp; Odour</u></p> <ul style="list-style-type: none"> <li>• Avoid the need for temporary reclamation and the associated odour nuisance as well as impacts of water quality and excavated sediment to be disposed of.</li> </ul> <p><u>Ecology</u></p> <ul style="list-style-type: none"> <li>• No encroachment onto any site of conservation importance.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Significant air quality and noise impacts to the residents in Ma Tau Kok during construction of the cut-and-cover tunnel.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Significant landscape and visual impacts to the residents in Ma Tau Kok during construction of the cut-and-cover tunnel.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Longest length of bored tunnel plus cut-and-cover tunnel; hence generation of the greatest amount of excavated materials.</li> <li>• Longest length of cut-and-cover tunnel; hence generation of more significant amount of demolition materials from buildings such as Jubilant Place, On Ning Building, Wacker Industrial Building and various buildings in Lung To Street, Fung Yi Street, Luk Ming Street, Lun Cheung Street, Ying Yeung Street &amp; Pang Ching Street etc.</li> </ul>
Option B	Underwater Tunnel	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce landscape and visual impact during operational stage.</li> </ul> <p><u>Sediment, Water Quality &amp; Odour</u></p> <ul style="list-style-type: none"> <li>• Shortest length of underwater tunnel; hence less sediment to be disposed and less water quality impact to the harbour and odour nuisance.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Shortest length of cut-and-cover tunnel and avoid</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Some air quality and noise impacts during construction of temporary reclamation.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Some landscape and visual impacts during construction of temporary reclamation.</li> </ul>

Alignment Options	Design	Environmental Benefits	Environmental Disbenefits
		<p>encroachment to private buildings; hence less excavated and demolition materials generated.</p> <p><u>Ecology</u></p> <ul style="list-style-type: none"> <li>• No encroachment onto any site of conservation importance.</li> </ul>	
Option C	Underwater Tunnel	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce landscape and visual impact during operational stage.</li> </ul> <p><u>Ecology</u></p> <ul style="list-style-type: none"> <li>• No encroachment onto any site of conservation importance.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Significant air quality and noise impacts during construction of temporary reclamation.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Significant landscape and visual impacts during construction of temporary reclamation.</li> </ul> <p><u>Sediment, Water Quality &amp; Odour</u></p> <ul style="list-style-type: none"> <li>• Longer length of underwater tunnel than Option B; hence generation of greater amount of excavated sediment from construction of temporary reclamation and the associated water quality impact to the harbour and odour nuisance.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of significant excavated and demolition materials from buildings along Chi Kiang Street.</li> </ul>
Option D	Underwater Tunnel	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce landscape and visual impact during operational stage.</li> </ul> <p><u>Ecology</u></p> <ul style="list-style-type: none"> <li>• No encroachment onto any site of conservation importance.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Significant air quality and noise impacts during construction of temporary reclamation.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Significant landscape and visual impacts during construction of temporary reclamation.</li> </ul> <p><u>Sediment, Water Quality &amp; Odour</u></p> <ul style="list-style-type: none"> <li>• Second longest length of underwater tunnel; hence generation of significant amount of excavated sediment from construction of temporary reclamation and the associated</li> </ul>

Alignment Options	Design	Environmental Benefits	Environmental Disbenefits
			<p>water quality impact to the harbour and odour nuisance.</p> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of significant excavated and demolition materials from buildings along Bailey Street.</li> </ul>
Option E	Underwater Tunnel	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce air quality and noise impact during operational stage.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Tunnel option would reduce landscape and visual impact during operational stage.</li> </ul> <p><u>Ecology</u></p> <ul style="list-style-type: none"> <li>• No encroachment onto any site of conservation importance.</li> </ul>	<p><u>Air Quality &amp; Noise</u></p> <ul style="list-style-type: none"> <li>• Significant air quality and noise impacts during construction of temporary reclamation.</li> </ul> <p><u>Landscape and Visual</u></p> <ul style="list-style-type: none"> <li>• Significant landscape and visual impacts during construction of temporary reclamation.</li> </ul> <p><u>Sediment, Water Quality &amp; Odour</u></p> <ul style="list-style-type: none"> <li>• Longest length of underwater tunnel; hence generation the greatest amount of excavated sediment from construction of temporary reclamation and the associated water quality impact to the harbour and odour nuisance.</li> </ul> <p><u>Waste</u></p> <ul style="list-style-type: none"> <li>• Generation of excavated and demolition materials from buildings such as Harbour Centre.</li> </ul>

## 2.4.2 Selection of Preferred Alignment

On selecting the preferred alignment option during the previous Investigation Study stage, in which the alignment is being fine tuned in the current Design and Construction stage, due regards have been paid to the views of the public and relevant government departments. All of the alignment options, including Option A, B, C, D and E, were discussed at the public forums, published in the project newsletters and posted on the dedicate web-site for the project. Throughout the public engagement activities, a general consensus of the public was reached that Alignment Option B is the preferred alignment option at the east portion of the route. Cogent and Convincing Materials for Temporary Reclamation in Kowloon Bay has been prepared for the purpose of supporting this alignment complying with the Protection of the Harbour Ordinance.

In general, the alignment (i.e. Option B) in the east portion is adopted for the following reasons:

- Inland Alignment Option A had been considered to avoid the need for temporary reclamation by providing an inland alignment option. The inland tunnel will need to run underneath the existing buildings at To Kwa Wan and clearly this would clash with the foundations of existing high-rise buildings. The buildings would require resumption and complete or partial demolition to facilitate the cut-cover tunnel construction of the in-land alignment option. In addition, the depressed road section to the east would conflict with the proposed multi-purpose stadium complex at Kai Tak Development. Therefore, it is not a reasonable alternative due to the need of large scale resumption and demolition of existing buildings.
- For the study of the feasibility of Marine Alignment Options B to E, some existing buildings will inevitably be affected. It was considered most important that the length of the underwater tunnel should to be kept as short as possible to minimize the extent of temporary reclamation and minimize the disturbance to the public/marine facilities and the environment during construction. Marine Alignment Option B was identified as the most preferred option as it requires the smallest extent of temporary reclamation as compared with Marine Alignment Options C, D and E. Option B would therefore generate the least amount of excavated sediment to be disposed of and would have the least water quality impact to the surrounding waters among other Marine Alignment Options.

The eastern end of CKR connects to Kai Tak Interchange and its slip roads leading to Kowloon Bay, Kwun Tong and Kai Tak Development, making it convenient to travel between these roads and West Kowloon. Vehicles can also make use of the road network in the Kai Tak Development to reach various destinations at the South Apron, North Apron and Runway of Kai Tak Development including the Cruise Terminal. The design of Kai Tak Interchange has taken into account the planned pedestrian linkage at Kai Tak and match with the theme of Kai Tak Development and Energize Kowloon East. Detailed assessments of the preferred Alignment Option B are given in Chapters 4 - 12 .

## 2.5 Selection of Preferred Alignment Option for Central Portion

The alignment of the central portion of CKR, between the above preferred options at the west and east portions (**Figure 2.2**), was selected mainly on tunnel engineering considerations with the consideration as listed below:

- At the point of Nathan Road, the alignment and orientation of CKR are constrained by the existing Yau Ma Tei Police Station and Alhambra Building.
- As from geological review, the bedrock level in To Kwa Wan area is relatively low at -20mPD. However, the bedrock level in the Kowloon City Ferry Pier PTI area to Ma Tau Wai Road is relatively higher (-20.0mPD to +2.0mPD) that allow the use of the drill-and-blast tunnel method for tunnel construction. It dictates the location of CKR at Ma Tau Wai Road. In geological consideration, the rock head level along the adopted alignment is relatively high. Therefore, the alignment can pass through strong Grade III or above fine-to-medium grained granite with sufficient bedrock cover to the tunnel. Having a sufficient bedrock cover to tunnel can increase the excavation stability and reduce the geotechnical risk. In addition, the weak compressible soil, such as marine deposit, is not found from the superficial layer, which can reduce the settlement problem.
- With the consideration of the constraints at the west and east of the drill-&-blast tunnel (at Nathan Road and Ma Tau Wai Road) and also take into account of the horizontal alignment design, the central bored tunnel section has to pass underneath Ho Man Tin West Fresh Water Service Reservoir, Ma Tau Wai Service Reservoir and Ho Man Tin High Level Salt Water Service Reservoir.

CKR will pass under a mainly urban environment. As such, it was important to select an alignment, which both follows the most favourable geological conditions for drill-and-blast tunnelling and maximises the rock cover above the tunnel. The selected alignment passes underneath the hills of Kings Park and Ho Man Tin. These areas not only have the advantage of greater rock cover but also have a lower building density than the surrounding low-lying areas. The preferred alignment of the bored tunnel section also maximises the actual length of bored tunnel, and thereby minimise the length of cut-and-cover tunnel.

In terms of the impacts on private land, the adopted alignment will have the least adverse effect on this aspect.

## 2.6 Selection of the Proposed Alignment

As discussed in **Sections 2.3 to 2.5**, a number of alignment options have been considered for the west, east and central portions. These options have been evaluated by considering a number of factors including engineering, public comments, environmental factors etc. The preferred alignment for each portion has been recommended and **Figure 1.1** shows the entire preferred alignment. **Figure 2.3** shows the longitudinal profile of CKR.

## 2.7 Justification on the Locations of Ventilation Buildings

For a such length of dual 3-lanes road tunnel, a total of 3 ventilation buildings (VB) are required for efficient extraction of vehicle pollutants inside the tunnel. These VBs not only accommodate with normal tunnel ventilation systems, an advanced technology, Air Purification System (APS), would be installed inside each VB with the air inside the tunnel passing through the APS before discharge to the atmosphere. Due considerations have been taken into account in identifying the possible locations for these VBs. The following table summarize the justifications on the VB locations.

**Table 2.6: Justifications on the ventilation building locations**

Ventilation Building	Justification on the selection of locations
Ventilation Building at Yau Ma Tei Interchange	The location for the ventilation building adopted in previous Investigation Stage was located near Ferry Street. A number of opinions from the stakeholders had expressed concern on the location of this option. Hence, the location of this ventilation building has been revisited and it has been moved towards the west and away from residential uses as much as practicable. This currently proposed location is near by Lin Cheung Road and West Kowloon Highway at Yau Ma Tei Interchange has been identified as feasible. The nearest resident development is located at more than 300m away and this would optimize the dispersion of ventilation building emission.
Ventilation Building at Ho Man Tin	Given the length of the tunnel, a ventilation building at the approximate midway of the tunnel would be required to even out the exhaust at the 3 buildings, and hence a ventilation building is required at Ho Man Tin. The area has a number of important infrastructure / public facilities, such as service reservoirs, that cannot be relocated / abandoned for the purpose of situating the ventilation building. The proposed ventilation building is located at the junction of Fat Kwong Street and Chung Hau Street, and above the proposed bored tunnels such as to facilitate the construction of the ventilation adit together with the construction access shaft. The site is at high level where is ideal for dispersion. It is the only site available since there is no other available / suitable government land in the close vicinity.
Ventilation Building at Kai Tak Development	The proposed ventilation building and administration building is located at Kai Tak and south to the Kai Tak tunnel portal. This site and the surrounding areas are currently vacated and will be occupied subject to future redevelopment projects under Kai Tak Development. Under the current OZP, the site has been designated for the proposed CKR ventilation and administration building. It should be noted that this ventilation building is located at Kai Tak and hence is further away from the existing residential areas in Ma Tau Kok which is separated by no less than 1200m. In fact, the OZP of Kai Tak has accommodated a separation distance of ~180m from the planned residential developments in Kai Tak.