CHAPTER 7

Transport and Logistics Bureau
Highways Department
Transport Department

Tuen Mun - Chek Lap Kok Link

Audit Commission
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This audit review was carried out under a set of guidelines tabled in the Provisional Legislative Council by the Chairman of the Public Accounts Committee on 11 February 1998. The guidelines were agreed between the Public Accounts Committee and the Director of Audit and accepted by the Government of the Hong Kong Special Administrative Region.

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TUEN MUN - CHEK LAP KOK LINK

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TUEN MUN - CHEK LAP KOK LINK

Executive Summary

1. The Tuen Mun - Chek Lap Kok Link (TM-CLKL) provides a strategic link connecting the North West New Territories to North Lantau, the Hong Kong International Airport and the Hong Kong-Zhuhai-Macao Bridge (HZMB). According to the Government, the commissioning of TM-CLKL provides better and more reliable transport infrastructure to Lantau, the aviation and land transport "double gateway" connecting Hong Kong to other parts of the world and Mainland cities of the Guangdong-Hong Kong-Macao Greater Bay Area, thereby reinforcing Hong Kong as an international and regional hub.

2. The Transport and Logistics Bureau is responsible for the formulation of policies on matters relating to Hong Kong's transportation and logistics, including planning for and implementing the construction and improvement of transport infrastructure. In November 2011 and June 2013, the Finance Committee of the Legislative Council approved a total funding of $46,708.0 million for the construction of TM-CLKL (the Project). The Highways Department (HyD) was the works agent responsible for implementing the Project. A consultancy agreement was awarded to a consultant (Consultant X) in November 2011 for the design and construction supervision work, and 8 works contracts (Contracts A to H) were awarded between June 2013 and June 2022 for the implementation of the Project. For the 8 works contracts awarded, the works under 7 contracts (Contracts A to F and H) were completed between June 2019 and August 2024, and Contract G was in progress as of August 2024. As of August 2024, $42,186.2 million (90% of the approved project estimate of $46,708.0 million) had been incurred for the Project.

3. TM-CLKL, which includes the Southern Connection (mainly a sea viaduct between North Lantau and the Hong Kong Port (HKP), which is a reclaimed artificial island) and the Northern Connection (mainly a sub-sea tunnel (Tuen Mun-Chek Lap Kok Tunnel (TM-CLK Tunnel)) between Tuen Mun and HKP), was fully commissioned in December 2020. The annual average daily traffic volume of TM-CLKL increased from 17,548 vehicles in 2021 to 29,967 vehicles in 2023. The Transport Department (TD) is responsible for monitoring the traffic conditions of various major tunnels and roads (including TM-CLKL). In September 2020, TD

awarded the first management, operation and maintenance (MOM) agreement for TM-CLK Tunnel through open tender to an operator (Operator A) at a fixed lump sum management fee of $298.6 million for four years from 27 December 2020 to 26 December 2024. The total management fee since commencement of the MOM agreement and up to December 2023 was about $221 million. The Audit Commission (Audit) has recently conducted a review of the implementation of the Project and traffic management of TM-CLKL.

Administration of Contracts A and B

4. Contracts A and B were lump sum design-and-build contracts, covering the design and construction of the Southern Connection of TM-CLKL and the Northern Connection sub-sea tunnel section of TM-CLKL respectively. Contracts A and B were awarded to Contractors A and B respectively and Consultant X was the Supervising Officer responsible for supervising the contract works. Contracts A and B were substantially completed 26.7 months (813 days) and 19.3 months (586 days) later than their respective original completion dates respectively. The final contract sum of Contract A was $9,272.7 million and the latest contract expenditure of Contract B as of August 2024 was $21,368.8 million (paras. 2.2 and 2.5).

5. ***Scope for improvement in managing interfacing works.*** The Northern Connection sub-sea tunnel section of TM-CLKL (i.e. TM-CLK Tunnel constructed under Contract B) and the Southern Connection of TM-CLKL (constructed under Contract A) are both connected with HKP (reclaimed under HZMB project). As such, the reclamation works of HKP under another HyD works contract (HKP Reclamation Contract) had extensive interfaces with the works of Contracts A and B. According to HyD, the progress of the reclamation works under HKP Reclamation Contract had been unsatisfactory since the commencement of works (resulting in knock-on delays in the handover of works sites to Contractors A and B), and lateral movements of seawall of HKP were observed since October 2014. As a result, Contractors A and B were unable to carry out subsequent works under Contracts A and B as planned, causing substantial works variations (valued at a total of $7,937.0 million), prolongation costs and disruption costs (of a total of $1,006.4 million), and extensions of time (EOTs) granted under Contracts A and B (of 779 and 475 days respectively). In Audit's view, there is scope for improvement in managing interfacing works by HyD (paras. 2.6 to 2.9).

6. ***Need to better ascertain site conditions for watermain diversion works.*** Under Contract A, Contractor A was required to divert a section of an existing fresh watermain due to the realignment of sections of Cheung Tung Road in North Lantau. Before the tendering of Contract A, based on the as-built records, HyD anticipated that the length of the watermain to be diverted was about 270 metres (m). After the commencement of Contract A, taking into account the actual site conditions, the actual length of the watermain to be diverted was measured to be about 422 m (or 56% longer). In July 2018, Consultant X issued a variation order (VO) to Contractor A to extend the diversion of watermain. In Audit's view, in implementing works contracts involving watermain diversion works, HyD needs to take measures to better ascertain the site conditions at the planning stage (paras. 2.12, 2.13 and 2.15).

7. ***Substantial increase in quantity of rock fill material required for reclamation works.*** Under Contract B, Contractor B was required to carry out reclamation works to form extra land of approximately 16.5 hectares at Tuen Mun for the northern landfall of TM-CLK Tunnel. The quantity of rock fill material for the reclamation works specified in Contract B was 441,400 cubic metres (m^3). After the commencement of Contract B, Contractor B carried out further pre-construction ground investigation and estimated that the required quantity of rock fill material was about 850,000 m^3 (i.e. about 90% higher than the quantity specified in Contract B). In the event, the final quantity of rock fill material was about 832,552 m^3. In November 2017, Consultant X certified a sum of $115.8 million for the claim submitted by Contractor B for additional payment attributable to the substantial increase in quantity of rock fill material required for the reclamation works. In Audit's view, in implementing works projects involving reclamation works, HyD needs to take measures to estimate the quantity of fill material required for the reclamation works as accurately as practicable (paras. 2.25 and 2.26).

8. ***Change of type of passive fire protection system inside TM-CLK Tunnel after contract commencement.*** Under Contract B, Contractor B was required to supply and install non-combustible thermal barrier inside TM-CLK Tunnel as the passive fire protection system, and the thermal barrier was specified to be spray type. After the commencement of Contract B, the maintenance party for the civil works of TM-CLK Tunnel had been expressing concerns about the spray type thermal barrier. Considering the concerns of using spray type thermal barrier and the long-term operation and maintenance benefits of using board type thermal barrier, 2 VOs (valued at a total of $328.7 million) were issued under Contract B in connection with the change of thermal barrier from spray type to board type. In this connection, Audit noted that HyD had promulgated guidelines in 2018 which stipulated that thermal

barrier inside tunnels should be board type. In Audit's view, in implementing tunnel works projects, HyD needs to regularly remind its staff and consultants to follow the related guidelines in specifying the passive fire protection system inside tunnels (paras. 2.27 to 2.29 and 2.31).

9. ***Need to continue to enhance the design of road drainage system in response to climate change.*** Under Contract B, Contractor B was required to design and construct the south approach ramp leading to the south portal of TM-CLK Tunnel, including the road drainage system for collecting surface runoff. On 28 June and 29 July 2021, significant flooding incidents occurred at the south portal of TM-CLK Tunnel, which caused disruption to tunnel traffic. In order to eliminate any risk of undesirable performance of the gully grating under extreme weather and ensure safe operation of TM-CLK Tunnel, Consultant X issued a VO (valued at $6.4 million) in January 2022 to instruct Contractor B to enhance the performance of the as-constructed gullies by constructing additional U-channels for the gullies. In Audit's view, in implementing tunnel works projects, HyD needs to continue to enhance the design of road drainage system in response to climate change (paras. 2.32 to 2.35).

10. ***Need to draw lessons from construction of emergency access hatches in TM-CLK Tunnel.*** In March 2014, Contractor B proposed to construct a service gallery underneath the tunnel carriageway and provide 45 emergency access hatches as supplementary evacuation/rescue routes. Both the service gallery and emergency access hatches were new designs adopted for the first time for tunnels in Hong Kong. After the commissioning of TM-CLK Tunnel in December 2020, an access hatch cover accidentally opened in the same month (which created safety hazards to road users), and defect rectification works were carried out by Contractor B. However, there were repeated malfunctioning of the emergency access hatches (i.e. accidental opening of an access hatch cover in July 2022 and repeated damages or dislocations of small parts of access hatch covers). Although Contractor B had carried out further defect rectification works to the emergency access hatches, accidental opening of an access hatch cover happened again in August 2023. In October 2023, having considered the balance among the availability of other supplementary evacuation routes, the possible risks to road safety, and the operation and maintenance efforts needed to upkeep the emergency access hatches, it was decided to seal off all emergency access hatches. In Audit's view, in implementing tunnel works projects, HyD needs to draw lessons from the experience gained in constructing emergency access hatches in carriageway along TM-CLK Tunnel (paras. 2.36 and 2.38 to 2.41).

Other contract management issues

11. ***Scope for improvement in ascertaining underground conditions for constructing slope and retaining wall.*** Under Contract C, Contractor C was required to carry out site formation works for the toll plaza, including construction works for a cut slope of about 285 m in length and a reinforced concrete retaining wall of about 180 m in length. After the commencement of Contract C, unforeseeable adverse ground conditions were encountered for a particular section of the slope and a layer of soft materials was unexpectedly found underneath the base of the retaining wall. In the event, Consultant X issued: (a) a VO (valued at $176.9 million) instructing Contractor C to carry out: (i) additional ground investigation; (ii) construction of the slope based on revised design by making reference to the additional ground information obtained; and (iii) delay recovery measures to minimise the potential delay and prolongation cost due to the change of design for the slope; and (b) another VO (valued at $21.1 million) instructing Contractor C to replace the existing fill below the base of the retaining wall with concrete, resulting in an EOT of 273 days and additional payment for prolongation cost of $31.5 million granted to Contractor C. In Audit's view, there is scope for improvement in ascertaining underground conditions for constructing slope and retaining wall by HyD (paras. 3.4 and 3.5).

12. ***Dislocation of manhole and drain covers.*** Under Contract C, Contractor C was required to modify and construct sewerage manholes at Lung Mun Road and construct cut-off drains near the portals of the vehicular underpass near Lung Fu Road Roundabout. Dislocation of covers of these sewerage manholes and cut-off drains occurred between May 2021 and February 2023. According to HyD: (a) after investigations, it was noted that the dislocation of covers was due to frequent traffic with high wheel loads; (b) as Contract C was already substantially completed in September 2019, Consultant X issued 3 VOs (valued at a total of $3 million) under Contract H (which covered road improvement works) instructing Contractor H to carry out modification works (e.g. change of design and upgrading works of covers which could resist higher wheel loads); and (c) subsequent to the completion of the modification works, dislocation of covers at the locations concerned did not occur. In Audit's view, HyD needs to draw lessons from the dislocation of manhole and drain covers constructed under Contract C with a view to improving the design of such works in future works projects (paras. 3.6 to 3.9).

13. ***Need to critically vet tender documents.*** Audit noted that: (a) according to Contract D, Contractor D was required to construct a vehicular access for future tunnel area operation vehicles. The vehicular access would also serve as an emergency vehicular access in future. However, the concrete paving, drainage and associated emergency vehicular access signage for the vehicular access had not been specified in the contract drawing nor included in the contract scope. In the event, a VO (valued at $5.5 million) was issued to instruct Contractor D to carry out the related works; and (b) there were discrepancies among contract documents (e.g. among contract drawings, or between Particular Specification and contract drawings) under Contract D. In the event, 10 instructions were issued by Consultant X under Contract D to clarify the details of works, resulting in a total additional cost of $92.6 million. In Audit's view, there was scope for improvement in vetting tender documents of Contract D (para. 3.13).

14. ***Scope for enhancing construction site safety.*** According to HyD, from the contract commencement dates of the respective contracts to August 2024, 2 fatal accidents happened at the construction sites of Contracts A and B, and 173 non-fatal reportable accidents happened at the construction sites of Contracts A to F and H. Audit noted that, according to HyD, Consultant X did not compile management information on whether the contractors had timely reported the reportable accidents and submitted the related reports to Consultant X in accordance with the Construction Site Safety Manual issued by the Development Bureau. In September 2024, HyD informed Audit that according to Consultant X, there were 2 and 7 cases of late submission of the preliminary accident report by Contractors A and B respectively, with delays ranging from 8 to 98 days (paras. 3.22 to 3.24).

15. ***Need to ensure that contractors submit reports relating to site safety monitoring procedure in accordance with contract requirements.*** Audit noted that, during the contract period for Contract B (83 months), the conditions for triggering the site safety monitoring procedure were met in 16 months and reports should be submitted by Contractor B outlining the problem areas in relation to site safety, actions taken/to be taken to improve the safety performance and the way the site safety improvement measures to be monitored. However, for 3 out of the 16 months, Contractor B did not submit the required reports (para. 3.27).

Operation and traffic management

16. ***Staff manning level requirements not met.*** Audit noted that, since the commissioning of TM-CLK Tunnel in December 2020 and up to June 2024 (i.e. 43 months): (a) the number of actual working hours of the designated ranks of Operator A's staff was less than that specified in the MOM agreement in all the 43 months (an average shortfall of 4%), resulting in the payment of liquidated damages totalling $6.2 million by Operator A to TD; and (b) the actual number of the designated ranks of Operator A's staff employed was less than that specified in the MOM agreement in all the 43 months. The monthly shortfall ranged from 8 to 30 staff (averaged 15 staff), representing 6% to 21% (averaged 11%) shortfall of the manning level of 140 staff (para. 4.5).

17. ***Scope for improvement in assessing the performance of the operator of TM-CLK Tunnel.*** TD prepares an overall quarterly performance assessment report on Operator A. According to TD, there are 20 items for assessing the performance of Operator A. An overall performance rating for the quarter will be formed based on the ratings of these 20 assessment items. There was a total of 15 quarters since the commissioning of TM-CLK Tunnel in December 2020 and up to July 2024 (paras. 4.9 and 4.10). Audit examination revealed that:

(a) ***No timeframe set for completion of overall quarterly performance assessment report on Operator A.*** TD did not set timeframe for the completion of the overall quarterly performance assessment report. As of September 2024, TD had not completed 1 overall quarterly performance assessment report covering the period from May to July 2024 (para. 4.10(a));

(b) ***Need to review assessment basis.*** For an assessment item on "arrival time for vehicle recovery within tunnel area", instead of arrival time, clearance time was adopted by TD as the assessment basis (para. 4.10(b)(ii)); and

(c) ***Need to document justification for performance rating.*** Of the 14 overall quarterly performance assessment reports completed by TD, performance ratings of "good" or "satisfactory" were given to the assessment item on "corporate governance" in 13 reports. However, TD did not document the justification for these ratings (para. 4.10(c)).

18. ***Scope for improvement in vehicle recovery operations.*** In accordance with the MOM agreement, TD provided 2 heavy recovery vehicles (HRVs) to Operator A solely and exclusively for discharging the obligations and duties under the MOM agreement. Audit noted that: (a) according to Operator A, it encountered problems in using HRV for two vehicle recovery operations in May and June 2021 respectively, and it had reported the problems encountered to TD and the Electrical and Mechanical Services Department (EMSD); and (b) from June 2021 and up to May 2024, 5 more vehicle recovery operations encountered similar problems, and as of May 2024 (i.e. about 3 years after the first vehicle recovery operation encountering problems in May 2021), the issue relating to the 2 HRVs had yet to be resolved or rectified. According to TD, it had ongoing discussions with EMSD since the issue was reported by Operator A. In September 2024, TD, EMSD and the manufacturer of the HRVs had ascertained the underlying reasons for the issue relating to the HRVs and were exploring feasible improvement measures. In Audit's view, TD needs to, in collaboration with EMSD, expedite follow-up actions to resolve the problems in using the HRVs with a view to ensuring timely and safe vehicle recovery operations in TM-CLK Tunnel (paras. 4.14 to 4.16).

19. ***Need to keep under review the traffic at TM-CLKL and relevant road sections in Tuen Mun.*** Audit noted that: (a) from 2021 to 2024, the Tuen Mun District Council Members had expressed concerns about the persistent traffic congestion in Tuen Mun (e.g. on Wong Chu Road) since the commissioning of the Northern Connection of TM-CLKL in December 2020; (b) a traffic survey conducted by Consultant X under the Project in 2021 showed that the traffic flows at the relevant major road sections in Tuen Mun (including Wong Chu Road) had increased; and (c) the volume-to-capacity ratios of Wong Chu Road (i.e. one of the relevant major road sections in Tuen Mun) had exceeded 1.0 (i.e. indicating the onset of traffic congestion) since 2022 and increased to 1.17 in 2023. In Audit's view, TD needs to keep under review the traffic at TM-CLKL and relevant road sections in Tuen Mun, and take traffic management measures where appropriate (paras. 4.26 and 4.27).

Audit recommendations

20. **Audit recommendations are made in the respective sections of this Audit Report. Only the key ones are highlighted in this Executive Summary. Audit has *recommended* that the Director of Highways should:**

Administration of Contracts A and B

(a) **in implementing works projects involving interfacing works contracts, take measures to improve the management of interfacing works with a view to mitigating the risks arising from interfacing issues, including:**

(i) **ensuring timely handover of works sites among interfacing works contracts (para. 2.10(a));**

(ii) **better coordinating with all related parties on interfacing works (para. 2.10(b)); and**

(iii) **enhancing project management planning (para. 2.10(c));**

(b) **in implementing works contracts involving watermain diversion works, take measures to better ascertain the site conditions at the planning stage (para. 2.23(a));**

(c) **in implementing works projects involving reclamation works, take measures to estimate the quantity of fill material required for the reclamation works as accurately as practicable (para. 2.42(a));**

(d) **in implementing tunnel works projects:**

(i) **regularly remind HyD staff and consultants to follow the related guidelines in specifying the passive fire protection system inside tunnels (para. 2.42(b)(i));**

(ii) **continue to enhance the design of road drainage system in response to climate change (para. 2.42(b)(iii)); and**

(iii) **draw lessons from the experience gained in constructing emergency access hatches in carriageway along TM-CLK Tunnel (para. 2.42(b)(iv));**

Other contract management issues

(e) **in implementing works projects involving construction of slope and retaining wall, remind HyD staff and consultants to conduct thorough pre-tender site investigation as far as practicable in accordance with the related guidelines (para. 3.18(a)(i));**

(f) **draw lessons from the dislocation of manhole and drain covers constructed under Contract C with a view to improving the design of such works in future works projects (para. 3.18(b));**

(g) **in preparing documents for works contracts, take additional measures to critically vet tender documents to ensure their completeness, accuracy and consistency with one another before tenders are invited (para. 3.18(d)(i));**

(h) **make continued efforts to enhance site safety with a view to safeguarding safety of all operations and all persons on sites (para. 3.29(a));**

(i) **take additional measures to ensure that HyD contractors timely report accidents at construction sites in accordance with related requirements (para. 3.29(b)); and**

(j) **enhance the monitoring to ensure that HyD contractors submit the reports relating to site safety monitoring procedure in accordance with the contract requirements (para. 3.29(c)).**

21. **Audit has *recommended* that the Commissioner for Transport should:**

Operation and traffic management

(a) **require the operator of TM-CLK Tunnel to take further measures with a view to complying with the staff manning level requirements stipulated in the MOM agreement (para. 4.19(c));**

(b) **take measures to improve the assessment of performance of the operator of TM-CLK Tunnel (para. 4.19(d));**

(c) **in collaboration with the Director of Electrical and Mechanical Services, expedite follow-up actions to resolve the problems in using the HRVs (para. 4.19(e)); and**

(d) **keep under review the traffic at TM-CLKL and relevant road sections in Tuen Mun, and take traffic management measures where appropriate (para. 4.28).**

Response from the Government

22. The Director of Highways, the Commissioner for Transport and the Director of Electrical and Mechanical Services agree with the audit recommendations.

PART 1: INTRODUCTION

1.1 This PART describes the background to the audit and outlines the audit objectives and scope.

Background

1.2 The Tuen Mun - Chek Lap Kok Link (TM-CLKL) provides a strategic link connecting the North West New Territories (NWNT) to North Lantau, the Hong Kong International Airport (HKIA) and the Hong Kong-Zhuhai-Macao Bridge (HZMB — see Figure 1 in para. 1.4). According to the Government, the commissioning of TM-CLKL provides better and more reliable transport infrastructure to Lantau, the aviation and land transport "double gateway" connecting Hong Kong to other parts of the world and Mainland cities of the Guangdong-Hong Kong-Macao Greater Bay Area, thereby reinforcing Hong Kong as an international and regional hub.

1.3 ***Strategic importance for constructing TM-CLKL.*** The Transport and Logistics Bureau (TLB — Note 1) is responsible for the formulation of policies on matters relating to Hong Kong's transportation and logistics, including planning for and implementing the construction and improvement of transport infrastructure. According to TLB, to dovetail with the commissioning of HZMB (a national-level cross-boundary infrastructure which was commissioned in 2018), it was necessary to construct TM-CLKL in time to connect North Lantau with NWNT so as to help enhance the transportation network between Hong Kong, Zhuhai, Macao and Shenzhen, and uplift the overall efficiency of transport network in Hong Kong. The commissioning of TM-CLKL would bring about the following functions:

(a) ***Synergy of HZMB.*** TM-CLKL would be a strategic link connecting HZMB with NWNT and North Lantau. It would help enhance the cross-boundary transportation and improve the regional transport network of Hong Kong, Zhuhai, Macao and Shenzhen, which is important to the

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Note 1: *In July 2022, TLB was formed to take over the policy responsibility for transport matters from the then Transport and Housing Bureau, which is also referred to as TLB in this Audit Report for simplicity.*

economic integration of the Guangdong-Hong Kong-Macao Greater Bay Area;

(b) ***Improvement of journey time and road capacity between NWNT and Lantau.*** TM-CLKL would reduce the travelling distance and time between NWNT and Lantau by about 22 kilometres (km) and 20 minutes respectively, and also release certain capacity of some existing roads (e.g. Tuen Mun Road and Lantau Link (LL)) to further improve their traffic conditions;

(c) ***Provision of an alternative route to HKIA.*** Prior to the commissioning of TM-CLKL, LL and North Lantau Highway (NLH) were the sole road corridor connecting HKIA and North Lantau with the urban areas. The construction of TM-CLKL would provide an alternative route for the existing road corridor to HKIA; and

(d) ***Meeting the transportation demand between Lantau and NWNT.*** TM-CLKL would help meet the rising transportation demand between Lantau and NWNT, and reduce the volume-to-capacity (v/c) ratios (Note 2) of LL and NLH (Siu Ho Wan Section) during peak hours.

Construction of TM-CLKL

1.4 In November 2011, TLB proposed a project for the construction of TM-CLKL (hereinafter referred to as the Project) to the Legislative Council (LegCo). The Highways Department (HyD) was the works agent responsible for implementing the Project. The scope of works under the Project (see Figure 1 for the layout plan for TM-CLKL) included, among others, the following:

Note 2: *According to the Transport Department, a v/c ratio is an indicator of the traffic condition of a road: (a) a v/c ratio equal to or less than 1.0 means that a road has sufficient capacity to cope with the anticipated volume of vehicular traffic and a v/c ratio above 1.0 indicates the onset of traffic congestion; (b) a v/c ratio between 1.0 and 1.2 indicates a manageable degree of congestion; and (c) a v/c ratio above 1.2 indicates more serious congestion with traffic speeds deteriorating progressively when there is further increase in traffic.*

Advance works

(a) construction of a permanent seawall of approximately 2 km long;

(b) reclamation to form extra land of approximately 20 hectares (ha) at the proposed reclamation of HZMB Hong Kong Boundary Crossing Facilities (later renamed as the Hong Kong Port (HKP)) for the southern landfall of TM-CLKL sub-sea tunnel (see (d) below) (Note 3);

(c) detailed design and site investigation of TM-CLKL;

Northern Connection (approximately 5.5 km long)

(d) construction of a dual 2-lane sub-sea tunnel (hereinafter referred to as the Tuen Mun-Chek Lap Kok Tunnel (TM-CLK Tunnel)) of approximately 5 km long between Tuen Mun in NWNT and HKP;

(e) reclamation to form extra land of approximately 16.5 ha at Tuen Mun for the northern landfall of TM-CLK Tunnel;

(f) construction of a toll plaza of approximately 5.4 ha and an associated footbridge;

(g) construction of associated approach roads including approximately 0.5 km of land viaducts and 230 metres (m) of vehicular underpass for linking TM-CLKL with the road network of Tuen Mun;

Southern Connection (approximately 3.5 km long)

(h) construction of a dual 2-lane sea viaduct of approximately 1.6 km long between HKP and North Lantau;

Note 3: *The reclamation works were taken forward at the same location under the same works contract together with HKP reclamation. Such reclamation works were entrusted to HZMB project, and are not covered in this audit review.*

(i) construction of associated approach roads including approximately 1.9 km of land viaducts linking the sea viaduct with NLH and the road network of HKP; and

Other associated works

(j) ancillary works including site formation, slope, drainage, sewerage, landscaping, electrical and mechanical (E&M) works, and traffic control and surveillance system (TCSS).

Figure 1

Layout plan for TM-CLKL

Legend:
- Northern Connection of TM-CLKL
- Southern Connection of TM-CLKL
- HZMB Hong Kong Link Road

Source: *HyD records*

1.5 The Project was implemented under two project votes (hereinafter referred to as Project Votes I and II). A total funding of $46,708.0 million was approved by the Finance Committee of LegCo in November 2011 and June 2013 for the Project (see Table 1).

Table 1

Funding approvals for the Project
(November 2011 and June 2013)

Date	Particulars	Approved amount ($ million)
Project Vote I		
November 2011	Detailed design, site investigation and advance works	1,909.6
Project Vote II		
June 2013	Construction works	44,798.4
	Total	46,708.0

Source: HyD records

1.6 In November 2011, HyD awarded a consultancy agreement to a consultant (Consultant X) for the design and construction supervision work of the Project, which involved 8 works contracts (Contracts A to H — see para. 1.7). As of August 2024, the consultancy fee paid to Consultant X was $253.6 million.

1.7 Between June 2013 and June 2022, HyD awarded 8 works contracts (Contracts A to H) for the implementation of the Project, and Consultant X is the Engineer or Supervising Officer responsible for supervising the contract works. HyD, being the managing department of Contracts A to H, is responsible for overseeing the implementation of the contract works (e.g. vetting and approving major variations, and offering views on the assessment of contractual claims) and the performance of Consultant X. The works under 7 contracts (Contracts A to F and H) were completed between June 2019 and August 2024, and Contract G was in progress as of August 2024. For the 7 completed contracts, except Contract E which was completed on time, the other 6 contracts (Contracts A to D, F and H) were completed 3.4 to 26.7 months later than their respective original completion dates (see Table 2). In

the event, the Southern Connection and Northern Connection of TM-CLKL were opened to the public in October 2018 (Note 4) and December 2020 respectively.

Table 2

Contracts awarded for the Project
(August 2024)

Contract	Works	Commencement date	Original completion date	Actual completion date	No. of months later than original completion date
A (Awarded in June 2013)	Southern Connection viaduct section	22.6.2013	2.4.2017	24.6.2019 (Note 1)	26.7
B (Awarded in July 2013)	Northern Connection sub-sea tunnel section	5.8.2013	25.10.2018	2.6.2020	19.3
C (Awarded in July 2014)	Northern Connection toll plaza and associated works	21.7.2014	3.12.2018	23.9.2019	9.7
D (Awarded in April 2018)	Northern Connection tunnel buildings and E&M works	7.5.2018	28.8.2020	9.12.2020	3.4
E (Awarded in May 2018)	Northern Connection TCSS (Note 2)	28.5.2018	26.1.2021	26.1.2021	–
F (Awarded in September 2020)	Establishment of landscape softworks	24.9.2020	4.10.2022	25.3.2024	17.7
G (Awarded in December 2021)	Provision of remaining compensation tree planting	13.12.2021	10.2.2025	In progress	
H (Awarded in June 2022)	Road improvement and other works	16.6.2022	5.4.2024	10.8.2024	4.2

Source: HyD records

Note 4: *According to HyD, the section of Southern Connection connecting NLH (Urban bound) was opened in October 2018 to tally with the commissioning of HZMB in the same month, and the other section of Southern Connection connecting NLH (Tung Chung bound) was opened in November 2018.*

Table 2 (Cont'd)

Note 1: According to HyD, the Southern Connection of TM-CLKL was opened to the public earlier than the completion date of Contract A (in June 2019) as the related road works under Contract A had been completed in November 2018.

Note 2: The construction of TCSS for the Southern Connection of TM-CLKL was entrusted to HZMB project, and is not covered in this audit review.

Project costs

1.8 For the 8 works contracts awarded, as of August 2024:

(a) the accounts of 5 contracts (i.e. Contracts A and C to F) were finalised between December 2021 and May 2024;

(b) the accounts of 2 contracts (i.e. Contracts B and H) had not been finalised; and

(c) 1 contract (i.e. Contract G) was still in progress.

Table 3 shows the contract expenditures of Contracts A to H.

Table 3

Contract expenditures of Contracts A to H
(August 2024)

Contract	Original contract sum (a) ($ million)	Final contract sum/latest contract expenditure (Note 1) (b) ($ million)	Increase/ (decrease) (c) = (b) - (a) ($ million)	Increase/ (decrease) in provision for price fluctuation adjustment (Note 2) (d) ($ million)	Increase/ (decrease) after price fluctuation adjustment (e) = (c) - (d) ($ million)	Inflation costs absorbed in variations which were not subject to price fluctuation adjustment (estimated by HyD — see para. 1.9(c)) (f) ($ million)	Increase/ (decrease) after netting inflation costs absorbed in variations (estimated by HyD — see para. 1.9(d)) (g) = (e) - (f) ($ million)
A	8,656.7	9,272.7	616.0 (7.1%)	(681.4) (-7.9%)	1,297.4 (15.0%)	3.8 (0.1%)	1,293.6 (14.9%)
B	18,153.9	21,368.8	3,214.9 (17.7%)	(3,819.9) (-21.0%)	7,034.8 (38.7%)	1,398.9 (7.7%)	5,635.9 (31.0%)
C	3,046.0	3,089.6	43.6 (1.4%)	(245.5) (-8.1%)	289.1 (9.5%)	10.9 (0.4%)	278.2 (9.1%)
D	2,590.0	2,649.2	59.2 (2.3%)	(113.3) (-4.3%)	172.5 (6.6%)	3.2 (0.1%)	169.3 (6.5%)
E	158.0	157.9 (Note 3)	(0.1) (-0.1%)	— (—)	(0.1) (-0.1%)	— (—)	(0.1) (-0.1%)
F	6.3	7.8	1.5 (23.8%)	0.5 (7.9%)	1.0 (15.9%)	0.2 (3.2%)	0.8 (12.7%)
G	29.4	27.4 (Note 3)	(2.0) (-6.8%)	(2.0) (-6.8%)	— (—)	0.4 (1.4%)	(0.4) (-1.4%)
H	51.0	57.4 (Note 3)	6.4 (12.5%)	(3.7) (-7.3%)	10.1 (19.8%)	0.1 (0.2%)	10.0 (19.6%)
Total	32,691.3	36,630.8 (Note 3)	3,939.5 (12.0%)	(4,865.3) (-14.9%)	8,804.8 (26.9%)	1,417.5 (4.3%)	7,387.3 (22.6%)

Source: *HyD records*

Note 1: *The figures for 5 contracts (Contracts A and C to F) were final contract sums, while those for the remaining 3 contracts (Contracts B, G and H) were the latest contract expenditures as of August 2024.*

Note 2: *The original contract sums of Contracts A to D and F to H included provisions for price fluctuation adjustments. According to HyD, a provision for price fluctuation adjustments was not included for Contract E.*

Note 3: *Of the $36,630.8 million: (a) $36,628.5 million was related to the Project; and (b) $1.4 million under Contract E, $0.5 million under Contract G and $0.4 million under Contract H were related to works or site office accommodation funded by other project votes (which were not related to the Project).*

1.9 According to HyD, regarding Table 3 in paragraph 1.8:

(a) the increase in total contract expenditures was mainly attributed to variations instructed after contract commencement, in particular those under Contract B for changing the design and construction method of the tunnels, approach ramps and other ancillary works to suit the actual site conditions and interfacing arrangement (see para. 2.8(a)(ii));

(b) the majority of varied works under Contract B were paid based on price levels at the time of executing the works, for which the costs had already absorbed the inflation in construction price since works commencement and were not subject to further price fluctuation adjustment. Hence, a portion of the provision for price fluctuation adjustment included in the original contract sum of Contract B was not spent, resulting in a decrease in provision for price fluctuation adjustment as shown in column (d) of Table 3 and a corresponding increase in the amount as shown in column (e) of Table 3;

(c) taking into account the price fluctuation factors calculated at the material time based on the provisions of Contract B and applicable to the varied works, HyD estimated that approximately $1,398.9 million (see column (f) of Table 3) out of the $7,034.8 million increase in the expenditure of Contract B (see column (e) of Table 3) was attributed to absorption of inflation costs in variations mentioned above. The increase in expenditure of Contract B (net of the inflation costs absorbed in variations) was estimated to be about $5,635.9 million (i.e. $7,034.8 million − $1,398.9 million) or about 31% of the original contract sum of $18,153.9 million; and

(d) the increase in total expenditures of Contracts A to H (net of the inflation costs absorbed in variations) was estimated to be about $7,387.3 million (i.e. $8,804.8 million (see column (e) of Table 3) − $1,417.5 million (see column (f) of Table 3)) or about 22.6% of the total original contract sum of $32,691.3 million. Such an increase has not resulted in an exceedance of the approved project estimate totalling $46,708.0 million for the Project.

1.10 As of August 2024, $42,186.2 million (90% of the approved project estimate totalling $46,708.0 million for the Project) had been incurred. Of this $42,186.2 million:

(a) $36,628.5 million (87%) was related to expenditures for the Project under Contracts A to H (see Note 3 to Table 3 in para. 1.8); and

(b) the remaining $5,557.7 million (13%) comprised:

(i) resident site staff costs (Note 5) of $2,760.8 million;

(ii) expenditures for the construction works entrusted to HZMB project of $2,056.1 million (Note 6);

(iii) consultancy fee of $253.6 million (see para. 1.6); and

(iv) other costs of $487.2 million (Note 7).

Traffic management of TM-CLKL

1.11 The Transport Department (TD) is responsible for monitoring the traffic conditions of various major tunnels and roads (including TM-CLKL). Its work involves designing and implementing traffic management measures, and other proposals to ensure the efficient use of limited road space and to enhance road safety.

Note 5: *Consultants are required to employ resident site staff of different grades (e.g. professional grade and technical grade) for supervising contractors' works. The Government reimburses consultants for the personal emoluments of resident site staff and pays an on-cost to consultants to cover their costs in managing the resident site staff.*

Note 6: *The construction works entrusted to HZMB project included reclamation works (see Note 3 to para. 1.4(b)) of $1,980.7 million and construction of TCSS for the Southern Connection of TM-CLKL (see Note 2 to Table 2 in para. 1.7) of $75.4 million.*

Note 7: *According to HyD, other costs mainly included miscellaneous costs for the Project (e.g. ground investigation works and works carried out by other government departments).*

Since the full commissioning of TM-CLKL in December 2020, the annual average daily traffic volume of TM-CLKL (Note 8) increased from 17,548 vehicles in 2021 to 29,967 vehicles in 2023.

Management, operation and maintenance of TM-CLK Tunnel

1.12 The Road Tunnels (Government) Ordinance (Cap. 368) provides for the control and regulation of vehicular and pedestrian traffic in Government road tunnels, the management, operation and maintenance (MOM) of such tunnels and for matters ancillary thereto and connected therewith. In April 2020, the Ordinance was amended to include TM-CLK Tunnel (which was commissioned in December 2020) as tunnels to which the Ordinance applies. TD is responsible for handling the tendering of management contracts for a number of government transport infrastructure and services (including TM-CLK Tunnel), and overseeing and monitoring the performance of the contractors that operate and maintain these transport infrastructure and services. In September 2020, TD awarded the first MOM agreement for TM-CLK Tunnel through open tender to an operator (Operator A) at a fixed lump sum management fee of $298.6 million for four years from 27 December 2020 to 26 December 2024 (Note 9). The total management fee since commencement of the MOM agreement and up to December 2023 was about $221 million.

Audit review

1.13 In April 2024, the Audit Commission (Audit) commenced a review of the implementation of the Project and traffic management of TM-CLKL. The audit review has focused on the following areas:

(a) administration of Contracts A and B (PART 2);

Note 8: *This refers to the section of TM-CLKL from Lung Fu Road to HKP. According to TD, this section provides a broad understanding of the traffic conditions of TM-CLKL and the related traffic flow data is available in TD's Monthly Traffic and Transport Digest. Unless otherwise specified, all traffic volume and v/c ratios of TM-CLKL mentioned in this Audit Report refer to the information for this section of TM-CLKL.*

Note 9: *The MOM agreement for TM-CLK Tunnel for the next term was awarded on 25 September 2024 through open tender.*

(b) other contract management issues (PART 3); and

(c) operation and traffic management (PART 4).

Audit has found room for improvement in the above areas and has made a number of recommendations to address the issues.

General response from the Government

1.14 The Secretary for Transport and Logistics has said that:

(a) TLB attaches great importance to the timely delivery of transport infrastructure projects and good traffic management with a view to enhancing connectivity as well as providing a safe, reliable and efficient traffic and transport system;

(b) TLB welcomes the audit recommendations and supports the proposed follow-up actions of HyD and TD; and

(c) TLB will continue to oversee the work of HyD and TD to ensure that the departments will take appropriate follow-up actions as undertaken in their responses to the audit recommendations.

1.15 The Director of Highways and the Commissioner for Transport agree with the audit recommendations.

Acknowledgement

1.16 Audit would like to acknowledge with gratitude the full cooperation of the staff of HyD and TD during the course of the audit review.

PART 2: ADMINISTRATION OF CONTRACTS A AND B

2.1 This PART examines the administration of Contracts A and B by HyD, focusing on:

(a) interfacing issues of Contracts A and B with reclamation contract for HKP (paras. 2.6 to 2.11);

(b) other issues under Contract A (paras. 2.12 to 2.24); and

(c) other issues under Contract B (paras. 2.25 to 2.43).

Contracts A and B

Contract A

2.2 Contract A was a lump sum design-and-build contract (Note 10), covering the design and construction of the Southern Connection of TM-CLKL, including the sea viaduct between HKP and North Lantau, the associated approach roads linking the sea viaduct with NLH and the road network of HKP, and modification and realignment of sections of Cheung Tung Road (see Photograph 1 for the sea viaduct and the associated approach roads constructed under Contract A). In June 2013, HyD awarded Contract A to Contractor A at a contract sum of $8,656.7 million. The works commenced in June 2013 with a contract period of about 45 months. Consultant X was the Supervising Officer responsible for supervising the contract works. In the event, the contract works were substantially completed in June 2019, about 26.7 months (813 days) later than the original completion date of April 2017.

Note 10: *Under a lump sum contract, the quantities of various works items are substantially measured firm and the final price to be paid is ascertained by adding to/deducting from the contractor's accepted tender price the value of variations and other specified items (e.g. provisional quantities and contingency items). Under a design-and-build contract, the contractor is required to design and construct the works in accordance with the Employer's Requirements.*

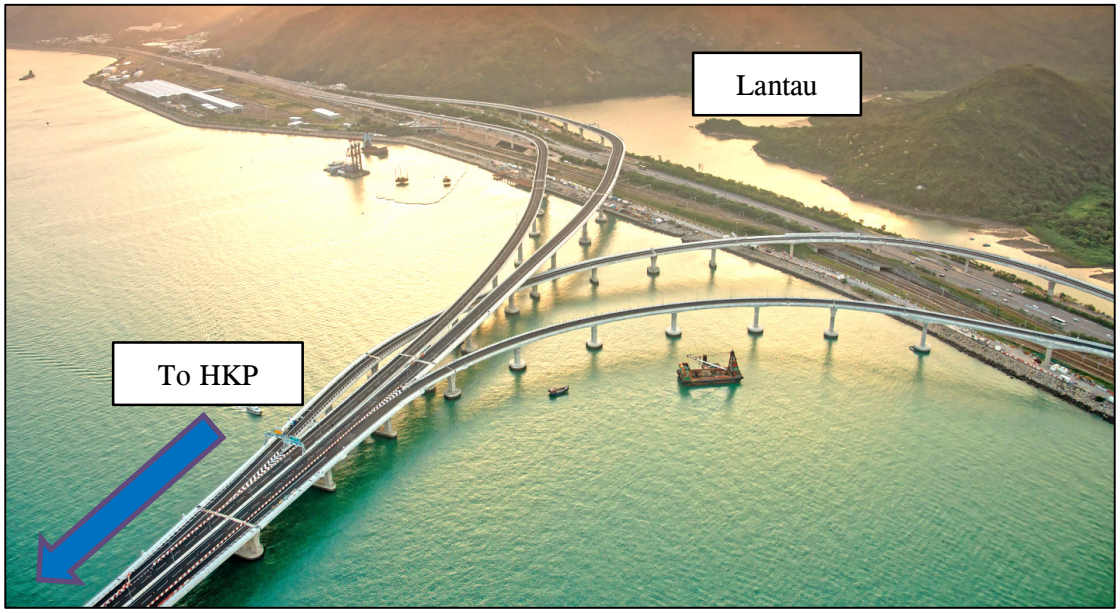
Of the 813 days, extensions of time (EOTs — Note 11) of 786 days were granted to Contractor A (Note 12). The account of Contract A was finalised in December 2021 and the final contract sum was $9,272.7 million (an increase of $616.0 million (7.1%) over the original contract sum of $8,656.7 million).

Note 11: *According to the General Conditions of Contract for Design and Build Contracts and General Conditions of Contract for Civil Engineering Works, regarding contract works commencement, completion and delay: (a) the works and any section thereof shall be completed within the time or times stated in the contract calculated from and including the date for commencement notified by the Supervising Officer/Engineer or such extended time as may be determined; (b) if the contractor fails to complete the works or any section of works within the time for completion or such extended time as may be granted, then the Employer shall be entitled to recover from the contractor liquidated damages for delay; and (c) if in the opinion of the Supervising Officer/Engineer, the cause of any delay to the progress of the works or any section of works is any of those stipulated in the General Conditions of Contract (e.g. inclement weather, a variation order issued by the Supervising Officer/Engineer, the contractor not being given possession of site, etc.), then the Supervising Officer/Engineer shall within a reasonable time consider whether the contractor is entitled to an EOT for completion of the works or any section thereof. According to the Project Administration Handbook for Civil Engineering Works issued by the Civil Engineering and Development Department, an EOT for completion in effect deprives the Government of the right to liquidated damages for delay in completion of the works for the period of the extension and therefore has a financial implication.*

Note 12: *Of the 786 days of EOTs granted, 779 days were due to interfacing issues with a reclamation contract for HKP (see paras. 2.6 to 2.9) and 7 days were due to inclement weather. For the remaining 27 days of delay (i.e. 813 days − 786 days) without EOTs granted, liquidated damages of $95.8 million in total were imposed and deducted from the payment to Contractor A by HyD.*

Photograph 1

Sea viaduct and associated approach roads constructed under Contract A (October 2018)



Source: *HyD records*

Contractual disputes under Contract A

2.3 In constructing the Southern Connection of TM-CLKL, there were contractual disputes under Contract A. According to HyD, the disputes between HyD and Contractor A were mainly on the following issues:

(a) valuation of claims/works relating to interfacing issues with a reclamation contract for HKP, including:

(i) valuation of a variation order (VO — Note 13) issued for additional design and construction works (see Note 21 to para. 2.8(a)(i)); and

(ii) claim for prolongation cost (Note 14) incurred due to the late possession of works sites (see Note 23 to para. 2.8(b)(i));

(b) valuation of claims/works relating to other issues under Contract A (see related issues in paras. 2.12 to 2.17); and

(c) claim for EOTs under Contract A.

2.4 These disputes were subsequently settled through the dispute resolution mechanism specified under Contract A in November 2021 and the Government agreed to pay a settlement sum to Contractor A (Note 15) for the full and final settlement of the disputes on a without admission of liability basis. With the advice and support of the Legal Advisory Division (Works) of the Development Bureau (DEVB), HyD considered that the settlement was in the best interest of the Government.

Note 13: *According to the General Conditions of Contract for Design and Build Contracts and General Conditions of Contract for Civil Engineering Works: (a) the Supervising Officer/Engineer may order any variation that is necessary for the completion of the works or is in his opinion desirable for or to achieve the satisfactory completion and functioning of the works; (b) the contractor shall carry out such variation in accordance with the Supervising Officer/Engineer's instruction; and (c) the Supervising Officer/Engineer shall determine the sum which in his opinion shall be added to or deducted from the contract sum as a result of issuing a VO.*

Note 14: *Prolongation costs are generally the time related costs (e.g. the costs of a contractor's site establishment, site overheads and general plant) that are typically affected by a delay to the critical path of construction works. Works contracts include provisions for granting EOTs for completion due to events covered by the contract provisions, such as additional works, inclement weather, etc. The Supervising Officer/Engineer would assess the actual situation of each case, with the prolongation costs calculated as the time related costs additionally incurred for the relevant delay duration of those events for which prolongation costs are grantable.*

Note 15: *According to HyD, based on the legal advice, the settlement sum was considered as highly sensitive information and should not be disclosed.*

Contract B

2.5 Contract B was a lump sum design-and-build contract, covering the design and construction of the Northern Connection sub-sea tunnel section of TM-CLKL (i.e. TM-CLK Tunnel) between Tuen Mun and HKP, and reclamation to form extra land of approximately 16.5 ha at Tuen Mun for the northern landfall of TM-CLK Tunnel (see Photograph 2 for the northern landfall of TM-CLK Tunnel constructed under Contract B). In July 2013, HyD awarded Contract B to Contractor B at a contract sum of $18,153.9 million. The works commenced in August 2013 with a contract period of about 63 months. Consultant X was the Supervising Officer responsible for supervising the contract works. In the event, the contract works were substantially completed in June 2020, about 19.3 months (586 days) later than the original completion date of October 2018 with EOTs for the whole period granted to Contractor B (Note 16). As of August 2024, the account of Contract B had not been finalised and the latest contract expenditure was $21,368.8 million (an increase of $3,214.9 million (17.7%) over the original contract sum of $18,153.9 million).

Note 16: *Of the 586 days of EOTs granted, 475 days were due to interfacing issues with a reclamation contract for HKP (see paras. 2.6 to 2.9), 92 days were due to inclement weather and 19 days were due to the outbreak of coronavirus disease (COVID-19) epidemic.*

Photograph 2

Northern landfall of TM-CLK Tunnel constructed under Contract B (April 2021)

Source: *HyD records*

Interfacing issues of Contracts A and B with reclamation contract for the Hong Kong Port

2.6 The Northern Connection sub-sea tunnel section of TM-CLKL (i.e. TM-CLK Tunnel) between Tuen Mun and HKP (constructed under Contract B), and the Southern Connection of TM-CLKL between HKP and North Lantau (constructed under Contract A) are both connected with HKP (a reclaimed artificial island under HZMB project). As such, the reclamation works of HKP (including the formation of 20-ha land for the Project entrusted to HZMB project — see para. 1.4(b)) under another HyD works contract (hereinafter referred to as the HKP Reclamation Contract — Note 17) had extensive interfaces with the works of Contracts A and B.

2.7 According to HyD:

(a) the progress of the reclamation works under HKP Reclamation Contract had been unsatisfactory since the commencement of works, resulting in knock-on delays in the handover of works sites (i.e. the 20-ha reclaimed land — see para. 2.6) to Contractors A and B (Note 18); and

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Note 17: *The works under HKP Reclamation Contract mainly comprised reclamation at the northeast of HKIA of an area of about 130 ha for the construction of an artificial island for the development of HKP, and an area of about 20 ha as the southern landfall of TM-CLK Tunnel. The works commenced in November 2011 with an original completion date of February 2016. In the event, the works were delayed and completed in October 2017.*

Note 18: *According to HyD: (a) different sections of the 20-ha reclaimed land at HKP were handed over to Contractors A and B (by the contractor of HKP Reclamation Contract) as the works sites for the construction of viaduct and the associated approach roads under Contract A, and the southern landfall of TM-CLK Tunnel under Contract B respectively; (b) to mitigate the impacts arising from various challenges during the course of the reclamation works, the newly reclaimed lands were handed over in phases to Contractors A and B for proceeding with critical works under the Project as far as practicable; and (c) HyD also participated in interface meetings between the contractor of HKP Reclamation Contract and Contractors A or B to facilitate handover and co-working arrangement as appropriate.*

(b) since October 2014, lateral movements of seawall of HKP were observed (Note 19).

Scope for improvement in managing interfacing works

2.8 As a result of the delays of reclamation works under HKP Reclamation Contract and lateral movements of seawall of HKP mentioned in paragraph 2.7, Contractors A and B were unable to carry out subsequent works under Contracts A and B as planned, causing the following substantial works variations, prolongation costs and disruption costs, and EOTs granted under Contracts A and B due to the late possession of works sites and lateral movements of seawall of HKP (Note 20):

(a) ***Substantial works variations under Contracts A and B.*** A number of VOs with significant amounts were issued under Contracts A and B due to interfacing issues with HKP Reclamation Contract. Details are as follows:

(i) ***Contract A.*** Between July 2015 and August 2018, 9 VOs (later valued at a total additional cost of $536.8 million) were issued, instructing Contractor A to carry out additional works (e.g. delay recovery measures, additional ground investigation works, and additional design and construction of the structures) under

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Note 19: *According to HyD: (a) there was uncertainty in securing a location for disposing of the potentially contaminated marine mud that would be excavated from the HKP reclamation works, which cast doubt on the construction programme; (b) with a view to achieving timely completion of HKP in tandem with that of HZMB and minimising environmental impacts, a non-dredged seawall design (being unprecedented in Hong Kong at that time) was adopted for the HKP reclamation works; (c) in view that such a seawall design was unprecedented in Hong Kong, HyD sought the advice of a renowned geotechnical overseas expert who had reviewed and concluded in 2010 that the non-dredged seawall scheme was appropriately designed. The HKP reclamation works subsequently commenced in November 2011; and (d) after the larger-than-expected movement of seawall of HKP was observed in October 2014, an independent expert was engaged by HyD to conduct continuous review on the performance of the entire seawall from 2016 to 2019 which confirmed that the as-constructed seawall was safe and stable despite the movement observed during the construction stage.*

Note 20: *According to HyD, there are contractual disputes between the Government and the contractor of HKP Reclamation Contract and the disputes are being handled through the dispute resolution mechanism specified under HKP Reclamation Contract.*

Contract A due to the delays of reclamation works under HKP Reclamation Contract and lateral movements of seawall of HKP (Note 21); and

(ii) ***Contract B.*** Between September 2015 and October 2019, 21 VOs (later valued at a total additional cost of $7,400.2 million) were issued, instructing Contractor B to carry out additional works and modify the design of TM-CLK Tunnel (e.g. lowering the vertical alignment of TM-CLK Tunnel, revising the design and construction method, and carrying out delay recovery measures) under Contract B due to the delays of reclamation works under HKP Reclamation Contract and lateral movements of seawall of HKP (Note 22);

(b) ***Prolongation costs and disruption costs under Contracts A and B.*** There were significant prolongation costs and disruption costs incurred under Contracts A and B due to interfacing issues with HKP Reclamation Contract. Details are as follows:

(i) ***Contract A.*** According to HyD, the contractor of HKP Reclamation Contract was not able to hand over the works sites to Contractor A in November 2014 (as stated in Contract A). In the event, access to and possession of works sites were only given to Contractor A in a phased manner from July 2015 to July 2016 (about 7.9 to 20.8 months later than the original handover date of November 2014). Contractor A therefore submitted a claim for the prolongation cost incurred due to the late possession of works sites. In September 2019, Consultant X certified $586 million for the prolongation cost incurred by Contractor A (Note 23); and

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Note 21: *In this connection, Contractor A disputed on the valuation of a VO relating to additional design and construction of the structures under Contract A, and the dispute was subsequently settled in November 2021 (see paras. 2.3(a)(i) and 2.4).*

Note 22: *According to HyD, the majority of the amount of these VOs was related to lowering the vertical alignment of the tunnel due to technical considerations at the interface between the tunnel and the seawall of HKP.*

Note 23: *In this connection, Contractor A disputed on the valuation of prolongation cost, and the dispute was subsequently settled in November 2021 (see paras. 2.3(a)(ii) and 2.4).*

(ii) ***Contract B.*** According to HyD, the contractor of HKP Reclamation Contract was not able to hand over the works sites to Contractor B in August 2015 (as stated in Contract B). In the event, access to and possession of works sites were only given to Contractor B in a phased manner from November 2015 to August 2017 (about 2.9 to 24.4 months later than the original handover date of August 2015 — Note 24). Furthermore, to facilitate reclamation works under HKP Reclamation Contract, Consultant X instructed Contractor B to suspend all the works at the southern landfall area in the vicinity of the seawall and to vacate its resources therefrom for safety considerations between February and April 2016 (Note 25). In the event, Contractor B submitted claims for the prolongation cost and disruption costs (for idling plant and labour resources) incurred due to the late possession of works sites and the adverse effect on the progress of works arising from the suspension order. In November 2017, Consultant X certified a total sum of $420.4 million for these claims; and

(c) ***Majority of EOTs granted under Contracts A and B due to interfacing issues with HKP Reclamation Contract.*** Apart from the substantial works variations, prolongation costs and disruption costs under Contracts A and B (see (a) and (b) above) owing to the late possession of works sites and lateral movements of seawall of HKP, EOTs of 779 days (of 786 days of EOTs granted under Contract A — see para. 2.2) and 475 days (of 586 days of EOTs granted under Contract B — see para. 2.5) were granted to Contractors A and B respectively.

Note 24: *According to HyD, actual delay of 475 days (about 15.6 months) under Contract B due to interfacing issues with HKP Reclamation Contract (see Note 16 to para. 2.5) was shorter than the delay in possession of works sites by Contractor B because various delay recovery measures had been carried out to mitigate the impacts.*

Note 25: *According to HyD: (a) in early 2016, a larger-than-expected seawall movement was observed at the north-eastern tip of HKP; and (b) it was decided in a joint meeting among relevant parties to suspend the co-working arrangement between the contractor of HKP Reclamation Contract and Contractor B from a risk management perspective.*

2.9 In Audit's view, there is scope for improvement in managing interfacing works by HyD.

Audit recommendations

2.10 **Audit has *recommended* that, in implementing works projects involving interfacing works contracts, the Director of Highways should take measures to improve the management of interfacing works with a view to mitigating the risks arising from interfacing issues (e.g. significant works variations, prolongation costs, disruption costs, granting of EOTs, and contractual claims and disputes), including:**

(a) **ensuring timely handover of works sites among interfacing works contracts;**

(b) **better coordinating with all related parties on interfacing works; and**

(c) **enhancing project management planning.**

Response from the Government

2.11 The Director of Highways agrees with the audit recommendations. He has said that HyD will take measures to improve the management of interfacing works in implementing future projects, including:

(a) ensuring timely handover of works sites among interfacing works contracts as far as practicable;

(b) better coordinating with all related parties on interfacing works; and

(c) enhancing project management planning.

Other issues under Contract A

Need to better ascertain site conditions for watermain diversion works

2.12 Under Contract A, Contractor A was required to divert a section of an existing fresh watermain due to the realignment of sections of Cheung Tung Road in North Lantau to facilitate the construction of a viaduct for the Southern Connection of TM-CLKL. Regarding the watermain diversion works, Audit noted that:

Before tendering of Contract A

(a) based on the as-built records, HyD anticipated that the length of the watermain to be diverted was about 270 m (which was subsequently stated in the Employer's Requirements under Contract A);

After commencement of Contract A

(b) according to HyD, taking into account the actual site conditions, the actual length of the watermain to be diverted was measured to be about 422 m (56% or 152 m longer than the 270 m stated in the Employer's Requirements). In January 2015, Consultant X requested Contractor A to extend the diversion of watermain; and

(c) in the event, the watermain diversion works were carried out by Contractor A between April 2015 and March 2017.

2.13 In July 2018, Consultant X issued a VO (VO A) to Contractor A for carrying out the watermain diversion works (Note 26). However, Contractor A disputed on the valuation of VO A and claimed for additional payment. In the event, the dispute on VO A was subsequently settled in November 2021 (see para. 2.4).

Note 26: *VO A was valued at an additional cost of $9.4 million, of which $5.1 million was related to the extension of watermain diversion, and the remaining $4.3 million was related to the implementation of a contingency plan for watermain connections. In this connection, prolongation cost of $12 million and EOTs of 239 days were granted to Contractor A due to the issuance of VO A.*

2.14 In this connection, Audit noted that, after the watermain diversion works had been carried out between April 2015 and March 2017, VO A was only issued in July 2018 retrospectively. According to HyD:

(a) HyD and Consultant X had been preparing VO A since 2015; and

(b) the varied works under VO A had been reported and discussed during regular management meetings, and it was agreed to proceed with the varied works to avoid unnecessary delay to the works under a tight construction programme.

2.15 According to the Project Administration Handbook for Civil Engineering Works issued by the Civil Engineering and Development Department (CEDD), there is no provision for issuing variations verbally for later confirmation in writing. All VOs are to be made in writing and signed by the Engineer or the Engineer's Representative with delegated authority. In Audit's view, HyD needs to:

(a) in implementing works contracts involving watermain diversion works, take measures to better ascertain the site conditions at the planning stage with a view to minimising variations of works (e.g. increasing the length of watermain required to be diverted) after contract commencement; and

(b) in issuing works variations, remind its staff and consultants to issue VOs in writing before carrying out the varied works in accordance with the related guidelines.

Need to timely provide response to design submissions

2.16 Contract A was a design-and-build contract. Contractor A was required to carry out the design, consult relevant stakeholders (including maintenance parties), and seek approval of the design before proceeding with the construction works. In accordance with the contract requirements, Contractor A had agreed with Consultant X a Project Design Plan which indicated the timeframes of submissions by Contractor A and approvals of the design submissions by Consultant X. According to Contract A, Contractor A should take into consideration the time required to process each submission and approval required by parties concerned, and to synchronise its submission schedule and secure all necessary approvals for its design and construction programme in order to meet the completion date.

2.17 During the design stage, Contractor A contended that when circulating various design submissions to Consultant X and relevant stakeholders for comments, some stakeholders' responses were given later than expected and hence Consultant X's approvals of design submissions were beyond the timeframes set out in the Project Design Plan. As such, Contractor A submitted a claim for additional design fees due to delayed responses to and longer-than-expected approvals on various design submissions. On the other hand, Consultant X considered that the purpose of the Project Design Plan was to show how Contractor A planned to exercise its design duties and responsibilities to obtain approvals from relevant stakeholders on the design submissions. In the event, the unresolved claim was subsequently settled in November 2021 (see para. 2.4). In Audit's view, in implementing design-and-build contracts, HyD needs to remind its consultants to closely liaise with relevant stakeholders with a view to ensuring their timely responses and to approve design submissions by its contractors after taking into account the stakeholders' views as early as possible.

Scope for improvement in ascertaining sub-surface conditions for piling works

2.18 Under Contract A, Contractor A was required to carry out piling works as the piled foundation for the construction of sea viaduct and associated approach roads. After the commencement of Contract A, Contractor A found that the actual rockhead levels at various piling works locations were deeper than the envisaged levels in the Geotechnical Baseline Report (which was prepared during the design stage to provide a reference of the sub-surface conditions for Contract A), and there was a need to change the construction method for constructing longer piles to achieve sufficient stability.

2.19 Between February 2014 and July 2015, Contractor A submitted 31 claims for additional payments in connection with the deviation of sub-surface conditions for piling works. In the event, Consultant X certified an additional payment of $52.2 million to Contractor A for these claims.

2.20 According to HyD:

(a) the Geotechnical Baseline Report had been developed from interpretation of the geotechnical information available at the time; and

(b) Consultant X had followed the prevailing guidelines in conducting ground investigation works. Both land and marine ground investigation works had been carried out during the design stage to obtain geotechnical information at selected locations. The scale of pre-contract ground investigation for the Project was comparable to that of other projects of similar nature and scale.

2.21 In this connection, Audit noted that after the award of Contract A (i.e. June 2013), the following further guidelines relating to ground investigations were issued:

(a) "Geoguide 2: Guide to Site Investigation" published by the Geotechnical Engineering Office of CEDD was updated in 2017 to provide:

(i) guidance on good site investigation practice for works departments to plan and carry out investigation of works sites; and

(ii) further guidelines in the application of new technologies and digital tools (such as geophysical survey methods and geographical information system) to enhance site investigation works; and

(b) further guidelines on geotechnical works of public works projects were promulgated in DEVB Technical Circular (Works) No. 3/2018 of March 2018 on "Enhancing Cost Effectiveness of Geotechnical Works of Capital Works Projects". Under the Technical Circular, for geotechnical works exceeding $500 million, works departments are required to submit the schematic design proposal with relevant information (e.g. ground investigation data) to the Geotechnical Engineering Office of CEDD for review and comment.

2.22 In Audit's view, in implementing works contracts involving piling works, HyD needs to:

(a) remind its staff and consultants to conduct thorough ground investigations as far as practicable in accordance with the related guidelines with a view to better ascertaining sub-surface conditions for piling works; and

(b) explore new technologies and digital tools for conducting more thorough ground investigations with a view to providing better information on site conditions.

Audit recommendations

2.23 **Audit has *recommended* that the Director of Highways should:**

(a) **in implementing works contracts involving watermain diversion works, take measures to better ascertain the site conditions at the planning stage with a view to minimising variations of works (e.g. increasing the length of watermain required to be diverted) after contract commencement;**

(b) **in issuing works variations, remind HyD staff and consultants to issue VOs in writing before carrying out the varied works in accordance with the related guidelines;**

(c) **in implementing design-and-build contracts, remind HyD consultants to closely liaise with relevant stakeholders with a view to ensuring their timely responses and to approve design submissions by HyD contractors after taking into account the stakeholders' views as early as possible; and**

(d) **in implementing works contracts involving piling works:**

(i) **remind HyD staff and consultants to conduct thorough ground investigations as far as practicable in accordance with the related guidelines with a view to better ascertaining sub-surface conditions for piling works; and**

(ii) **explore new technologies and digital tools for conducting more thorough ground investigations with a view to providing better information on site conditions.**

Response from the Government

2.24 The Director of Highways agrees with the audit recommendations. He has said that HyD will:

(a) in implementing works contracts involving watermain diversion works, make continued efforts to better ascertain the site conditions at planning stage with a view to minimising variations of works after contract commencement;

(b) remind its staff and consultants to issue VOs in writing before carrying out the varied works in accordance with the related guidelines;

(c) in implementing design-and-build contracts, remind its consultants to enhance liaison with relevant stakeholders with a view to ensuring their timely responses and to approve design submissions by its contractors after taking into account the stakeholders' views as early as possible; and

(d) in implementing works contracts involving piling works:

(i) remind its staff and consultants to conduct thorough ground investigations as far as practicable in accordance with the related guidelines with a view to better ascertaining sub-surface conditions for piling works; and

(ii) explore new technologies and digital tools for conducting more thorough ground investigations with a view to providing better information on site conditions.

Other issues under Contract B

Substantial increase in quantity of rock fill material required for reclamation works

2.25 Under Contract B, Contractor B was required to carry out reclamation works to form extra land of approximately 16.5 ha at Tuen Mun for the northern landfall of TM-CLK Tunnel. According to Contract B, Grade 400 rock fill

material (Note 27) was specified as the fill material for the reclamation works, and its quantity was specified as a remeasurement item (Note 28). The quantity of Grade 400 rock fill material specified in the Pricing Schedule of Contract B was 441,400 cubic metres (m^3) at a rate of \$160/m^3.

2.26 After the commencement of Contract B, Contractor B carried out further pre-construction ground investigation and estimated that the required quantity of Grade 400 rock fill material was about 850,000 m^3 (i.e. about 90% higher than the quantity of 441,400 m^3 specified in the Pricing Schedule) (Note 29). In September 2013, Contractor B submitted a claim for additional payment attributable

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Note 27: *According to the General Specification for Civil Engineering Works, fill material shall consist of naturally occurring or processed material, or inert construction and demolition material, which at the time of disposition is capable of being compacted to form stable areas of fill. Different types of fill material shall have the particle size distributions within various ranges. For Grade 400 rock fill material, all of its particle size shall be within 400 millimetres, of which 20% to 75% shall be within 200 millimetres.*

Note 28: *According to HyD, Contract B was a lump sum design-and-build contract with remeasurement items. According to Contract B, for remeasurement items: (a) the quantities set out in the Pricing Schedule are estimated quantities and they are not to be taken as the actual and correct quantities of the work to be executed; (b) where the Supervising Officer is satisfied that the actual quantity of work executed in respect of any remeasurement item will be greater or less than that stated in the Pricing Schedule, he shall ascertain and determine by measurement the quantity of such work executed. Such work shall be valued at the rate for the remeasurement set out in the Pricing Schedule or if there are no appropriate rates in the Pricing Schedule then at other rates determined in accordance with Contract B; and (c) should the actual quantity of work executed in respect of any remeasurement item be substantially greater or less than that stated in the Pricing Schedule and if in the opinion of the Supervising Officer such increase or decrease of itself shall render the rate for the item unreasonable or inapplicable, the Supervising Officer shall determine an appropriate increase or decrease of the rate for the item using the rates in the Pricing Schedule as the basis for such determination.*

Note 29: *According to HyD: (a) ground investigation at the location of proposed seawall was conducted before tendering of Contract B to estimate the quantity of rock fill material specified in the Pricing Schedule; (b) under Contract B, Contractor B was required to carry out further pre-construction ground investigation to determine the final dredged level; and (c) in the event, after the final dredged level was determined, the required quantity of rock fill material was estimated to increase by about 90%.*

to the substantial increase in quantity of rock fill material required for the reclamation works. According to Consultant X's assessment of the claim:

(a) Contractor B's original sources of Grade 400 rock fill material stated in the tender submission came from local market. Site records showed that the actual quantity of rock fill material collected from local market was close to the quantity of 441,400 m^3 specified in the Pricing Schedule;

(b) the final quantity of Grade 400 rock fill material was about 832,552 m^3 and the additional quantity of Grade 400 rock fill material was sourced by Contractor B from a non-local market (as such substantial amount of rock fill material could not be sourced from local market). Hence, due to the substantial increase in quantity of Grade 400 rock fill material required, the existing rate of Grade 400 rock fill material (i.e. 160/m^3 — see para. 2.25) was unreasonable or inapplicable;

(c) Contractor B had incurred extra costs for the additional quantity of Grade 400 rock fill material due to extra material, labour and plant cost for sourcing from a non-local market; and

(d) the rate of additional quantity of Grade 400 rock fill material of 391,152 m^3 (i.e. 832,552 m^3 − 441,400 m^3) should be increased to \$456/m^3 and the rate of the original quantity specified in the Pricing Schedule (i.e. 441,400 m^3) should remain unchanged at \$160/m^3.

In November 2017, Consultant X certified a sum of \$115.8 million for the claim (Note 30). In Audit's view, in implementing works projects involving reclamation works, HyD needs to take measures to estimate the quantity of fill material required for the reclamation works as accurately as practicable.

Note 30: *A "poor" performance rating was given in cost estimates and quality of tender documents/drawings aspect in Consultant X's quarterly performance report from October to December 2013 to reflect Consultant X's poor performance in the estimation of quantity of rock fill material required for reclamation works.*

Change of type of passive fire protection system inside TM-CLK Tunnel after contract commencement

2.27 Under Contract B, Contractor B was required to supply and install non-combustible thermal barrier inside TM-CLK Tunnel as the passive fire protection system. In accordance with the Employer's Requirements under Contract B, the thermal barrier was specified to be spray type (Note 31) with design life of not less than 20 years, and shall be capable of withstanding fire for 2 hours.

2.28 Contract B commenced in August 2013. Since late 2015, the maintenance party to be responsible for the civil works of TM-CLK Tunnel after its completion (i.e. the New Territories Regional Office of HyD — Note 32) had been expressing concerns about the specified spray type thermal barrier. According to the maintenance party:

(a) there would be risk of detachment of the spray type thermal barrier from the overhead ventilation ducts in the long term, which would create potential hazards to road users;

(b) it would be difficult to identify any loose layer of the spray type thermal barrier on the bottom slab of the overhead ventilation ducts during routine maintenance inspection. Any necessary repair works would cause serious disruption to tunnel operations; and

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Note 31: *According to HyD, the spray type thermal barrier was originally adopted under Contract B in consideration of: (a) the successful adoption of spray type thermal barrier for fire protection in overseas tunnel projects; and (b) exploring new technologies as the spray application by robotic technology could offer programme and cost benefits with the assumption of ideal interface with no other construction activities in the adjacent areas of the spray application.*

Note 32: *According to HyD: (a) the New Territories Regional Office is responsible for the maintenance of civil works of TM-CLK Tunnel and associated roads (i.e. tunnel structures, pavement, highway structures, traffic signs, etc.); and (b) the tender documents including specifications and drawings of the passive fire protection system were circulated to the New Territories Regional Office in August 2012, and no comment was received on the thermal barrier.*

(c) renovation of the spray type thermal barrier inside a tunnel is almost impractical as striping of spray type thermal barrier is quite tedious and the reinstatement works would be very costly.

2.29 Considering the above technical concerns of using spray type thermal barrier and the long-term operation and maintenance benefits of using board type thermal barrier from a whole-life cycle perspective, Consultant X recommended to replace the originally specified spray type thermal barrier with board type thermal barrier (Note 33). In the event, 2 VOs (later valued at a total additional cost of $328.7 million) were issued under Contract B in connection with the change, as follows:

(a) in November 2016, a VO (later valued at an additional cost of $157.5 million) was issued to Contractor B to change the passive fire protection system from spray type to board type thermal barrier; and

(b) with the change of passive fire protection system from spray type to board type thermal barrier, Consultant X considered that the construction sequence and allocation of works among interfacing contracts needed to be revised. In February 2018, Consultant X issued another VO (later valued at an additional cost of $171.2 million) under Contract B, instructing Contractor B to carry out the related fixing works (e.g. E&M and TCSS steel fixings) which were originally planned to be included under Contracts D and E.

Note 33: *According to Consultant X: (a) both spray type and board type passive fire protection systems have their own merits; and (b) for board type thermal barrier: (i) it can be relatively easy to install and replace by using simple tools with low dust emissions; (ii) it can be assembled with no interruption of traffic with simple standard tools during operation and maintenance of the tunnel, minimising maintenance concerns; and (iii) the time required for repair and replacement of board type thermal barrier is much shorter, thus minimising the disruption time on tunnel operations.*

2.30 According to HyD:

(a) the proposal of using board type instead of spray type thermal barrier did not incur abortive work as the spray type thermal barrier had neither been procured nor installed; and

(b) the related fixing works (see para. 2.29(b)) were allocated to Contract B for better integration of works, and were not included in the scopes of Contracts D and E which were tendered subsequently.

2.31 In this connection, Audit noted that "Guidance Notes on Design of Road Tunnel Structures and Tunnel Buildings to be maintained by Highways Department" was promulgated by HyD in 2018 which stipulated that thermal barrier inside tunnels should be board type. In Audit's view, in implementing tunnel works projects, HyD needs to:

(a) regularly remind its staff and consultants to follow the related guidelines in specifying the passive fire protection system inside tunnels; and

(b) continue to explore new technologies for constructing passive fire protection system inside tunnels with a view to improving the design of tunnel structures.

Need to continue to enhance the design of road drainage system in response to climate change

2.32 Under Contract B, Contractor B was required to design and construct the south approach ramp leading to the south portal of TM-CLK Tunnel, including the road drainage system for collecting surface runoff. According to HyD, regarding the design of the road drainage system at the south approach ramp leading to the south portal of TM-CLK Tunnel:

(a) Contractor B submitted the detailed design and the check certificate issued by an independent design checker to Consultant X in September 2018 and July 2019 respectively; and

(b) the detailed design (including the use of a specific type of gully grating, which complied with the prevailing design guidelines) was also circulated to relevant government departments for comments, and subsequently approved by Consultant X in July 2019.

In the event, the related construction works for the road drainage system was completed in December 2020 and TM-CLK Tunnel was opened to the public in the same month.

2.33 On 28 June and 29 July 2021, significant flooding incidents occurred at the south portal of TM-CLK Tunnel, which caused disruption to tunnel traffic for about 3 hours and about 1 hour respectively. In particular, the entire TM-CLK Tunnel was closed for 15 minutes on 28 June 2021 for clearance of muddy water due to the flooding incident. According to HyD, it was noted that the maximum 5-minute rainfall data recorded in the morning of 28 June 2021 and the afternoon of 29 July 2021 were 11.0 millimetres and 11.3 millimetres respectively, which were nearly twofold of the threshold triggering the Black Rainstorm Signal (i.e. 5.8 millimetres in 5-minute, being scaled down from 70 millimetres in an hour).

2.34 In July 2021, HyD raised concerns regarding the use of the specific type of gully grating (see para. 2.32(b)) and requested modification of the as-constructed gullies in order to enhance road drainage efficiency. In order to eliminate any risk of undesirable performance of the gully grating under extreme weather and ensure safe operation of TM-CLK Tunnel, Consultant X issued a VO (later valued at an additional cost of $6.4 million) in January 2022 to instruct Contractor B to enhance the performance of the as-constructed gullies by constructing additional U-channels for the gullies.

2.35 In this connection, Audit noted that HyD had updated the "Guidance Notes on Design of Road Tunnel Structures and Tunnel Buildings to be maintained by Highways Department" in 2023 to cater for climate change in the design of drainage for road tunnels. In Audit's view, in implementing tunnel works projects, HyD needs to continue to enhance the design of road drainage system in response to climate change, and regularly remind its staff and consultants to follow the related guidelines for the design of drainage for road tunnels.

Need to draw lessons from construction of emergency access hatches in TM-CLK Tunnel

2.36 According to Contract B, Contractor B was required to design and construct TM-CLK Tunnel. In March 2014, Contractor B proposed to construct a service gallery underneath the entire length of the tunnel carriageway and relocate some E&M and TCSS facilities (e.g. power supply and control systems) to the service gallery, and provide 45 emergency access hatches (i.e. for access to the service gallery from road level in case of emergency for evacuation/rescue purpose — see Photographs 3 and 4) in carriageway at about 200 m interval along the tunnel as supplementary evacuation/rescue routes. Both the service gallery and emergency access hatches were new designs adopted for the first time for tunnels in Hong Kong.

Photographs 3 and 4

Emergency access hatches in carriageway along TM-CLK Tunnel

Source: HyD records

2.37 According to Contractor B, the proposed construction of the service gallery and emergency access hatches would provide a number of benefits (e.g. more flexibility for layout arrangement of E&M equipment, enhanced tunnel functionality

as the service gallery would enable uninterrupted access for activities of regular and emergency maintenance, and provision of supplementary evacuation/rescue routes in case of emergency). In connection with the proposed construction of the service gallery and emergency access hatches, Contractor B offered a lump sum saving of $12 million to the Government (Note 34), which was deducted from the payment to Contractor B by HyD.

2.38 The construction works under Contract B were substantially completed in June 2020. After the commissioning of TM-CLK Tunnel in December 2020, an access hatch cover accidentally opened on 30 December 2020, which created safety hazards to road users. Audit noted that:

(a) defect rectification works (e.g. reconstruction of access hatch frames) were carried out by Contractor B (Note 35) in 2021; and

(b) between February 2021 and February 2022, 1 VO (later valued at an additional cost of $6.9 million) was issued under Contract D and 2 VOs (later valued at a total additional cost of $1.9 million) were issued under Contract E for improvement works to the E&M and TCSS systems of TM-CLK Tunnel through the use of the prevailing electronic means (e.g. installation of additional closed circuit television and monitoring sensors in fire lobbies inside the service gallery) to better monitor the condition of access hatch covers (Note 36).

Note 34: *According to HyD, the proposed construction of the service gallery (for relocating some E&M and TCSS facilities to the service gallery) would also bring benefits to Contractor B as it would enable more certain construction programme by eliminating some technical difficulties and programme uncertainties.*

Note 35: *According to HyD, the costs incurred for the defect rectification works of emergency access hatches were borne by Contractor B.*

Note 36: *According to HyD: (a) these measures could allow remote monitoring of the access hatch operation and provide an early warning to tunnel operators for their prompt responses should there be any opening of the access hatch covers without the need to first attend the site in person; (b) the improvement works were carried out under Contracts D and E (rather than under Contract B) according to the respective contractors' expertise; and (c) these works were meant to facilitate the monitoring of the access hatch status during operation and maintenance, and not considered as remedial works associated with the construction of the emergency access hatches, thus the relevant costs were borne by HyD (instead of charging against Contractor B).*

2.39 Notwithstanding the defect rectification works carried out by Contractor B in 2021, there were repeated malfunctioning of the emergency access hatches, including:

(a) accidental opening of an access hatch cover in July 2022; and

(b) repeated damages or dislocations of small parts (e.g. hinges and bolts) of access hatch covers.

According to HyD, in response to the above incidents, Contractor B had carried out further defect rectification works to the emergency access hatches (e.g. redesign and modification of access hatches) as appropriate with relevant costs borne by Contractor B. However, accidental opening of an access hatch cover happened again in August 2023.

2.40 In October 2023, having considered the balance among the availability of other supplementary evacuation routes (e.g. cross passages between tunnel tubes), the possible risks to road safety, and the operation and maintenance efforts needed to upkeep the emergency access hatches, it was decided in a joint meeting among relevant parties to seal off all emergency access hatches in both tunnel tubes and maintain the functions of service gallery, which serves to house E&M facilities, drains and fire services installation (Note 37). In April 2024, Contractor B commenced the sealing-off works for all emergency access hatches (see Photograph 5 for an example), which were subsequently completed in September 2024 (Note 38).

Note 37: *According to HyD, the sealing-off works would not affect the functions of the service gallery, which serves to house E&M facilities, drains and fire services installation, whilst the fire lobbies at about 200 m interval alongside the service gallery will continue to be used as refuge areas with intercom telephones connecting to the main control building and protected by a 4-hour fire separation from the service gallery in case of fire inside the service gallery. Furthermore, rescue operations would not be compromised due to the sealing-off works.*

Note 38: *According to HyD, the costs incurred for the sealing-off works would be borne by Contractor B.*

Photograph 5

An example of emergency access hatch after sealing-off in carriageway along TM-CLK Tunnel

Source: HyD records

2.41 In Audit's view, in implementing tunnel works projects, HyD needs to draw lessons from the experience gained in constructing emergency access hatches in carriageway along TM-CLK Tunnel with a view to improving the design of tunnel structures.

Audit recommendations

2.42 **Audit has *recommended* that the Director of Highways should:**

(a) **in implementing works projects involving reclamation works, take measures to estimate the quantity of fill material required for the reclamation works as accurately as practicable; and**

(b) **in implementing tunnel works projects:**

(i) **regularly remind HyD staff and consultants to follow the related guidelines in specifying the passive fire protection system inside tunnels;**

(ii) **continue to explore new technologies for constructing passive fire protection system inside tunnels with a view to improving the design of tunnel structures;**

(iii) **continue to enhance the design of road drainage system in response to climate change, and regularly remind HyD staff and consultants to follow the related guidelines for the design of drainage for road tunnels; and**

(iv) **draw lessons from the experience gained in constructing emergency access hatches in carriageway along TM-CLK Tunnel with a view to improving the design of tunnel structures.**

Response from the Government

2.43 The Director of Highways agrees with the audit recommendations. He has said that HyD will:

(a) in implementing works projects involving reclamation works, carry out more thorough pre-contract ground investigation when and where appropriate to estimate the quantity of fill material as accurately as practicable; and

(b) in implementing tunnel works projects:

(i) continue to follow the related guidelines in specifying the passive fire protection system inside tunnels;

(ii) continue to explore new technologies for constructing passive fire protection system inside tunnels with a view to improving the design of tunnel structures;

(iii) continue to enhance the design of road drainage system in response to climate change and follow the related guidelines for the design of drainage for road tunnels; and

(iv) share the experience gained in constructing emergency access hatches in carriageway along TM-CLK Tunnel with a view to improving the design of tunnel structures.

PART 3: OTHER CONTRACT MANAGEMENT ISSUES

3.1 This PART examines other contract management issues related to TM-CLKL, focusing on:

(a) administration of Contracts C to H (paras. 3.2 to 3.19); and

(b) site safety (paras. 3.20 to 3.30).

Administration of Contracts C to H

3.2 Apart from Contracts A and B (see PART 2), between July 2014 and June 2022, HyD further awarded 6 works contracts (i.e. Contracts C to H) to contractors (i.e. Contractors C to H — Note 39) for the implementation of the Project (see Table 2 in para. 1.7), as follows:

(a) Contracts C, D and H (with a total final contract sum/the latest contract expenditure of $5,796.2 million as of August 2024) for the construction of a toll plaza (Note 40), tunnel buildings and other associated works;

(b) Contract E (with a final contract sum of $157.9 million) for the construction of TCSS for the Northern Connection of TM-CLKL; and

(c) Contracts F and G (with a total final contract sum/the latest contract expenditure of $35.2 million as of August 2024) for the landscaping and establishment works.

Note 39: *Contractor D was the same company as Contractor A.*

Note 40: *In the 2019 Policy Address, the Chief Executive of the Hong Kong Special Administrative Region announced the initiative of waiving the tolls of TM-CLK Tunnel. According to TD, the site originally designated for the toll plaza of TM-CLK Tunnel was subsequently modified and rented to a franchised bus company as a bus depot since July 2021 under a short term tenancy (the total rentals from July 2021 to August 2024 were $72 million).*

3.3 Contracts C to F and H were completed between September 2019 and August 2024. Except Contract E which was completed on time, Contracts C, D, F and H were completed 3.4 to 17.7 months later than their respective original completion dates (Note 41), but within the extended completion dates with EOTs granted. As of August 2024, Contract G was still in progress. For all the 6 contracts (i.e. Contracts C to H), Consultant X was the Engineer responsible for supervising the contract works. Table 4 shows the works and expenditures under Contracts C to H.

Table 4

Contracts C to H
(August 2024)

Contract	Contract type	Works	Final contract sum/ latest contract expenditure (Note) ($ million)
C	Remeasurement contract	Northern Connection toll plaza and associated works	3,089.6
D		Northern Connection tunnel buildings and E&M works	2,649.2
E	Lump sum design-and-build contract	Northern Connection TCSS	157.9
F	Remeasurement contract	Establishment of landscape softworks	7.8
G		Provision of remaining compensation tree planting	27.4
H		Road improvement and other works	57.4
		Total	5,989.3

Source: *HyD records*

Note: *The figures for 4 contracts (Contracts C to F) were final contract sums, while those for the remaining 2 contracts (Contracts G and H) were the latest contract expenditures as of August 2024.*

Note 41: *According to HyD, the delay in completion of Contract F of 17.7 months was mainly due to the outbreak of COVID-19 epidemic which hindered the delivery of vegetation from nurseries in the Mainland and slowed down the handover process due to the prevailing quarantine measures. The planting works were completed in 2023 with establishment works completed in 2024.*

Scope for improvement in ascertaining underground conditions for constructing slope and retaining wall

3.4 The works under Contract C included the construction of a toll plaza and associated works (including the construction of slopes and retaining walls). Audit noted that there was scope for improvement in ascertaining underground conditions, as follows:

(a) ***Construction of a slope adjacent to toll plaza.*** Under Contract C, Contractor C was required to carry out site formation works for the toll plaza, including construction works for a cut slope of about 285 m in length. Audit noted that:

(i) after the commencement of Contract C, despite the fact that pre-contract ground investigation had been carried out during the design stage, unforeseeable adverse ground conditions (e.g. lower-than-expected rockhead level and intermittent layers of soft materials) were encountered for a particular section of the slope; and

(ii) Consultant X issued a VO (later valued at an additional cost of $176.9 million) in August 2016 under Contract C, instructing Contractor C to carry out:

- additional ground investigation to obtain further ground information;

- the construction of the slope based on revised design by making reference to the additional ground information obtained; and

- delay recovery measures (by deploying extra plant and labour with additional cost) to minimise the potential delay and prolongation cost due to the change of design for the slope (Note 42); and

(b) ***Construction of a retaining wall.*** Under Contract C, Contractor C was required to construct a reinforced concrete retaining wall of about 180 m in length next to Lung Mun Road (LMR) (near Butterfly Beach). Audit noted that:

(i) after the commencement of Contract C, a layer of soft materials was unexpectedly found underneath the base of the retaining wall. To cater for the unforeseen ground condition and maintain the stability of the retaining wall, Consultant X proposed a VO to replace the soft materials below the base of the retaining wall (the value of the VO was estimated at $25.7 million, resulting in a potential delay of 3.5 months and prolongation cost of about $13.6 million);

(ii) in January 2018, when seeking the view from the Project Cost Management Office (PCMO) of DEVB (Note 43) regarding the proposed VO, HyD informed PCMO that:

- the section of LMR next to the proposed retaining wall was a single lane one-way traffic carriageway. It was not practical to close LMR to sink any drillholes at the exact location of the proposed retaining wall to obtain underground conditions during the design stage; and

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Note 42: *According to HyD: (a) due to the change of design for the slope, Contract C might suffer a potential delay of 9 months and might attract prolongation cost of about $46 million if no mitigation measures were implemented; and (b) by implementing the delay recovery measures, Contractor C managed to recover part of the potential delay, and the actual delay due to the change of design for the slope was reduced to 42 days with no prolongation cost.*

Note 43: *In June 2016, DEVB established PCMO (later upgraded and renamed as the Project Strategy and Governance Office) to implement cost management initiatives and initiate measures which are conducive to the delivery of public works projects in a timely and cost-effective manner. According to DEVB's memo "Enhanced Cost Management Mechanisms for Variations of Works Contracts", for a VO with an estimated value exceeding $1.4 million, the view from PCMO shall be sought before authorising it.*

- underground information of some existing drillholes located about 15 m away from the proposed retaining wall was adopted during the design stage;

(iii) when reviewing the proposed VO, PCMO commented that:

- while underground condition was a common reason for varied works which was sometimes difficult to avoid, HyD may need to review the location and extent of drillholes to ascertain the underground conditions as far as practicable during the design stage; and

- HyD should closely monitor the progress of the varied works to minimise the time implication; and

(iv) in the event, Consultant X issued a VO (later valued at an additional cost of $21.1 million) in January 2018 under Contract C, instructing Contractor C to replace the existing fill below the base of the retaining wall with concrete. The issuance of the VO had a knock-on effect on several sections of works under Contract C, and an EOT of 273 days and additional payment for prolongation cost of $31.5 million were granted to Contractor C.

3.5 In this connection, Audit noted that, after the award of Contract C (i.e. July 2014), further guidelines on good site investigation practice and geotechnical works of public works projects were promulgated in 2017 and 2018 respectively (see para. 2.21(a) and (b)). Furthermore, Audit noted that, the actual time and cost implications due to the issuance of the VO relating to the retaining wall (i.e. EOT of 273 days and the additional payment for prolongation cost of $31.5 million) were more than the estimated potential delay of 3.5 months and prolongation cost of $13.6 million (see para. 3.4(b)(i)). In Audit's view, in implementing works projects involving construction of slope and retaining wall, HyD needs to:

(a) remind its staff and consultants to conduct thorough pre-tender site investigation as far as practicable in accordance with the related guidelines; and

(b) closely monitor the progress of varied works (if any) to minimise the time and cost implications.

Dislocation of manhole and drain covers

3.6 Under Contract C, Contractor C was required to:

(a) modify an existing sewerage manhole (Manhole A) at LMR and re-install the multi-part cover of manhole desilting opening;

(b) construct another sewerage manhole (Manhole B) at LMR; and

(c) construct cut-off drains near the portals of the vehicular underpass near Lung Fu Road Roundabout.

3.7 After completion of Contract C in September 2019, dislocation of covers of these sewerage manholes and cut-off drains occurred between May 2021 and February 2023, as follows:

(a) for Manhole A, dislocation of covers occurred twice, once in April 2022 and in February 2023;

(b) for Manhole B, dislocation of covers occurred thrice between September and November 2021; and

(c) dislocation of covers of the cut-off drains occurred four times between May 2021 and November 2022, and the concrete surrounding of cut-off drains was found to be cracked.

3.8 According to HyD:

(a) subsequent to the incidents, Consultant X conducted investigations and noted that the dislocation of covers was due to frequent traffic with high wheel loads (which was agreed by HyD);

(b) as Contract C was already substantially completed in September 2019, Consultant X issued 3 VOs (later valued at a total additional cost of $3 million) under Contract H (which covered road improvement works) between August 2022 and April 2023, instructing Contractor H to carry out the related modification works (e.g. change of design and upgrading works of covers which could resist higher wheel loads) to prevent dislocation of manhole and drain covers to enhance road safety; and

(c) subsequent to the completion of the related modification works (which included upgrading works of covers for resisting higher wheel loads), dislocation of covers at the locations concerned did not occur.

3.9 In Audit's view, HyD needs to draw lessons from the dislocation of manhole and drain covers constructed under Contract C with a view to improving the design of such works in future works projects.

Need to take into account future maintenance needs in a timely manner

3.10 According to Contract D, Contractor D was required to design, supply and install tunnel Vitreous Enamel (VE) panel walls along two sides of tunnel tubes for TM-CLK Tunnel. After the commencement of Contract D, based on the contract drawings of the reference design (which indicated that the tunnel VE panel walls should comprise an inclined panel at the upper part and a vertical panel at the lower part), Contractor D submitted a final design (which comprised a 1.45-m high inclined VE panel at the upper part and a 2.9-m high vertical VE panel at the lower part) in February 2019, which was later approved by HyD and Consultant X in March 2019.

3.11 Audit noted that:

(a) at the planning stage, HyD project team and Consultant X had circulated the reference design drawings of the tunnel VE panel to the maintenance office of HyD (i.e. the New Territories Regional Office of HyD — see Note 32 to para. 2.28) for comment in April 2016. The maintenance office of HyD had no comment on the reference design;

(b) after the approval of final design in March 2019, the maintenance office of HyD subsequently commented in the same month that, these 2.9-m high vertical VE panels would impose difficulty in manual dismantling due to their heavy weight from operation and maintenance viewpoint; and

(c) to enhance mobilisation and workers' safety in future operation and maintenance, particularly under emergency condition, it was considered necessary to split the vertical VE panel into 2 rows (each of 1.45-m high) with lighter weight to facilitate manual dismantling for future maintenance operation.

In the event, in April 2020, a VO (later valued at an additional cost of $5.5 million) was issued to instruct Contractor D to revise the design and split the vertical VE panel into 2 rows.

3.12 In Audit's view, in implementing works contracts involving tunnel works, HyD needs to take into account future maintenance needs in a timely manner when formulating VE panel design.

Need to critically vet tender documents

3.13 Audit noted that there was scope for improvement in vetting tender documents of Contract D, as follows:

(a) ***Construction works for emergency vehicular access not specified in contract documents.*** According to Contract D, Contractor D was required to construct a vehicular access for future tunnel area operation vehicles. The vehicular access would also serve as an emergency vehicular access in future. After the commencement of Contract D, Consultant X noted that the concrete paving, drainage and associated emergency vehicular access signage for the vehicular access surrounding the maintenance depot had not been specified in the contract drawing nor included in the contract scope. In the event, a VO (later valued at an additional cost of $5.5 million) was issued in November 2019 to instruct Contractor D to carry out the related works; and

(b) ***Discrepancies among contract documents.*** During the course of construction, Contractor D had sought clarifications from Consultant X for the details of works as there were discrepancies among contract documents (e.g. among contract drawings, or between Particular Specification and contract drawings) under Contract D. In the event, 10 instructions were issued by Consultant X under Contract D to clarify the details of works, resulting in a total additional cost of $92.6 million.

3.14 According to the Project Administration Handbook for Civil Engineering Works, care should be taken to avoid any ambiguities or discrepancies in the documents which form a contract as contractual claims and disputes are often caused by inconsistencies in or between the documents. As such, the documents forming a contract must be scrutinised for comprehensive coverage, accuracy and consistency with one another before tenders are invited.

3.15 In this connection, Audit noted that after the award of Contract D (i.e. April 2018), HyD had updated its internal guidelines in December 2018 to enhance the checking of the submissions from its consultants. In Audit's view, in preparing documents for works contracts, HyD needs to:

(a) take additional measures to critically vet tender documents to ensure their completeness, accuracy and consistency with one another before tenders are invited; and

(b) remind its staff and consultants to follow the related guidelines in checking tender documents.

Need to keep under review the adoption of new technologies

3.16 Audit noted that Contract D had introduced and adopted certain new technologies, as follows:

(a) in September 2019, Consultant X issued a VO (later valued at an additional cost of $3.9 million) instructing Contractor D to use the Building Information Modelling (BIM) to provide three-dimensional visualisation of screen captured images and drive-through simulation videos before commissioning of TM-CLKL, which could facilitate communication with

various stakeholders including road users, operational and maintenance parties. According to HyD, the BIM model was handed over to and is being used by the maintenance office of HyD as a reference to facilitate day-to-day inspection and maintenance; and

(b) in December 2020, Consultant X issued a VO (later valued at an additional cost of $2.6 million) instructing Contractor D to design, supply, and install a Smart Fire System Mobile Application (Note 44) for remote monitoring the real time status of the fire alarm system at TM-CLK Tunnel.

3.17 In Audit's view, HyD needs to keep under review the adoption of new technologies under Contract D (e.g. BIM and the Smart Fire System Mobile Application) and conduct reviews on their effectiveness for tapping the experience for implementing future works projects.

Audit recommendations

3.18 **Audit has *recommended* that the Director of Highways should:**

(a) **in implementing works projects involving construction of slope and retaining wall:**

(i) **remind HyD staff and consultants to conduct thorough pre-tender site investigation as far as practicable in accordance with the related guidelines; and**

Note 44: *According to HyD: (a) to align with the Government's directive to promote wider use of innovation and technology, HyD was requested to actively deploy innovation and technology solutions to enhance the operational efficiency and fire safety of TM-CLKL after the commencement of Contract D; and (b) in this connection, a mobile application for fire event notification (i.e. the Smart Fire System Mobile Application) has been developed as an enhancement of fire communication and emergency response, and to give alerts in case of fire incidents. As soon as a fire incident is detected in the main fire alarm panel, the system would automatically generate notifications to relevant tunnel front-line staff about the fire location via the mobile application for prompt action. Moreover, other information on the fire alarm panel could be displayed on the mobile application as appropriate. This would enable the fire alarm system to provide direct update of fire location information to staff at all levels for enhancing emergency response action.*

(ii) **closely monitor the progress of varied works (if any) to minimise the time and cost implications;**

(b) **draw lessons from the dislocation of manhole and drain covers constructed under Contract C with a view to improving the design of such works in future works projects;**

(c) **in implementing works contracts involving tunnel works, take into account future maintenance needs in a timely manner when formulating VE panel design;**

(d) **in preparing documents for works contracts:**

(i) **take additional measures to critically vet tender documents to ensure their completeness, accuracy and consistency with one another before tenders are invited; and**

(ii) **remind HyD staff and consultants to follow the related guidelines in checking tender documents; and**

(e) **keep under review the adoption of new technologies under Contract D (e.g. BIM and the Smart Fire System Mobile Application) and conduct reviews on their effectiveness for tapping the experience for implementing future works projects.**

Response from the Government

3.19 The Director of Highways agrees with the audit recommendations. He has said that HyD will:

(a) in implementing works projects involving construction of slope and retaining wall:

(i) remind its staff and consultants to conduct thorough pre-tender site investigation as far as practicable in accordance with the related guidelines; and

(ii) enhance the monitoring of the progress of varied works (if any) to minimise the time and cost implications;

(b) adopt appropriate type of manhole and drain covers taking into account the actual traffic loading as far as practicable for use in carriageways especially those exposed to frequent and heavy traffic;

(c) in implementing works contracts involving tunnel works, take into account future maintenance needs in a timely manner when formulating VE panel design;

(d) in preparing documents for works contracts, remind its staff and consultants to follow the latest guidelines in vetting tender documents to ensure their completeness, accuracy and consistency with one another before tenders are invited; and

(e) keep under review the adoption of new technologies and their effectiveness for tapping the experience for implementing future works projects.

Site safety

3.20 According to Contracts A to H, contractors should:

(a) throughout the progress of the works take full responsibility for the adequate stability and safety of all operations on the site and have full regard for the safety of all persons on the site; and

(b) keep the site and the works in an orderly state appropriate to the avoidance of danger to all persons.

3.21 According to the Construction Site Safety Manual issued by DEVB, contractors are required to:

(a) verbally report to the Supervising Officer/Engineer's site staff immediately dangerous occurrences and accidents involving death, serious injury,

serious damage or with worker admitted to the hospital, followed by preliminary accident report within 24 hours; and

(b) send a monthly report to the Supervising Officer/Engineer's Representative of all accidents and dangerous occurrences whether they are of a serious nature or not.

According to HyD, a safety review meeting (attended by HyD, Consultant X and the contractor) was held for Contracts A and B after their completion respectively to review the accidents occurred during the contract period.

Scope for enhancing construction site safety

3.22 According to HyD, from the contract commencement dates of the respective contracts to August 2024, 2 fatal accidents and 173 non-fatal reportable accidents happened at the construction sites of Contracts A to F and H (Note 45).

3.23 ***Fatal accidents.*** The following 2 fatal accidents happened at the construction sites of Contracts A and B:

(a) on 7 April 2015, at the reclamation area of the Northern Connection sub-sea tunnel section (i.e. the construction site of Contract B), an auxiliary hook of a crawler crane fell on the crane operator's cabin, resulting in a fatal injury of the crane operator. For this fatal accident, Contractor B and its subcontractor were prosecuted for violation of the Factories and Industrial Undertakings Ordinance (Cap. 59). The summonses against Contractor B and its subcontractor were dismissed after the trial. According to HyD:

(i) the crane operator together with 5 workers were working on crane dismantling work. The auxiliary hook was considered to be over-hoisted and fell on the crane operator's cabin, causing this fatal

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Note 45: *As of August 2024, 7 contracts (Contracts A to F and H) were completed and 1 contract (Contract G) was in progress. For Contract G, there had been no fatal accidents nor non-fatal reportable accidents at the construction site since its contract commencement date and up to August 2024.*

accident. A "poor" performance rating was reflected in the site safety aspect in Contractor B's performance report for the period from March to May 2015 in respect of this fatal accident on 7 April 2015; and

(ii) improvement measures had been taken, including developing a more detailed crane inspection checklist, providing toolbox talk to crane operators, and implementing a new permit system regarding crawler crane; and

(b) on 23 April 2016, at the Southern Connection viaduct section (i.e. the construction site of Contract A), a worker was dragged into the sea by the falling metal fence and drowned while working near the edge of a sea viaduct under construction. For this fatal accident, Contractor A and its subcontractor were prosecuted for violation of the Factories and Industrial Undertakings Ordinance and the Factories and Industrial Undertakings (Safety Management) Regulation (Cap. 59AF). They were convicted and fined for a total of $250,000 in January 2019. According to HyD:

(i) while the worker had attached the lanyard of the safety harness to the metal fence, the metal fence suddenly detached from the segment. The worker fell into the sea together with the metal fence, and eventually sank due to the weight of the metal fence, causing this fatal accident. A "very poor" performance rating was reflected in the site safety aspect in Contractor A's performance report for the period from March to May 2016 in respect of this fatal accident on 23 April 2016; and

(ii) improvement measures had been taken, including appointing engineers to enhance communication and control of edge protection erected on site, posting signs to clearly show pre-tested designated anchor points and reviewing existing and the development of new edge protection system.

3.24 ***Non-fatal reportable accidents.*** From the contract commencement dates of the respective contracts to August 2024, 173 non-fatal reportable accidents happened at the construction sites of Contracts A to F and H (34 for Contract A, 130 for Contract B, 2 for Contract C, 7 for Contract D, and nil for

Contracts E, F and H), involving sick leave ranging from 4 to 750 days. Audit noted that:

(a) according to HyD, Consultant X did not compile management information on whether the contractors had timely reported the reportable accidents and submitted the related reports to Consultant X in accordance with the Construction Site Safety Manual (see para. 3.21). In September 2024, HyD informed Audit that according to Consultant X, there were 2 and 7 cases of late submission of the preliminary accident report by Contractors A and B respectively, with delays ranging from 8 to 98 days; and

(b) of the 173 non-fatal reportable accidents, 3 (2 under Contract A and 1 under Contract B) were reported in the safety review meetings but not included in the monthly reports submitted by the contractors to Consultant X.

3.25 In Audit's view, in implementing works projects, HyD needs to:

(a) make continued efforts to enhance site safety with a view to safeguarding safety of all operations and all persons on sites; and

(b) take additional measures to ensure that its contractors timely report accidents at construction sites (including submission of related reports) in accordance with related requirements, including:

(i) requiring the Supervising Officer/Engineer to compile management information for monitoring the compliance with related requirements; and

(ii) reminding its contractors to include all accidents in the monthly reports submitted to the Supervising Officer/Engineer's Representative.

Need to ensure that contractors submit reports relating to site safety monitoring procedure in accordance with contract requirements

3.26 According to the site safety monitoring procedure laid down in Contracts A and B, the contractors shall submit a report to Consultant X to outline the problem areas in relation to site safety, actions taken/to be taken to improve the safety performance and the way the site safety improvement measures to be monitored when:

(a) there are 2 or more accidents in the previous 2 months and the two-month moving average of the accident rate (i.e. the number of reportable accidents per 100,000 man-hours worked) is higher than 0.6; and/or

(b) there are 3 or more accidents in the previous 2 months and the three-month moving average of the accident rate is higher than 0.9 (Note 46).

3.27 Audit noted that, during the contract periods for Contracts A and B (i.e. 73 and 83 months from the contract commencement dates to the actual completion dates respectively), in 2 out of the 73 months for Contract A and 16 out of the 83 months for Contract B, the conditions for triggering the site safety monitoring procedure were met and reports should be submitted by the contractors outlining the problem areas in relation to site safety, actions taken/to be taken to improve the safety performance and the way the site safety improvement measures to be monitored. However, for 3 out of the 16 months, Contractor B did not submit the required reports.

3.28 In Audit's view, in implementing works projects, HyD needs to enhance the monitoring to ensure that its contractors submit the reports relating to site safety monitoring procedure in accordance with the contract requirements.

Note 46: *For Contracts C to H, similar site safety monitoring procedure was laid down. During the periods from their respective contract commencement dates to August 2024, the conditions for triggering the site safety monitoring procedure did not occur for Contracts C to H.*

Audit recommendations

3.29 **Audit has *recommended* that the Director of Highways, in implementing works projects, should:**

(a) **make continued efforts to enhance site safety with a view to safeguarding safety of all operations and all persons on sites;**

(b) **take additional measures to ensure that HyD contractors timely report accidents at construction sites (including submission of related reports) in accordance with related requirements, including:**

(i) **requiring the Supervising Officer/Engineer to compile management information for monitoring the compliance with related requirements; and**

(ii) **reminding HyD contractors to include all accidents in the monthly reports submitted to the Supervising Officer/Engineer's Representative; and**

(c) **enhance the monitoring to ensure that HyD contractors submit the reports relating to site safety monitoring procedure in accordance with the contract requirements.**

Response from the Government

3.30 The Director of Highways agrees with the audit recommendations. He has said that HyD will:

(a) make continued efforts to enhance site safety with a view to safeguarding safety of all operations and all persons on sites;

(b) take additional measures to ensure that its contractors timely report accidents at construction sites in accordance with related requirements, including:

(i) requiring the Supervising Officer/Engineer to compile management information for monitoring the compliance with related requirements; and

(ii) reminding its contractors to include all accidents in the monthly reports submitted to the Supervising Officer/Engineer's Representative; and

(c) enhance the monitoring to ensure that contractors submit reports relating to site safety monitoring procedure in accordance with the contract requirements.

PART 4: OPERATION AND TRAFFIC MANAGEMENT

4.1 This PART examines the operation and traffic management related to TM-CLKL, focusing on:

(a) MOM of TM-CLK Tunnel (paras. 4.2 to 4.23); and

(b) traffic management of TM-CLKL (paras. 4.24 to 4.29).

Management, operation and maintenance of the Tuen Mun-Chek Lap Kok Tunnel

4.2 In September 2020, TD awarded the first MOM agreement for TM-CLK Tunnel through open tender to Operator A at a fixed lump sum management fee of $298.6 million for four years from 27 December 2020 to 26 December 2024. Operator A is responsible for the proper MOM of TM-CLK Tunnel, including ensuring safe and efficient traffic movement, regulating and controlling vehicular traffic, managing and patrolling the area, and removing any vehicle or thing causing obstruction.

4.3 ***Monitoring operation of TM-CLK Tunnel.*** According to TD:

(a) TD is responsible for monitoring the operation and performance of Operator A; and

(b) the Electrical and Mechanical Services Department (EMSD) is engaged by TD to provide advisory services, technical supports and monitoring services relating to the E&M equipment in TM-CLK Tunnel.

Staff manning level requirements not met

4.4 According to the MOM agreement:

(a) Operator A shall at all times provide and maintain sufficient number of staff at various ranks (e.g. operations supervisor, traffic officer and technical supervisor) for MOM of TM-CLK Tunnel. If the number of actual working hours of Operator A's staff of the designated ranks is less than the required number of working hours specified in the MOM agreement, TD will require Operator A to pay the sum for shortfall of working hour of each designated rank of staff for each hour as liquidated damages;

(b) when the number of Operator A's staff employed at any designated rank is potentially to fall below the manning level (i.e. 140 staff), Operator A shall notify TD and submit for approval a proposal of remedial measures to make up the possible shortfall; and

(c) Operator A shall implement the human resources plan as set out in the MOM agreement to ensure staff stability and sufficient competent staff. TD may from time to time review and revise the manning level stipulated in the MOM agreement, or require Operator A to review and revise the human resources plan.

4.5 Audit noted that, since the commissioning of TM-CLK Tunnel in December 2020 and up to June 2024 (i.e. 43 months):

(a) the number of actual working hours of the designated ranks of Operator A's staff was less than that specified in the MOM agreement in all the 43 months (an average shortfall of 4%), resulting in the payment of liquidated damages totalling $6.2 million by Operator A to TD; and

(b) the actual number of the designated ranks of Operator A's staff employed was less than that specified in the MOM agreement in all the 43 months. The monthly shortfall ranged from 8 to 30 staff (averaged 15 staff), representing 6% to 21% (averaged 11%) shortfall of the manning level of 140 staff (see Table 5).

Table 5

Shortfall of designated ranks of Operator A's staff (December 2020 to June 2024)

Type of staff	Manning level per MOM agreement	Actual staff shortfall on average
Operations staff	82	6
Maintenance staff	58	9
Overall	140	15

Source: TD records

4.6 According to TD:

(a) recruiting and retaining operations and maintenance staff of the tunnel industry has become increasingly difficult in recent years given the increasing number of new tunnels in operation and the specialised nature of the work;

(b) the duties of the shortfall of the designated ranks of staff are partly made up by overtime work of existing staff;

(c) it had reviewed the manning level of operations and maintenance staff of Operator A from time to time and had requested Operator A to take improvement measures, including:

(i) conducting training courses with a training body to attract new comers of operations staff to the tunnel industry; and

(ii) enhancing efforts in recruitment such as placing of recruitment advertisements, participating in public recruitment events and encouraging staff referrals; and

(d) with the implementation of the improvement measures and continued reminders from TD, as of June 2024, the shortfalls in both operations staff and maintenance staff were 4, which had been significantly improved as

compared to the peak of shortfall in operations staff of 13 (in January 2023) and maintenance staff of 18 (in December 2020).

4.7 Nonetheless, Audit noted that the shortfall of the designated ranks of Operator A's staff persisted. In particular, there was a shortfall of maintenance staff for all the 43 months since the commissioning of TM-CLK Tunnel and up to June 2024. Moreover, according to TD's review in February 2024, the required manning level for the next MOM agreement to be commenced in December 2024 would increase from 140 to 150 staff in view of the increasing traffic volume and the associated operational and maintenance needs to safeguard the safe and efficient operations of TM-CLK Tunnel. In Audit's view, overtime work of existing staff might not be adequate to address the situation and might have adverse impact on the service level and performance of the operator of TM-CLK Tunnel. Audit considers that TD needs to:

(a) keep under review the staff manning level requirements specified in the MOM agreement for TM-CLK Tunnel;

(b) require the operator of TM-CLK Tunnel to continue to review and revise the human resources plan in the MOM agreement as and when necessary with a view to ensuring staff stability and sufficient competent staff employed by the operator; and

(c) require the operator of TM-CLK Tunnel to take further measures with a view to complying with the staff manning level requirements (in particular for maintenance staff) stipulated in the MOM agreement.

Scope for improvement in assessing the performance of the operator of TM-CLK Tunnel

4.8 According to the MOM agreement, TD shall regularly measure the extent of Operator A's compliance with the quality and service standards specified in the MOM agreement, and Operator A shall monthly prepare and provide TD with major parameters in operating TM-CLK Tunnel (e.g. violations of environmental control standards). The performance assessment so derived shall constitute a sufficient ground for TD to consider Operator A's eligibility and suitability for undertaking other contracts to be awarded by TD, among a basket of assessment criteria.

4.9 In accordance with TD's guidelines, TD and EMSD quarterly assess Operator A's performance on aspects under their respective purview. Based on these assessments, TD prepares an overall quarterly performance assessment report on Operator A. According to TD, there are 20 items for assessing the performance of Operator A (e.g. air quality, arrival time for vehicle recovery within tunnel area and corporate governance). An overall performance rating for the quarter will be formed based on the ratings of these 20 assessment items.

4.10 Audit examination revealed that there was scope for improvement in assessing the performance of the operator of TM-CLK Tunnel, as follows:

(a) ***No timeframe set for completion of overall quarterly performance assessment report on Operator A.*** There was a total of 15 quarters since the commissioning of TM-CLK Tunnel in December 2020 and up to July 2024. TD did not set timeframe for the completion of the overall quarterly performance assessment report on Operator A. As of September 2024:

(i) TD had not completed 1 overall quarterly performance assessment report covering the period from May to July 2024; and

(ii) TD had completed 14 overall quarterly performance assessment reports covering the period from December 2020 to April 2024. However, TD did not date the reports to record the timing of completion;

(b) ***Need to review assessment basis.*** According to the overall quarterly performance assessment report:

(i) for 2 assessment items on "air quality" and "operation of ventilation system":

- the number of substandard cases was adopted as the assessment basis; and

- a performance rating of "very good" would be given when there were no substandard cases in the quarter under assessment.

According to TD, the ratings for these 2 assessment items were based on the number of substandard cases found during its routine on-site inspections and no substandard cases were found in all 14 quarters. Based on the results of the on-site inspections, a performance rating of "very good" was given to these 2 assessment items in all the 14 overall quarterly performance assessment reports completed by TD. In this connection, Audit noted that of these 14 quarters, Operator A reported 1 to 50 violations of environmental control standards (air quality relating to carbon monoxide, nitrogen dioxide or visibility levels) (Note 47) stated in the MOM agreement in 13 quarters. In only 1 quarter did Operator A report no violation of environmental control standards. There might be merit to take into consideration the number of related violations reported by Operator A in the assessment; and

(ii) for an assessment item on "arrival time for vehicle recovery within tunnel area", instead of arrival time (i.e. the time between the arrival of recovery vehicle at the incident spot and the arrival of first operational staff at the incident spot), clearance time (i.e. the time between the re-opening of the traffic lane to the traffic and the arrival of recovery vehicle at the incident spot) was adopted by TD as the assessment basis; and

(c) ***Need to document justification for performance rating.*** According to TD, for an assessment item on "corporate governance" in the overall quarterly performance assessment report, the performance rating was given by a Senior Transport Officer in consultation with his/her subordinates. Of the 14 overall quarterly performance assessment reports completed by TD:

(i) a performance rating of "poor" was given to the assessment item in 1 report with justification documented; and

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Note 47: *According to TD, the environmental control standards are monitored and recorded by a real-time air quality monitoring system at 5-minute intervals throughout the day. The 50 violation cases in the monthly operation reports submitted by Operator A covering the period between 1 May and 31 July 2021 represented 0.063% of the total number of records in the quarter.*

(ii) performance ratings of "good" or "satisfactory" were given to the assessment item in the remaining 13 reports. However, TD did not document the justification for these ratings.

4.11 In Audit's view, TD needs to take measures to improve the assessment of performance of the operator of TM-CLK Tunnel, including:

(a) considering setting timeframe for the completion of the overall quarterly performance assessment report on the operator;

(b) reviewing the assessment basis for each assessment item in the overall quarterly performance assessment report where appropriate; and

(c) improving the documentation on the justification for performance ratings in the overall quarterly performance assessment report.

Maintenance requirements of some tunnel equipment not included in the MOM agreement

4.12 Operator A shall take possession of, operate and maintain the tunnel equipment in accordance with the stipulations in the MOM agreement. Audit noted that the maintenance requirements of two tunnel equipment items (i.e. breathing apparatus and landfill gas monitoring equipment) were not included in the first MOM agreement (awarded in September 2020) and the maintenance responsibilities of the two items had not been ascertained before the commissioning of TM-CLK Tunnel in December 2020. Details are as follows:

(a) in August 2021 (i.e. 8 months after the commissioning of TM-CLK Tunnel), HyD requested TD to take up the maintenance responsibilities of the two tunnel equipment items. However, TD had a different view, as follows:

(i) it had not been notified earlier of the maintenance requirement of one of the two items; and

(ii) it was only first notified of the maintenance requirement of the other item on 26 November 2020, which was after the award of the first MOM agreement in September 2020;

(b) in April 2022 (i.e. 16 months after the commissioning of TM-CLK Tunnel), HyD proposed TD to require Operator A to take up the maintenance responsibilities of the two tunnel equipment items. TD responded that:

(i) these two items were not included in the first MOM agreement as the request for maintenance of the two items was raised only after the award of the MOM agreement and thus fell outside the maintenance obligation of Operator A; and

(ii) it would include the maintenance requirements of the two items in the second MOM agreement for TM-CLK Tunnel; and

(c) in September 2022 (i.e. 20 months after the commissioning of TM-CLK Tunnel), as an interim measure, HyD issued two VOs at an estimated cost of $0.5 million under Contract H, instructing Contractor H to take up the maintenance of these two tunnel equipment items until the commencement of the second MOM agreement for TM-CLK Tunnel in December 2024.

4.13 In Audit's view, HyD, in collaboration with TD, needs to:

(a) ascertain the maintenance responsibilities of all tunnel equipment before tender/award of MOM agreements for tunnels; and

(b) take additional measures to ensure that the maintenance requirements of tunnel equipment are included in MOM agreements for tunnels as appropriate.

Scope for improvement in vehicle recovery operations

4.14 According to the MOM agreement, all broken-down vehicles must be towed away expeditiously (within the standard clearance time of 5 to 12 minutes, depending on the type of vehicles involved (e.g. 8 minutes for heavy goods vehicles)) as the breakdown of vehicle interrupts traffic movements in the tunnel. In accordance with

the MOM agreement, TD provided 2 heavy recovery vehicles (HRVs) to Operator A solely and exclusively for discharging the obligations and duties (including vehicle recovery operations) under the MOM agreement.

4.15 Audit noted that:

(a) according to Operator A, it encountered problems in using HRV for two vehicle recovery operations (involving heavy goods vehicles) in May and June 2021 respectively, in which the front wheels of the HRV were tilted up off the ground, causing the recovery operations impossible. The two vehicle recovery operations were eventually completed by alternative methods (e.g. engaging an external party to provide vehicle recovery service) with a clearance time of 140 and 68 minutes respectively (exceeding the standard clearance time by 132 and 60 minutes respectively). Operator A had reported the problems encountered in these two vehicle recovery operations to TD and EMSD; and

(b) from June 2021 (the second vehicle recovery operation mentioned in (a) above) and up to May 2024, 5 more vehicle recovery operations (involving heavy goods vehicles) encountered similar problems (i.e. the front wheels of the HRV tilted up off the ground). The clearance time of these 5 vehicle recovery operations ranged from 20 to 80 minutes (exceeding the standard clearance time by 12 to 72 minutes). As of May 2024 (i.e. about 3 years after the first vehicle recovery operation encountering problems in May 2021), the issue relating to the 2 HRVs had yet to be resolved or rectified.

4.16 According to TD, it had ongoing discussions with EMSD since the issue was reported by Operator A. In September 2024, TD, EMSD and the manufacturer of the HRVs had ascertained the underlying reasons for the issue relating to the HRVs and were exploring feasible improvement measures such as strengthening the axle loading of the HRVs. In Audit's view, TD needs to, in collaboration with EMSD, expedite follow-up actions to resolve the problems in using the HRVs with a view to ensuring timely and safe vehicle recovery operations in TM-CLK Tunnel.

Need to explore measures to identify out-of-gauge vehicles

4.17 According to the MOM agreement, out-of-gauge vehicle (e.g. over-length) without a permit (Note 48) shall be refused to travel in TM-CLK Tunnel. Audit noted that over-height vehicle detectors were provided by TD under TCSS to Operator A to detect over-height vehicles. However, no other equipment or technology were provided to Operator A for auto-detection of other types of out-of-gauge vehicles. According to TD:

(a) once an over-height vehicle is detected, the operations staff will be alerted by the over-height alarm and proceed to stop the vehicle concerned from entering the tunnel; and

(b) when suspecting vehicles are over-length or over-width based on the observation on-site or via closed circuit television, the operations staff will stop the suspected vehicles and conduct measurement. For the suspected over-weight vehicles, the operations staff will direct the vehicles to the weighbridge station to weigh the vehicles.

4.18 In Audit's view, TD needs to explore additional measures to help the operator of TM-CLK Tunnel identify out-of-gauge vehicles with a view to preventing out-of-gauge vehicles without a permit passing through TM-CLK Tunnel.

Audit recommendations

4.19 **Audit has *recommended* that the Commissioner for Transport should:**

(a) **keep under review the staff manning level requirements specified in the MOM agreement for TM-CLK Tunnel;**

(b) **require the operator of TM-CLK Tunnel to continue to review and revise the human resources plan in the MOM agreement as and when**

Note 48: *According to the MOM agreement, Operator A shall be responsible for the issue of permits required under Regulation 14 of the Road Tunnels (Government) Regulations (Cap. 368A). The permit fee specified in the Regulation (i.e. $82 as of August 2024) shall be paid on the issue of a permit for the passage of a vehicle through TM-CLK Tunnel.*

necessary with a view to ensuring staff stability and sufficient competent staff employed by the operator;

(c) **require the operator of TM-CLK Tunnel to take further measures with a view to complying with the staff manning level requirements (in particular for maintenance staff) stipulated in the MOM agreement;**

(d) **take measures to improve the assessment of performance of the operator of TM-CLK Tunnel, including:**

(i) **considering setting timeframe for the completion of the overall quarterly performance assessment report on the operator;**

(ii) **reviewing the assessment basis for each assessment item in the overall quarterly performance assessment report where appropriate; and**

(iii) **improving the documentation on the justification for performance ratings in the overall quarterly performance assessment report;**

(e) **in collaboration with the Director of Electrical and Mechanical Services, expedite follow-up actions to resolve the problems in using the HRVs with a view to ensuring timely and safe vehicle recovery operations in TM-CLK Tunnel; and**

(f) **explore additional measures to help the operator of TM-CLK Tunnel identify out-of-gauge vehicles with a view to preventing out-of-gauge vehicles without a permit passing through TM-CLK Tunnel.**

4.20 **Audit has *recommended* that the Director of Highways should, in collaboration with the Commissioner for Transport:**

(a) **ascertain the maintenance responsibilities of all tunnel equipment before tender/award of MOM agreements for tunnels; and**

(b) **take additional measures to ensure that the maintenance requirements of tunnel equipment are included in MOM agreements for tunnels as appropriate.**

Response from the Government

4.21 The Commissioner for Transport agrees with the audit recommendations in paragraphs 4.19 and 4.20. She has said that TD will:

(a) continuously assess and monitor the staffing requirements specified in the MOM agreement for TM-CLK Tunnel;

(b) work with the operator of TM-CLK Tunnel to assess and adjust the human resources plan in the MOM agreement as and when necessary;

(c) require the operator of TM-CLK Tunnel to take further measures with a view to complying with the staff manning level requirements (in particular for maintenance staff);

(d) improve the performance assessment of the operator of TM-CLK Tunnel, including:

(i) setting timeframe for the completion of the overall quarterly performance assessment report on the operator;

(ii) revisiting and refining the assessment basis for each assessment item in the overall quarterly performance assessment report where appropriate; and

(iii) enhancing the documentation on the justifications for performance ratings;

(e) along with EMSD, take prompt follow-up actions to address issues related to the use of HRVs; and

(f) explore additional measures to help the operator of TM-CLK Tunnel identify out-of-gauge vehicles passing through TM-CLK Tunnel.

4.22 The Director of Highways agrees with the audit recommendations in paragraph 4.20. He has said that HyD will, in collaboration with TD:

(a) stocktake the tunnel equipment as exhaustively as possible so as to identify the maintenance responsibilities of all tunnel equipment in early stage of the project; and

(b) enhance liaison with all stakeholders with a view to ensuring that the maintenance requirements of tunnel equipment are included in MOM agreements for tunnels as appropriate.

4.23 The Director of Electrical and Mechanical Services agrees with the audit recommendation in paragraph 4.19(e).

Traffic management of the Tuen Mun - Chek Lap Kok Link

4.24 TM-CLKL provides an alternative road access between HKIA and the urban areas in addition to LL, and helps diverting traffic to and from Lantau. TD is responsible for monitoring the traffic conditions of TM-CLKL, designing and implementing traffic management measures, and other proposals to ensure the efficient use of limited road space and to enhance road safety (see para. 1.11). From 2021 to 2023, the annual average daily traffic volume of TM-CLKL (Note 49) increased from 17,548 vehicles in 2021 to 29,967 vehicles in 2023, and the v/c ratios (see Note 2 to para. 1.3(d)) of TM-CLKL (Note 50) ranged from 0.33 to 0.50.

Note 49: *This refers to the section of TM-CLKL from Lung Fu Road to HKP (see Note 8 to para. 1.11).*

Note 50: *According to TD, as of September 2024, the v/c ratios of TM-CLKL for 2023 were provisional figures yet to be finalised.*

Need to keep under review the traffic at TM-CLKL and relevant road sections in Tuen Mun

4.25 At a meeting of the Tuen Mun District Council in September 2020, in response to District Council Members' concerns on the impact of the commissioning of the Northern Connection of TM-CLKL on the traffic in Tuen Mun, TD commented that:

(a) the opening to traffic of TM-CLKL would not have a significant impact on the traffic in Tuen Mun. According to the research by Consultant X, the congestion on the busier major road sections in Tuen Mun would remain manageable until 2026; and

(b) TD would closely monitor traffic demand and changes in the road networks of Tuen Mun, and devise traffic management measures accordingly in a timely manner.

4.26 Audit noted that:

(a) from 2021 to 2024, the Tuen Mun District Council Members had expressed concerns about the persistent traffic congestion in Tuen Mun (e.g. on Wong Chu Road) since the commissioning of the Northern Connection of TM-CLKL in December 2020;

(b) a traffic survey was conducted by Consultant X under the Project in 2021 after the commissioning of the Northern Connection of TM-CLKL in December 2020. The traffic survey showed that the traffic flows at the relevant major road sections in Tuen Mun (including Wong Chu Road) had increased; and

(c) according to TD:

(i) the congestion on the relevant major road sections in Tuen Mun was still manageable;

(ii) the v/c ratios of Wong Chu Road (i.e. one of the relevant major road sections in Tuen Mun) had exceeded 1.0 (i.e. indicating the

onset of traffic congestion) since 2022 and increased to 1.17 in 2023; and

(iii) it had been monitoring the traffic at TM-CLKL after its commissioning and had planned/implemented improvement measures to alleviate the traffic conditions (Note 51).

4.27 In Audit's view, TD needs to keep under review the traffic at TM-CLKL and relevant road sections in Tuen Mun, and take traffic management measures where appropriate.

Audit recommendation

4.28 **Audit has *recommended* that the Commissioner for Transport should keep under review the traffic at TM-CLKL and relevant road sections in Tuen Mun, and take traffic management measures where appropriate.**

Response from the Government

4.29 The Commissioner for Transport agrees with the audit recommendation. She has said that TD will continue to take forward measures to alleviate traffic conditions in Tuen Mun, including the relevant transport infrastructure projects set out in the Hong Kong Major Transport Infrastructure Development Blueprint.

Note 51: *According to TD: (a) in October 2023, TD implemented improvement measures relating to the enlargement and signalisation of Lung Fu Road Roundabout (connecting TM-CLK Tunnel to Lung Fu Road which ends at the junction with Wong Chu Road). After the implementation, the average waiting time for entering the roundabout was reduced by 1.5 minutes. TD had also planned/implemented other improvement measures such as adding road marking and junction improvement works; (b) as a medium-term measure, TD, with HyD, had formulated a traffic improvement scheme which included construction of slip roads connecting Tsing Wun Road and Lung Fu Road, and a slip road between Hoi Wing Road westbound and Tuen Mun Road northbound. As of August 2024, the design of the construction works under the traffic improvement scheme was in progress; and (c) as long-term measures, a group of major transport infrastructure projects to connect NWNT with Lantau and the urban areas, including Route 11, Tuen Mun Bypass, and widening of Yuen Long Highway, had been taken forward.*

Acronyms and abbreviations

Audit	Audit Commission
BIM	Building Information Modelling
CEDD	Civil Engineering and Development Department
DEVB	Development Bureau
E&M	Electrical and mechanical
EMSD	Electrical and Mechanical Services Department
EOTs	Extensions of time
ha	hectares
HKIA	Hong Kong International Airport
HKP	Hong Kong Port
HRVs	Heavy recovery vehicles
HyD	Highways Department
HZMB	Hong Kong-Zhuhai-Macao Bridge
km	kilometres
LegCo	Legislative Council
LL	Lantau Link
LMR	Lung Mun Road
m	metres
m^3	cubic metres
MOM	Management, operation and maintenance
NLH	North Lantau Highway
NWNT	North West New Territories
PCMO	Project Cost Management Office
TCSS	Traffic control and surveillance system
TD	Transport Department
TLB	Transport and Logistics Bureau
TM-CLKL	Tuen Mun - Chek Lap Kok Link
TM-CLK Tunnel	Tuen Mun-Chek Lap Kok Tunnel
VE	Vitreous Enamel
VO	Variation order
v/c	Volume-to-capacity