

PROVISIONAL LOCAL VESSELS ADVISORY COMMITTEE

Hong Kong Section of Hong Kong–Zhuhai–Macao Bridge and North Lantau Highway Connection

Purpose

1. The purpose of this paper is to advise members of the initial alignment and form of the Hong Kong Section of the Hong Kong–Zhuhai–Macao Bridge (HZMB) and its connection with North Lantau Highway (i.e. the North Lantau Highway Connection (NLHC)). A Marine Impact Assessment (MIA) is presently being conducted to evaluate the marine impacts associated with the construction and operation of the Hong Kong Section of HZMB and NLHC. This paper presents the initial findings of the MIA study.

Background

2. In January 2003, the National Development and Reform Commission and the Hong Kong Special Administrative Region (HKSAR) Government jointly commissioned the Institute of Comprehensive Transportation to conduct a study on the transport linkage between Hong Kong and Pearl River West. Completed in July 2003, the study concluded that there is an urgent need for a land transport link connecting Hong Kong, Zhuhai and Macao. Such a link would contribute to the development of tourism, logistics, finance and trade in HKSAR, reinforce its status as an international shipping and aviation centre, and promote the economic integration between the HKSAR and the Pearl River West and beyond. To take forward the advance planning for the HZMB, the HZMB Advance Work Co-ordination Group (AWCG) set up by the governments of the HKSAR, Guangdong Province, and the Macao Special Administrative Region commissioned the China Highway Planning and Design Institute Consultants to conduct a feasibility study for the project in February 2004. In parallel, the HKSAR Government appointed a consultant in March 2004 to undertake an investigation and preliminary design (I&PD) study for the Hong Kong Section of HZMB and NLHC.

Proposed Alignment

3. The AWCG has reached agreement on the alignment and landing points of the HZMB. The agreed alignment, known as northern bridge-cum-tunnel alignment will land in Northwest Lantau near San Shek Wan headland of the HKSAR on the east, and in Gongbei of Zhuhai and A P rofa of the Macao SAR on the west, as shown in **Figure 1**.

4. As regards the NLHC, various alignment options have been investigated in the I&PD study for connecting the HZMB to the existing road network. For the western section of NLHC, preliminary assessment reveals that option in the form of a viaduct running along the Airport Channel will have less impact than the other options and is compatible with the Hong Kong landing point of the HZMB at San Shek Wan. This alignment connects with the Hong Kong Section of HZMB at the headland between San Shek Wan and Sha Lo Wan by a viaduct spanning over the headland. The alignment continues to run along the southern side of the Airport Channel and lands at the Airport Island beyond the Government Flying Service to allow safe operation of helicopters.

5. For the eastern section of NLHC, after a series of public consultations, two alignment options (i.e. a viaduct option running seaward side of Tung Chung and a tunnel option running hillside at the back of Tung Chung) are shortlisted for further consideration (see **Figure 2**). As shown in **Figure 2**, the proposed viaduct option for NLHC as well as the Hong Kong Section of HZMB will cross the existing navigation channels at western and eastern sides of Airport Island and the Airport Channel. In order to maintain the navigation channels for marine traffic, the viaduct of NLHC will be designed to span over and across the channels with sufficient navigation width and clearance below the bridge.

Proposed Navigation Bridge Span

Western side of Airport Island

6. The bridge span for the navigation channel at the western side of Airport Island is proposed to have a twin 150m spans to provide for a clear navigable width of two 100m one-way shipping channels under the bridge. The twin spans are separated by a third 150m span in the middle (see **Figure 3** for the proposed bridge spans). The exact alignment of the Hong Kong Section of HZMB at western side of Airport Island is to be confirmed, taking into consideration the airport height restrictions (AHR) and subject to the exact alignment of the Zhujiang section of HZMB being studied. A minimum of 41m of net navigable height during high tide at 1 in 100 return year would be provided, which could cater for the local marine traffic vessels using this area.

Airport Channel

7. The bridge crossing is very constrained by the alignment skewness and the AHR. A bridge with span length of 180m is proposed for the crossing which gives a net navigable width of 46m and height of 10.55m during high tide at 1 in 100 return year (see **Figure 4** for the proposed bridge span). Various stakeholders, who are allowed to use this sea channel, including Airport Authority Hong Kong, Fire Services Department (FSD), MTR Corporation, Civil Engineering and Development Department and Fast Ferry have been consulted and the provided navigation width and height have satisfied their requirements. Islands District Council was also consulted on 2 June 2005 and 17 October 2005 and no adverse comment was raised on the proposed alignment of this section of NLHC and the channel bridge crossing.

Eastern side of Airport Island

Sea Viaduct Option

8. For the viaduct option running seaward side of Tung Chung as shown in **Figure 2**, the alignment of the eastern section of NLHC would cross the existing navigation channel at the eastern side of Airport Island. A bridge with span length of 200m is proposed due to its skewness with the navigation channel, which gives a net navigable width of 100m and height of 21.3m during high tide at 1 in 100 return year (see **Figure 5** for the proposed bridge span). The provided navigation width would be sufficient for two-way marine traffic for regular users of this navigation channel and the construction barges. Adjacent to the proposed navigation span for the existing channel, another bridge span with the same net navigable width and height is also provided for the future navigation channel (see **Figure 5**) in view of the possible blockage of the existing navigation channel by the proposed future reclamation at Tung Chung east (see **Figure 2**).

Land Tunnel Option

9. For the land tunnel option running at the back of Tung Chung as shown in **Figure 2**, the alignment would have no impact on the navigation channel at the eastern side of Airport Island. However, since it would cross the Airport Channel from Pak Sha Tsui near Scenic Hill to Wong Nai Uk before entering into the tunnel (see **Figure 6**), a viaduct with spans length of typical 60m and minimum bridge soffit level of +12.95mPD is proposed for the crossing, which gives the net navigable height of 8m and width of 60m during high tide at 1 in 100 return year. Such navigable height would be the same as the three existing bridges (two road bridges and one railway bridge) crossing the Airport Channel from Tung Chung to Airport Island, while the net navigable width would be more than that of the three existing bridges, with a typical span length of about 45m.

Assessment of Navigation Safety

10. The navigation safety with respect to the proposed spans as outlined in the above paragraphs has been examined by simulations using a Full Mission Ship Simulator in the Marine Department (MD) Training Centre. The simulator comprises 3D computer model of the proposed navigation bridge spans with a 210° angle of view and a virtual marine environment created with projection on a curved screen. The simulator has modelled the real situation very well. Experienced pilots of Rivertrade, Fast Ferry and FSD vessel have been responsible for steering the simulated vessels in the simulator to transit the proposed navigation spans. The key conclusions reached are as follows:

- **Navigation Span at Western side of Airport Island** – It is identified from the simulations that the arrangement of bridge piers, bridge spans and marine navigation aids are suitable for masters to observe on-coming traffic and are adequately aligned for the bridge passage for safe transit.

- ***Navigation Span at Airport Channel***– The constraints (i.e. channel width, bridge angle and width) associated with the site environment allow provision for only one-way access for larger vessels (i.e. barges), although two ways passage for smaller vessels is feasible and safe. Sightlines have been checked for adequacy and the bridge shape changed to allow mariners and other parties to be engaged in future airport cargo operations to manage this channel in a one-way manner.
- ***Navigation Span at Eastern side of Airport Island (for Sea Viaduct Option)*** – The span is considered wide enough for two vessels to transit simultaneously. The bridge piers are located at the present edges of dredged channel and the alignment of the existing navigable channel would not be changed with the proposed NLHC.
- ***Viaduct Span across Airport Channel (for Land Tunnel Option)*** – Navigation simulation has not been conducted for these viaduct spans. However, as compared with the existing bridges crossing the channel, the proposed viaduct spans are considered wide and high enough for existing vessels using the channel.

Marine Impact Assessment and Mitigation Measures

Radar System Impact

11. An additional radar will be installed near the navigation span at western side of Airport Island to compensate for the anticipated interference of the proposed bridge on MD’ s existing radar facilities at Black Point.

12. It is noted that the Airport Channel and the eastern side of Airport Island where the Sea Viaduct Option would be located are currently not under the coverage of MD’ s existing radar facilities. Therefore, both the Sea Viaduct and Land Tunnel Options will have no impact on the marine radar coverage.

Construction Issues

13. Construction of the HZMB will be largely a marine supported offshore operation with a large volume of off-site pre-fabrication. Impacts on the marine risk environment will arise with works barge traffic. Critical areas of marine risk and conflict with existing parties will be associated with operations near existing traffic routes. As most of the marine construction activities occur in lightly trafficked areas, the impact is anticipated to be low. However, the future contractor will require close co-ordination to maintain safe passage for non-works vessels.

14. As existing marine traffic in the area within the Airport Channel and the eastern side of Airport Island is very light, impact of the construction work on marine traffic is anticipated to be low. Again, the future contractor will be required to co-ordinate with MD and other relevant parties for maintaining safe passage of vessels during construction stage.

Ship Impact Protection

15. The area adjacent to the viaduct of the Hong Kong Section of HZMB and NLHC will be designated as a restricted area for vessels above a specific limiting airdraft which may pose hazard to the bridge deck (in a similar manner to the height restricted areas for Tsing Ma Bridge and Kap Shui Mun Bridge). Ship impact protection will be designed to limit load transfer to the bridge, and damage to the ships.

Ongoing Assessments

16. Ongoing analysis is being conducted to establish operational requirements for the traffic control system and risk assessment of the marine traffic environment. This will adopt the following techniques:

- Marine Construction Risk and Navigation Control Assessment - Develop diversion planning of marine traffic flows and the requirements for one-way or two-way navigation control.
- Dynamic traffic simulation to test the future traffic regime.

Advice Sought

17. Members are invited to express their views on the project, the scope of marine impact assessment and any potential impacts of the project on marine operations.

Presentation

18. Highways Department and the Consultant responsible for the HZMB consultancy assignment, Ove Arup & Partners Hong Kong Ltd, together with marine specialist BMT Asia Pacific to be accompanied by Tony T.F. Li of MD, will present the paper.

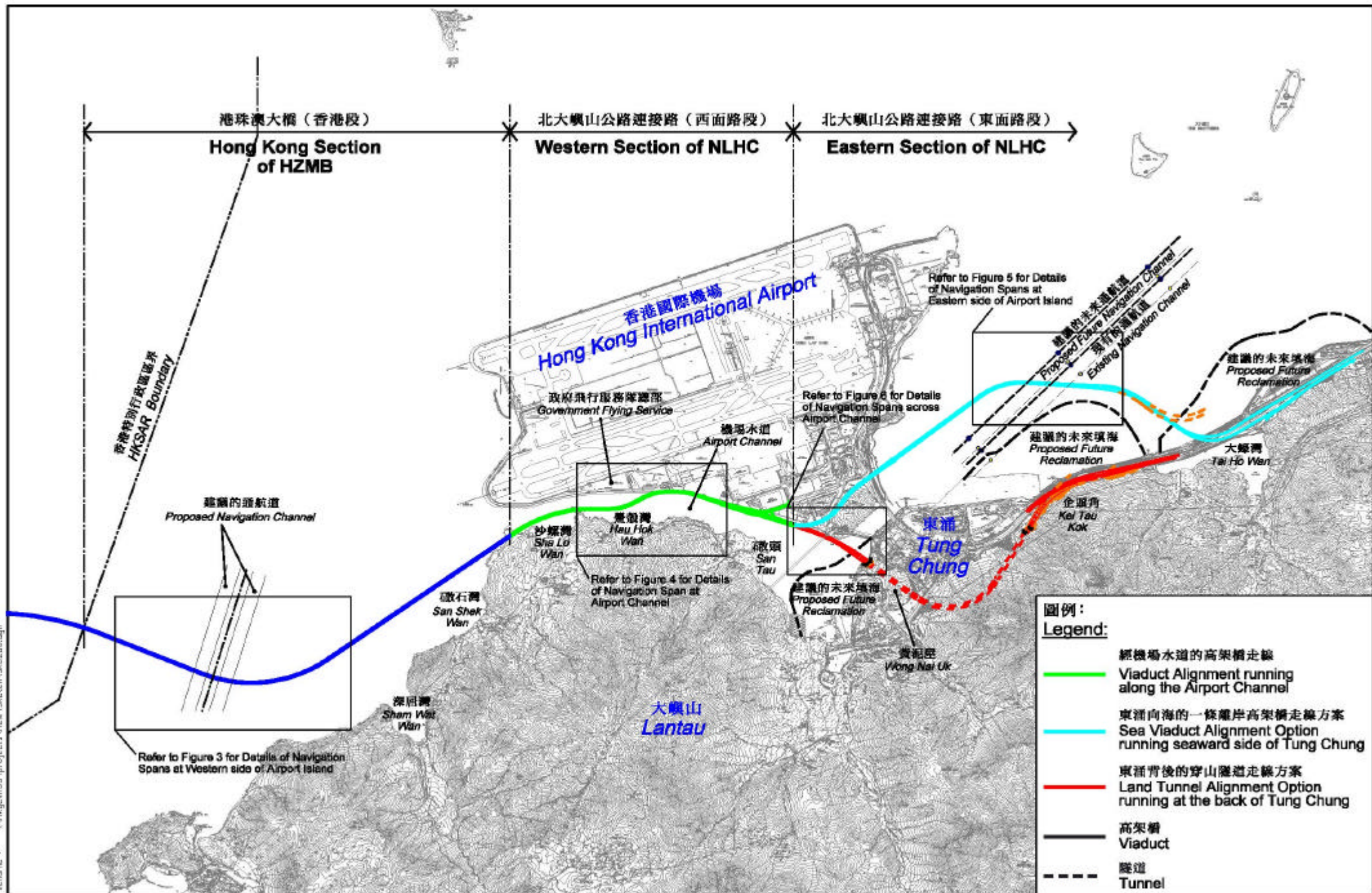
*Planning, Development & Port Security Branch
Planning & Services Division
Marine Department
February 2006*

港珠澳大橋的建議走線

Recommended Alignment for the HZMB



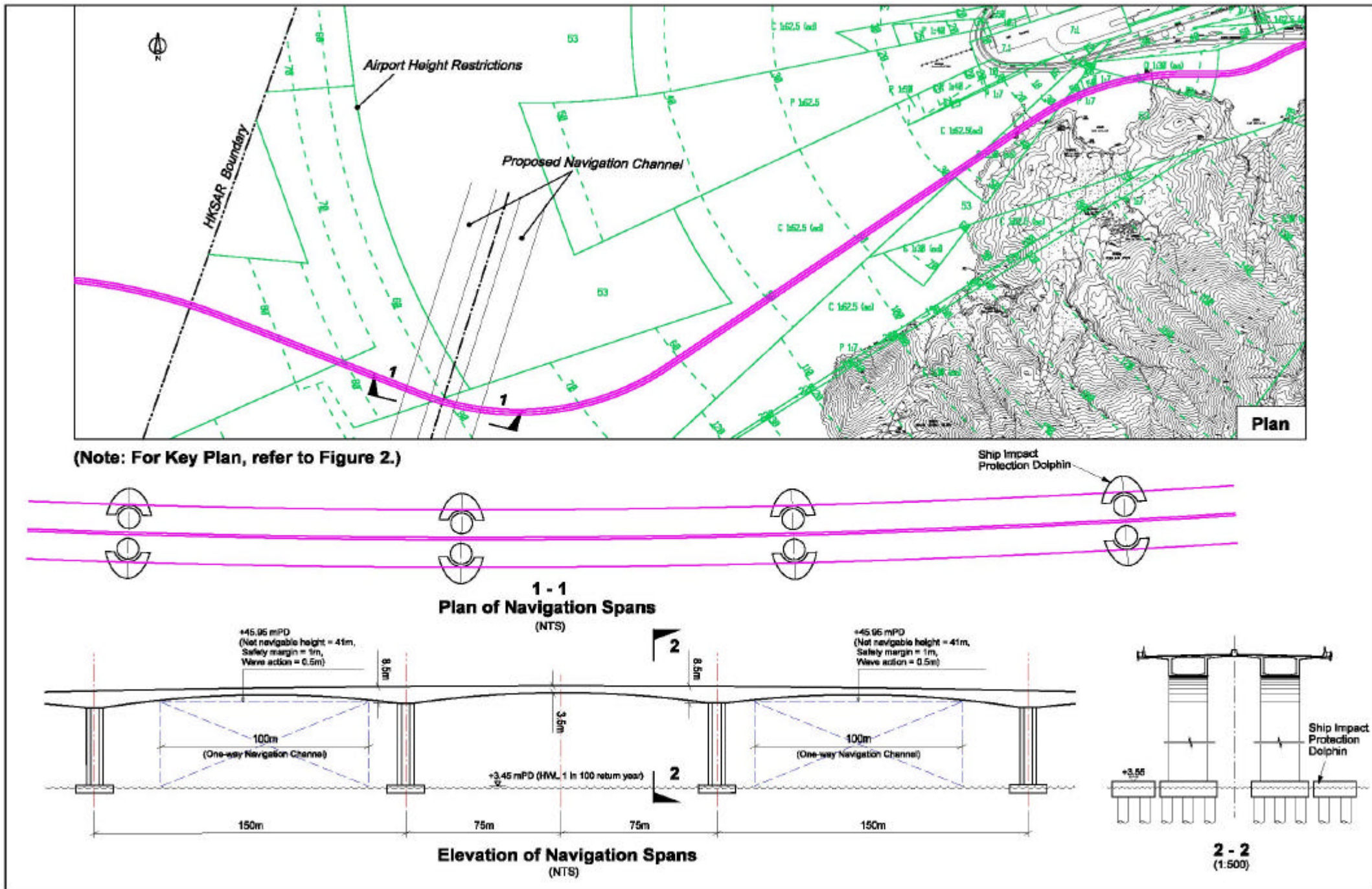
Figure 1



Proposed Alignment Options for HKS of HZMB and NLHC

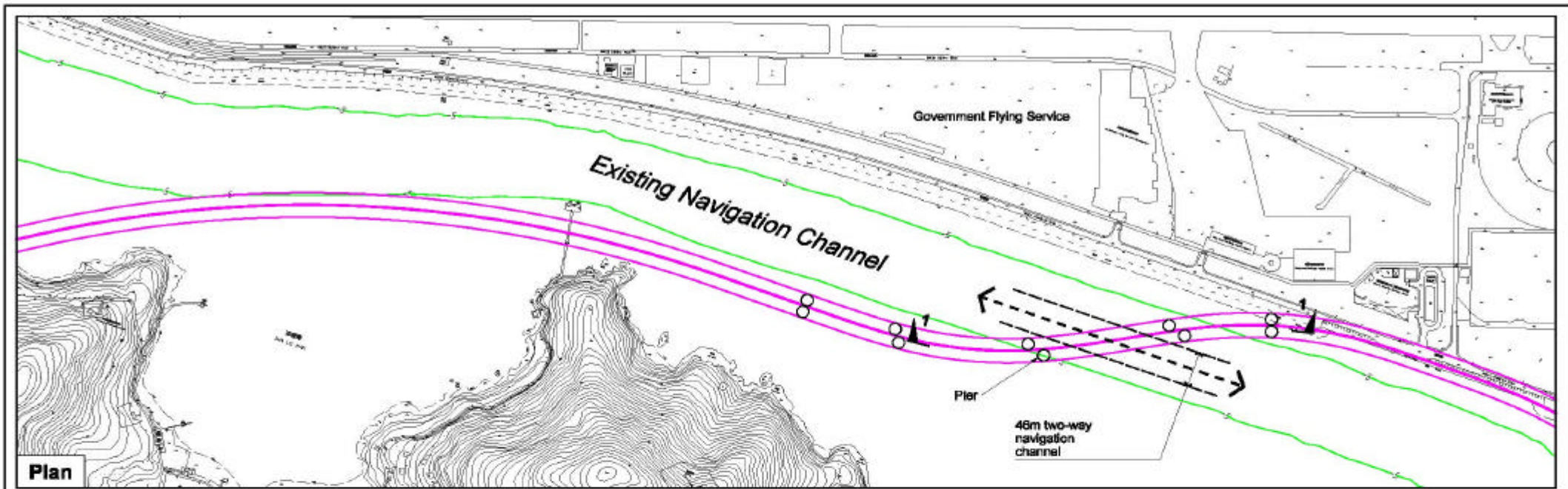
Figure 2

Printed by : samuelkwong4-f4p-2006
 Filename : \\hkge\vol33\projects\HZMB\Sketch\uk0286.dgn

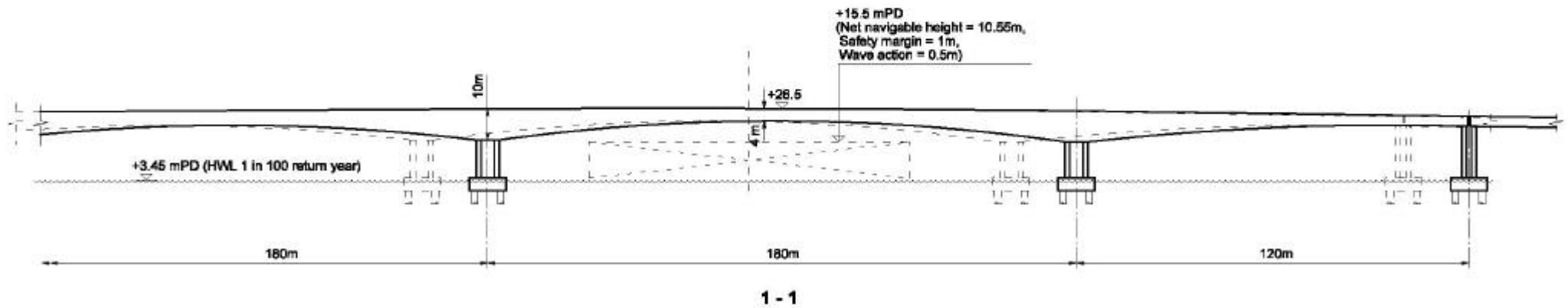


Navigation Spans at Western side of Airport Island

Figure 3

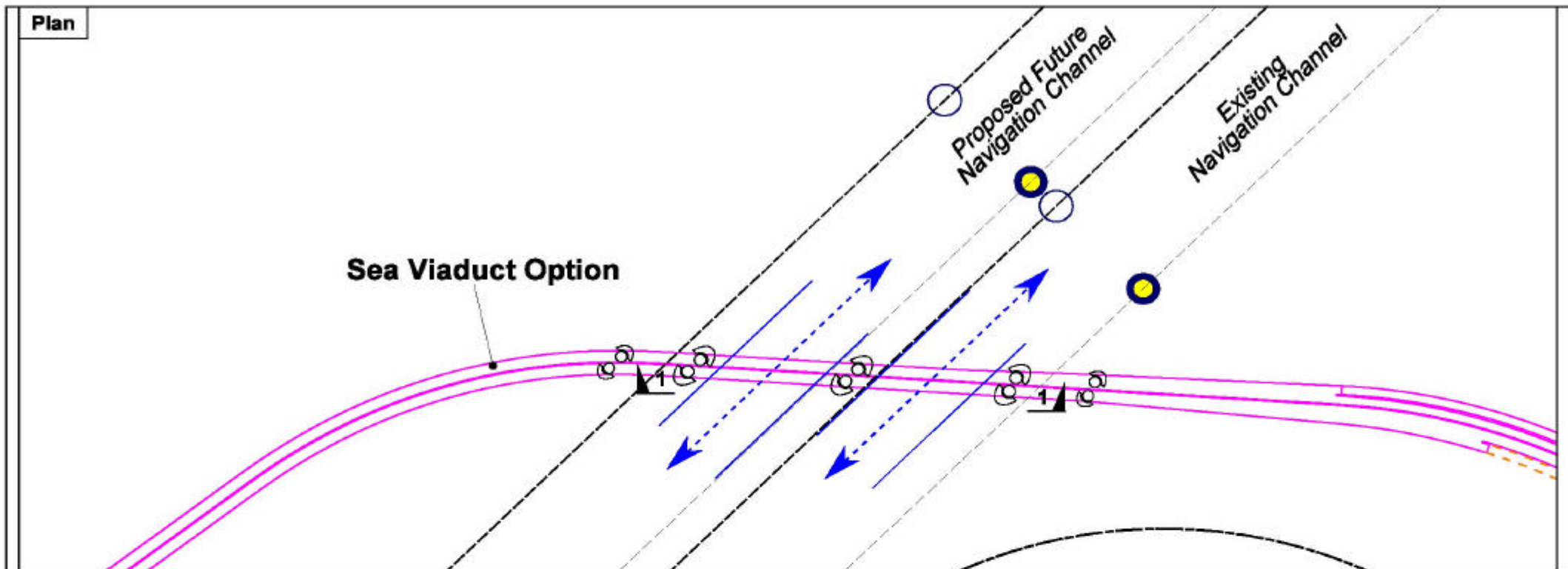


(Note: For Key Plan, refer to Figure 2.)

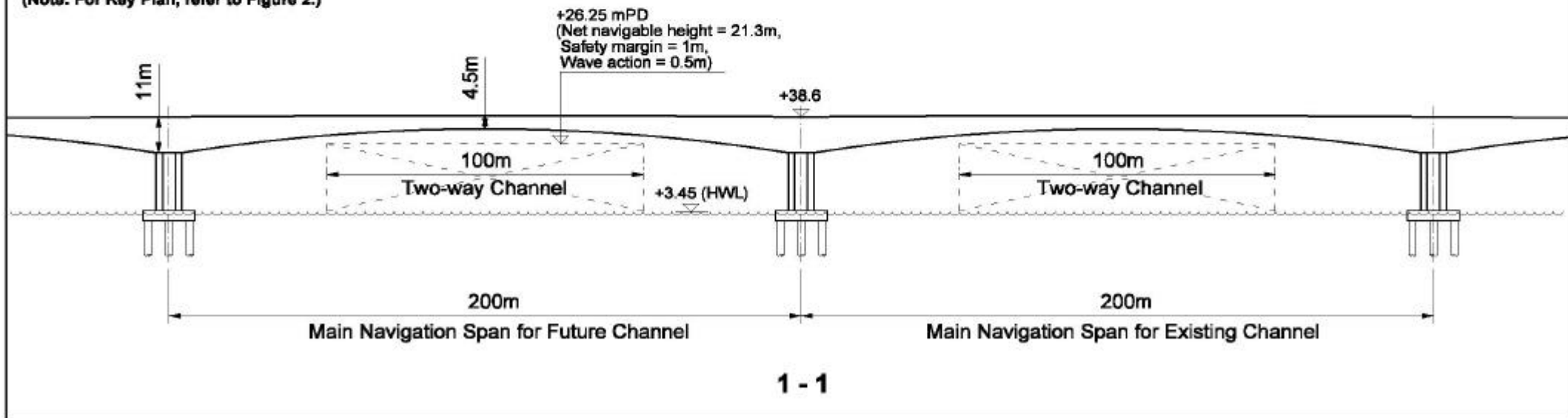


Navigation Span at Airport Channel

Figure 4

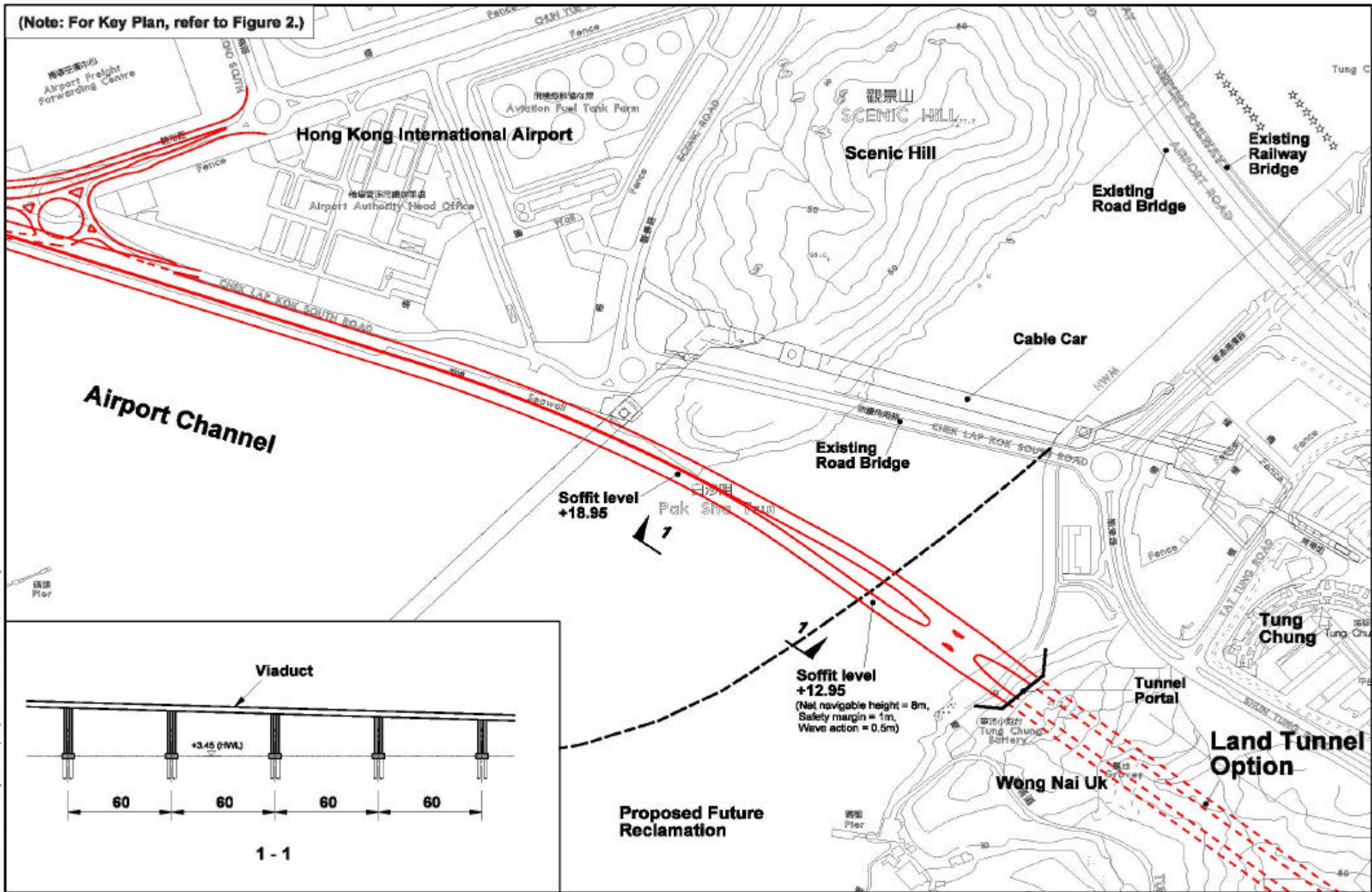


(Note: For Key Plan, refer to Figure 2.)



Navigation Spans at Eastern side of Airport Island

Figure 5



Viaduct Spans across Airport Channel

Figure 6

Created by: sunshinewater-air-land
 File name: \\hk.gov.hk\133\proj\hzm\Sketch\sk0284.dgn