5 NOISE IMPACT

5.1 Introduction

This chapter presents the findings of the noise assessment for the proposed CKR during both the construction and operational phases. Construction airborne noise associated with the use of Powered Mechanical Equipment (PME) has been conducted. With the implementation of practical mitigation measures, construction noise impacts at most of the neighboring noise sensitive uses would be controlled to acceptable levels. However, for some receivers that are very close to some of the works sites, adverse residual impacts exceeding the construction noise criterion are anticipated even after implementing all practicable mitigation measures. Construction groundborne noise associated with the use of PME has also been conducted at representative noise sensitive receivers along the tunnel and the construction groundborne noise impacts would comply with the noise criteria.

Operational noise impacts associated with road traffic noise and fixed noise sources have also been investigated. With the implementation of mitigation measures, potential noise impacts would comply with the statutory criteria.

5.2 Legislation and Standards

5.2.1 Construction Phase

Construction Noise during Non-restricted Hours

The Noise Control Ordinance (NCO) (Cap. 400) provides the statutory framework for noise control in Hong Kong. Assessment procedures and standards are set out in the respective Technical Memoranda (TM) promulgated under the NCO. The following TMs are applicable to the assessment and control of construction noise.

- TM on Noise from Construction Work other than Percussive Piling (TM-GW);
- TM on Noise from Percussive Piling (TM-PP); and
- TM on Noise on Construction Work in Designated Areas (TM-DA).

To ensure a better environment, the TM-EIAO promulgated under the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) has imposed more stringent criteria. For construction, there is no statutory limit on daytime construction noise under the NCO and related TMs. Nevertheless, the TM-EIAO stipulates noise standards of 65 – 75 dB(A) for daytime construction activities, as shown in the table below.

Table 5.1: Noise Standards for Construction Activities

Uses	Noise Standards [1], $L_{eq\ (30\ mins)}$ dB(A)	
	0700 to 1900 hours on any day not being a Sunday or general holiday	1900 to 0700 hours or any time on Sundays or general holiday
All domestic premises including	75	(See Note 2)

Uses	Noise Standards [1], $L_{eq\ (30\ mins)}$ dB(A)	
	0700 to 1900 hours on any day not being a Sunday or general holiday	1900 to 0700 hours or any time on Sundays or general holiday
temporary housing accommodation		
Hotels and hostels	75	
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	70 65 (During examinations)	

Notes:
[1] The above standards apply to uses that rely on opened windows for ventilation.
[2] The criteria laid down in the relevant technical memoranda under the NCO for designated areas and construction works other than percussive piling may be used for planning purpose. A Construction Noise Permit (CNP) shall be required for the carrying out construction work during the period.

Construction Noise during Restricted Hours

The NCO also provides statutory control on general construction works during restricted hours (ie 1900 to 0700 hours (of the next day) from Monday to Saturday and at any time on Sundays or public holidays). The use of PME for construction works during restricted hours would require a Construction Noise Permit (CNP). The TM-GW details the procedures adopted by EPD for assessing such application. The granting of a CNP is subject to conditions stated in the CNP and it may be revoked at any time for failure to comply with the permit conditions.

In addition to the general controls on the use of PME during restricted hours, the use of Specified Powered Mechanical Equipment (SPME) and the undertaking of Prescribed Construction Work (PCW) during the restricted hours in a designated area are controlled by the TM-DA. Construction plant or equipment classified as SPME under the TM-DA includes hand-held breakers, bulldozers, concrete mixer lorries, dump trucks and poker vibrators. The PCW includes the erection or dismantling of formwork or scaffolding, hammering, handling of rubble, wooden boards, steel bars, or scaffolding material, and the disposal of rubble through plastic chutes.

The TM-DA details the procedures that should generally be adopted by the Authority for assessing the use of SPME during restricted hours and for determining whether a CNP would be issued.

Maximum noise levels from construction activities during restricted hours at affected NSRs are controlled under the TMs and shall not exceed the specified Acceptable Noise Levels (ANLs). These ANLs are stipulated in accordance with the Area Sensitivity Ratings established for the NSRs. The ANLs for construction works in Designated Areas are more stringent than those given in the GW-TM and summarized in the table below.

Table 5.2: Acceptable Noise Levels for Construction during Restricted Hours

Time Period	Acceptable Noise Levels for Area Sensitivity Ratings, dB(A)		
	A	B	C
All weekdays during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the day and	60 (45)	65 (50)	70 (55)

Time Period	Acceptable Noise Levels for Area Sensitivity Ratings, dB(A)		
	A	B	C
evening (0700 to 2300 hours)			
All days during the night-time (2300 to 0700 hours)	45 (30)	50 (35)	55 (40)

Note: Figures in brackets are ANLs for SPME construction work in designated areas

Area Sensitivity Rating (ASR)

The appropriate ASR for the NSR shall consider under consideration from below table.

Any NSR shall, irrespective of **Table 5.3**, be assigned an ASR of "C" if it is within 100 m of a zone designated as "Industrial" or "Industrial Estate" on a statutory Outline Zoning Plan, or an ASR of "B" if it is between 100 m and 250 m from such a zone, except in cases where **Table 5.3** indicates an ASR of "C".

Table 5.3 Area Sensitivity Ratings (ASRs)

Type of Area containing NSR	Degree to which NSR is affected by IF		
	Not Affected	Indirectly Affected	Directly Affected
(i) Rural area, including country parks or village type developments	A	B	B
(ii) Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii) Urban area	B	C	C
(iv) Area other than those above	B	B	C

Note:

For the purpose of Table 5.3, the following definitions apply:

"country park" means an area that is designated as a country park pursuant to section 14 of the Country Parks Ordinance;

"directly affected" means that the NSR is at such a location that noise generated by the IF is readily noticeable at the NSR and is a dominant feature of the noise climate of the NSR;

"indirectly affected" means that the NSR is at such a location that noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR;

"not affected" means that the NSR is at such a location that noise generated by the IF is not noticeable at the NSR; and

"urban area" means an area of high density, diverse development including a mixture of such elements as industrial activities, major trade or commercial activities and residential premises.

Despite any description made in this EIA, there is no guarantee that a CNP will be issued for the project construction. The Noise Control Authority will consider a well-justified CNP application, once filed, for construction works within restricted hours as guided by the relevant TMs issued under the NCO. The Noise Control Authority will take into account contemporary conditions / situations of adjoining land uses and any previous complaints against construction activities at the site before making a decision in granting a CNP. Nothing in the EIA report shall bind the Noise Control Authority in making a decision. If a CNP is to be issued, the Noise Control Authority shall include in it any conditions demand. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution under the NCO.

Percussive Piling

Under the TM-PP, CNPs are also required for percussive piling involving the use of diesel, pneumatic and / or steam hammer. This TM specifies the permitted hours and other conditions for percussive piling. The table below lists the acceptable percussive piling noise levels for various types of NSR.

Table 5.4: Acceptable Noise Levels for Percussive Piling

NSR Window Type or Means of Ventilation	ANL (dB(A))
(i) NSR (or part of NSR) with no window or other opening	100
(ii) NSR with central air conditioning system	90
(iii) NSR with windows or other openings but without central air conditioning system	85

Depending on the numbers and types of piling machines and the separation from NSRs, percussive piling may be restricted to 12, 5 or 3 hours per day. For NSRs that are particularly sensitive to noise, such as hospitals, medical clinics, educational institutions and courts of law, a further reduction of 10 dB(A) shall be applied to the above ANLs.

Blasting

The administrative and procedural control of all blasting operations in Hong Kong is vested in the Mines Division of the Civil Engineering and Development Department (CEDD). The Dangerous Goods (General) Regulations, Chapter 295 also stipulates that no person shall carry out blasting unless he possesses a valid mine blasting certificate to be issued by the Mines Division of CEDD. The Superintendent of Mines will review the application on a case-by-case basis before issuing the Mine Blasting Certificate. Although there is no statutory noise level for blasting, the noise associated with the removal of debris and rocks are controlled under the TM-EIAO.

Construction Groundborne Noise

Noise arising from general construction works during normal working hours is governed by the TM-EIAO under the EIAO. The Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (TM-IND) under the NCO stipulates that noise transmitted primarily through the structural elements of building, or buildings, shall be 10 dB(A) less than the relevant ANLs.

Based on the same principle for the ground-borne noise criteria (i.e. ANL-10 dB(A) under the TM-IND), the construction groundborne noise levels inside domestic premises and schools shall be limited to 65 dB(A) and 60 dB(A) respectively when compared to the TM-EIAO. The construction groundborne noise criteria has been summarized in **Table 5.5**.

For construction works conducted on general holidays, Sundays and weekdays during evening (1900-2300 hrs) and night time (2300-0700 hrs) the following day, the construction groundborne noise level shall be limited to 10 dB(A) below the respective ANLs for the ASR appropriate to those NSRs affected by the Project. A summary of these criteria is given in the table below.

Table 5.5: Construction Groundborne Noise Criteria (Leq 30min, dB(A))

NSR type	Construction Groundborne Noise Criteria, dB(A)		
	Daytime (0700–1900) except general holidays and Sunday	Daytime (0700-1900) during general holidays and Sundays and all days during Evening (1900-2300 hrs)	Night-time (2300 – 0700 hrs)
All domestic premises including temporary housing accommodation	65	50/55/60[1,2]	35/40/45[1,2]
Hotels and hostel			
Educational institutions including kindergarten, nurseries and all others where unaided voice communication is required	60 55 (for during examination)	N/A[3]	N/A[3]

Notes:

[1] Based on the Basic Noise Level for NSRs with Area Sensitivity Ratings of A, B, and C detailed in the Technical Memorandum on Noise From Construction Work Other Than Percussive Piling.

[2] Construction Noise Permit is required for works during this period.

[3] No sensitive use in educational institutions during evening and night-time during normal period and on general holidays and Sunday is assumed except specified.

5.2.2 Operational Noise

The relevant legislation and associated guidelines applicable to the operational noise assessment includes:

- EIAO (Cap. 499);
- TM for the assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (TM-Places); and
- Hong Kong Planning Standards and Guidelines (HKPSG).

Road Traffic Noise

The TM-EIAO has stipulated the noise standards for various noise sources as shown in the following table.

Table 5.6: Noise Standards for Operational Phase (Road Traffic Noise)

Common Uses	Noise Standards [1]
	Road Traffic Noise $L_{10\ (1hour)}$ dB(A)
All domestic premises including temporary housing accommodation	70
Hotels and hostels	70
Offices	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65
Places of public worship and courts of law	65

Common Uses	Noise Standards [1]
	Road Traffic Noise $L_{10\ (1hour)}$ dB(A)
Hospitals, clinics, convalescences and homes for the aged, diagnostic rooms, wards	55

Notes:
[1] The above standards apply to uses that rely on opened windows for ventilation.

Fixed Noise Sources

Operational noise from fixed noise sources is controlled under the NCO's Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites. To plan for a better environment, the TM-EIAO has specified the following requirements.

- 5 dB(A) below the appropriate ANLs in the Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites (TM-IND); or
- the existing noise levels (For quiet areas with level 5dB(A) below the ANL).

Table 5.7: Noise Standards for Operational Phase (Fixed Noise Sources)

Common Uses	Noise Standards [1]
	Fixed Noise Sources
All domestic premises including temporary housing accommodation	(a) 5dB(A) below the appropriate Acceptable Noise Levels (ANL) shown in Table 2 of the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites, or (b) the prevailing background noise levels (For quiet areas with level 5 dB(A) below the ANL)
Hotels and hostels	
Offices	
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	
Places of public worship and courts of law	
Hospitals, clinics, convalescences and homes for the aged, diagnostic rooms, wards	

The ANLs for different ASR (refers to **Table 5.3**) during different periods are summarized in the following table.

Table 5.8: Acceptable Noise Levels for Fixed Noise Sources

Time Period	ANL, dB(A)			ANL-5, dB(A)		
	ASR A	ASR B	ASR C	ASR A	ASR B	ASR C
Day (0700 to 1900 hours)	60	65	70	55	60	65
Evening (1900 to 2300 hours)	60	65	70	55	60	65
Night (2300 to 0700 hours)	50	55	60	45	50	55

Note: ASR – Area Sensitivity Rating

Noise from Public Transport Interchange

There are no noise level standards stipulated for the noise from the operation of public transport interchange (PTI). Chapter 9 of Hong Kong Planning Standards and Guidelines (HKPSG) provides considerations for the Project Proponent to determine the location and layout of a PTI during planning stage.

5.3 Noise Sensitive Receivers

With reference to Annex 13 of the TM-EIAO, NSRs include residential uses (all domestic premises including temporary housing), institutional uses (educational institutions including kindergarten and nurseries), hospitals, medical clinics, homes for the aged, convalescent homes, places of public worship, libraries, court of law, performing arts centers, auditoria and amphitheatres, country park and others. All hospitals and performance venues are air-conditioned and do not rely on opened windows for ventilation.

Representative NSRs within a distance of 300m from the either side of the project boundary have been identified. The first layer of NSRs has been identified and selected for assessment. These NSRs will cover all existing sensitive developments (including those occupied before completion of the construction) for construction noise assessment, and both the existing and planned developments for operational noise assessment.

Existing Receivers

The existing NSRs are identified by means of topographic maps, aerial photos, land status plans and several site surveys.

Planned/Committed Receivers

Planned/committed NSRs are identified by making reference to relevant Outline Zoning Plans (OZP), Outline Development Plans, Layout Plans and other published plans in the vicinity of the alignment, including:

- South West Kowloon (KPA 20) Outline Zoning Plan (No. S/K20/27);
- Tsim Sha Tsui (KPA 1) Outline Zoning Plan (No. S/K1/26);
- Yau Ma Tei (KPA 2) Outline Zoning Plan (No. S/K2/21);
- Ho Man Tin (KPA 6 & 7) Outline Zoning Plan (No. S/K7/22);
- Hung Hom (KPA 9) Outline Zoning Plan (No. S/K9/24);
- Ma Tau Kok (KPA 10) Outline Zoning Plan (No. S/K10/20);
- Kai Tak (KPA 22) Outline Zoning Plan (No. S/K22/4); and
- Ngau Tau Kok & Kowloon Bay (KPA 13 & 17) Outline Zoning Plan (No. S/K13/27)

A list of planned/ committed noise sensitive receivers was identified and summarized below.

West Portion

There are several areas zoned as Governmental, Institution and Community (G/IC) in West Portion. Planning use of these G/IC zone has been requested from Planning Department and a letter from Planning Department showing the potential uses of G/IC sites in West Kowloon latest OZP No. S/K20/27 is shown in **Appendix 5.1A**. Some of the G/IC uses are identified as noise sensitive receivers including Refuse Collection Point and Street Sleepers' Shelters, Primary School and Hindu Temple for assessment.

According to the information provided by the respective project proponents of Street Sleepers' Shelters and Hindu Temple, the Street Sleepers' Shelters will be a 4-storey building with sensitive facades facing Ferry Street and Hau Cheung Street, the Hindu Temple will be a 10-storey building with sensitive facade facing West Kowloon Highway. However, there are no confirmed information on the layout of the planned school, referenced has been made to the existing schools in surrounding. It has therefore been assumed the school is 8-storey. The Coronation is a residential premises located at OZP No. S/K20/27, which is zoned as R(A)1. The latest layout and number of storey have been adopted in this assessment, which has already confirmed by site inspection. There are no confirmed intake programme of Hindu Temple and Primary School, hence, these two receivers are not included as construction noise impact assessment.

Central Portion

According to the latest OZP No. S/K7/21, there is a R(B)2 zone next to the planned Project site office which is under construction. However, as no confirmed building layout is available during the preparation of this EIA study, assessments point at the boundary has been selected for airborne construction noise impact assessment.

East Portion

All selected planned / committed receivers at East portion were based on latest Kai Tak Outline Zoning Plan (No. S/K22/4) gazetted on 14 Sept 2012. As no confirmed building layout is available during the preparation of this EIA study, assessment locations have been selected at this area including residential uses, comprehensive development area, planned hospital and planned school. The building height restriction and the population intake of these planned receivers is based on the latest Kai Tak Outline Zoning Plan.

For the planned school, the school layout has assumed as typical school layout and sensitive facades surrounding the building layout are selected for assessment.

Overall

The locations of the representative NSRs for noise impact assessment during both construction and operation of the project are illustrated in **Figures 5.1.1 – 5.3.2**, and are summarized in the table below. Groundborne noise sensitive receivers have been selected at both portal end and central portion given that separation distance between these selected noise sensitive receivers to the rock head level would be minimum along the alignment. **Figure 2.3** shows the longitudinal profile of CKR. A summary of noise sensitive receivers is tabulated in **Appendix 5.1**. Photos showing existing noise sensitive receivers are given in **Appendix 5.2**.

Table 5.9: Representative NSRs for Noise Impact Assessment

NSR ID	Description	Landuse [1]	No. of Storey	Construction Phase		Operational Phase	
				Airborne	Groundborne	Road Traffic Noise	Fixed Plant Noise
West Portion							
W-N1A	Yau Ma Tei Catholic Primary School (Hoi Wang Road)	E	8	√	X	√	√
W-N1B	Yau Ma Tei Catholic Primary School (Hoi Wang Road)	E	8	X	X	√	X
W-N2	Charming Garden Block 12	R	23	√	X	√	√
W-N3	Yau Ma Tei Catholic Primary School (Tung Kun Street)	E	7	√	X	√	X
W-N6	Man Cheong Building	R	18	X	X	√	X
W-N6A	Man Wai Building	R	18	X	X	√	X
W-N7	Kum Lam Building	R	12	√	X	√	X
W-N8	Dickson Building	R	18	√	X	√	X
W-N8A	Tak Cheong Building	R	18	√	X	√	X
W-N9A	Yau Ma Tei Jockey Club Polyclinic	H	10	X	X	√	X
W-N9B	Yau Ma Tei Jockey Club Polyclinic	H	10	X	X	√	X
W-N10A	Alhambra Building (West façade)	R	15	√	√	√	X
W-N10B	Alhambra Building (West façade)	R	15	√	X	X	X
W-N10C	Alhambra Building (North façade)	R	15	X	X	√	X
W-N11	Hong Kong Community College (HKCC) of the HK [1]	E	19	√	X	√	X
W-N14	Charming Garden Block 1	R	22	X	X	√	√
W-N15	HKMA David Li Kwok Po College	E	8	√	X	√	X

NSR ID	Description	Landuse [1]	No. of Storey	Construction Phase		Operational Phase	
				Airborne	Groundborne	Road Traffic Noise	Fixed Plant Noise
W-N18	Hydan Place	R	17	√	X	√	X
W-N19	Methodist College	E	6	√	√	√	X
W-N20	Tang's Mansion	R	15	X	X	√	X
W-N21	Temple Street No. 56	R	7	√	X	√	X
W-N22	Kamly Court	R	10	√	X	√	X
W-N23	Hang Wan House	R	23	√	X	√	X
W-N24	Prosperous Garden Block 5	R	27	√	X	√	X
W-N25A	Prosperous Garden Block 1	R	28	√	X	√	X
W-N25B	Prosperous Garden Block 1	R	28	X	X	√	X
W-N26A	Prosperous Garden Block 2	R	28	X	X	√	X
W-N26B	Prosperous Garden Block 2	R	28	X	X	√	X
W-N27	Prosperous Garden Block 3	R	28	X	X	√	X
W-N28	Wah Tak Building	R	17	X	X	√	X
W-N29	Tin Hau Temple	W	1	X	X	√	X
W-N30	The Sorrento	R	50	X	X	√	X
W-N31	Shanghai Street No. 217-225	R	5	√	X	X	X
W-N32	Sing On Building	R	5	√	X	X	X
W-P6A, C	Refuse Collection Point and Street Sleepers' shelters (Planned)	GIC	4	√	X	√	X
W-P7A-G	Primary School (Planned)	E	8	X	X	√	X
W-P8	Hindu Temple (Planned) [2]	W	10	X	X	√	√

NSR ID	Description	Landuse [1]	No. of Storey	Construction Phase		Operational Phase	
				Airborne	Groundborne	Road Traffic Noise	Fixed Plant Noise
W-P9	The Coronation	R	30	√	X	√	X
W-P10	The Coronation	R	30	X	X	√	X
W-P11	The Coronation	R	30	√	X	√	X
W-P12	The Coronation	R	30	√	X	√	X
W-P13	The Coronation	R	30	X	X	√	X
W-P14	The Coronation	R	30	X	X	√	X
Central Portion							
M-N1	Kar Man House, Oi Man Estate	R	6	√	√	X	√
M-N2	Carmel on the Hill	R	25	√	X	X	√
M-N3	SKH Tsoi Kung Po Secondary School	E	8	√	√	X	√
M-N4	Man Fuk House Block A	R	15	√	X	X	√
M-N5	Cascades Block A	R	18	√	X	X	X
M-N6	Ko Fai House, Kwun Fai Court	R	9	√	√	X	√
M-P2	Planned Residential Area B (Planned)	R	-	√	X	X	√
M-P3	Planned Residential Area B (Planned)	R	-	√	X	X	√
East Portion							
E-N6	Grand Waterfront Tower 5	R	51	√	X	X	X
E-N11	Holy Carpenter Primary School	E	6	√	X	X	X
E-N12	Grand Waterfront Tower 3	R	51	√	√	X	X
E-N13	Grand Waterfront Tower 1	R	51	√	X	X	X

NSR ID	Description	Landuse [1]	No. of Storey	Construction Phase		Operational Phase	
				Airborne	Groundborne	Road Traffic Noise	Fixed Plant Noise
E-N14	Chong Chien Court Block J	R	13	√	√	X	X
E-N15	Hang Chien Court Block I	R	13	√	X	X	X
E-N19	Buddhist Chi King Primary School	E	8	√	X	√	X
E-N20	Hing Yan Street No. 29	R	7	√	X	X	X
E-N21	Hang Chien Court Block J	R	13	√	X	X	X
E-N22	Hang Chien Court Block H	R	13	√	X	X	X
E-P1	Site 1L2 (Planned)	R	32	X	X	√	X
E-P6	Site 5A4a (Planned)	CDA	20	X	X	√	X
E-P7	Site 5A4b (Planned)	CDA	35	X	X	√	X
E-P8	Site 1L3 (Planned)	R	15	X	X	√	√
E-P13A-B	Site 3C1 – Hospital (Planned)	H	14	X	X	√	X
E-P14A-G	Site 3B1- Secondary School (Planned)	E	10	X	X	√	√
E-P16	Site 1L3 (Planned)	R	32	X	X	√	X
E-P20	Site 1I3 (Planned)	R	32	√	X	√	X
Barging Point							
B-N1	Grand Horizons	R	36	√	X	X	X

Notes:
R – residential; E – educational; H – clinic/ home for the aged/hospital; W – worship; GIC – government, institution and community; CDA – Comprehensive Development Area
√ – Include for assessment; X – Not included for assessment. Selected NSRs would better represent the impacts already.
[1] Central air-conditioning is provided.
[2] According to the information provided by the respective project proponent, this planned temple would have 10 storey high. The tentative layout has also been adopted in this EIA.

Prevailing Noise Levels

According to the latest design, there are three ventilation buildings, one near the western portal, one near the eastern portal and the central ventilation building will locate at the central portion near Ho Man Tin West Service Reservoir. Noise measurements have been conducted to establish the prevailing noise levels in the vicinity of the proposed ventilation buildings where fixed noise sources are anticipated. **Appendix 5.3** shows the measurement locations for prevailing noise levels. A summary of the results is given in the table below.

Table 5.10: Measurements of Prevailing Noise Levels

Measurement Location	Prevailing Noise Levels [1], dB(A) L_{eq}	
	Day & Evening [2]	Night [2]
West Portion (Location A)	64-68	60-61
West Portion (Location B)	65-66	55-56
Central Portion (Location C)	73-75	70-71
Central Portion (Location D)	73-74	69-70
East Portion (Location E)	69-71	66-69

Note:

[1] Measurements conducted in November 2011

[2] Day: 0700 to 1900 hours, Evening: 1900 to 2300 hours, Night: 2300 to 0700 hours

Area Sensitivity Rating

The table above shows the NSRs which close to the ventilation buildings may have potential fixed plant noise impact and these NSRs have been selected for fixed plant noise assessment. The ASR of NSRs identified for the fixed plant noise is summarized in the table below.

Table 5.11: ASR of Representative NSRs for Fixed Plant Noise Assessment

NSR ID	Landuse [1]	Type of Area	Influence Factor (IF)	Degree to which NSR is affected by IF	ASR
W-N1A	E	Urban	N/A	N/A	B
W-N2	R	Urban	N/A	N/A	B
W-N14	R	Urban	West Kowloon Expressway [2]	Directly	C
W-P8	W	Urban	West Kowloon Expressway [2]	Directly	C
M-N1	R	Urban	N/A	N/A	B
M-N2	R	Urban	N/A	N/A	B
M-N3	E	Urban	N/A	N/A	B
M-N4	R	Urban	N/A	N/A	B
M-N6	R	Urban	N/A	N/A	B
M-P2	R	Urban	N/A	N/A	B
M-P3	R	Urban	N/A	N/A	B
E-P8	R	Urban	Kai Fuk Road [3]	Directly	C

NSR ID	Landuse [1]	Type of Area	Influence Factor (IF)	Degree to which NSR is affected by IF	ASR
E-P14A	E	Urban	Kai Fuk Road [3]	Directly	C

Notes:
[1] R– residential; E – educational; W – Place of public worship
[2] The AADT of West Kowloon Expressway (Station no. 3707) is greater than 30,000 according to AADT 2011
[3] The AADT of Kai Fuk Road (Station no. 3206) is greater than 30,000 according to AADT 2011

Noise Criteria

A summary of the noise criteria at representative NSRs which would be subject to the impact of fixed plant noise is given in the following table. The prevailing noise level at each NSR would be determined based on measurement results at the nearest location as shown in the table below.

Table 5.12: Summary of Noise Criteria at NSRs for Fixed Noise Sources

Location	NSR	Time Period [1]	Prevailing Noise Levels, dB(A) [2]	ASR	ANL-5 dB(A) [3]	Criteria dB(A) [4]
West Portion (Location A)	W-N1A, W-N2	Day & evening	64	B	60	60
		Night	60	B	50	50
West Portion (Location A)	W-N14	Day & evening	64	C	65	64
		Night	60	C	55	55
West Portion (Location B)	WP-8	Day & evening	65	C	65	65
		Night	55	C	55	55
Central Portion (Location C)	M-N2, M-N3, M-N4	Day & evening	73	B	60	60
		Night	70	B	50	50
Central Portion (Location D)	M-N1, M-N6, M-P2, M-P3	Day & evening	73	B	60	60
		Night	69	B	50	50
East Portion (Location E)	E-P8, E-P14A	Day & evening	69	C	65	65
		Night	66	C	55	55

Note:
[1] Day: 0700 to 1900 hours, Evening: 1900 to 2300 hours, Night: 2300 to 0700 hours.
[2] Prevailing noise level determined based on the measurement result recorded at the representative location nearest to the respective NSR.
[3] A 5 dB(A) has been deducted from ANL as specified in requirement of TM-EIAO.
[4] The Minimum of [2] & [3] is adopted.

5.4 Construction Noise Impact Assessment

5.4.1 Construction Airborne Noise

Noise Sources

The latest construction methodology is described in **Chapter 3**. Based on the construction methodologies, the major construction works would include the following activities:

- Site clearance and formation activities;
- Structure dismantling;
- Tunnel construction (including non-blasting tunneling, drill-and-blast tunneling, underwater tunnel and cut-and-cover);
- Rock crushing inside the tunnel shaft of West, Central and East Portions;
- Construction of approach roads;
- Portal construction;
- Diversion of utilities;
- Spoils removal from underground works & stockpiling;
- Backfilling and reinstatement works; and
- Barging activities.

These construction activities would be carried out with the use of PME including breakers, excavators, lorries, mobile cranes, concrete pumps, concrete mixers, pokers, road rollers, etc. Sound Power Level (SWL) for each PME would be established according to TM-GW and other relevant information as appropriate.

All the works associated with the tunnel works (e.g. holes drilling and rock excavation etc) would be conducted deep inside the tunnel. For the operation of rock crushers in particular, they would be located typically at about 20 to 30m from the portals inside the tunnel. The approximate location of rock crushers are shown in **Appendix 5.4C**. Although the horizontal distance between the mucking out points and the sensitive receivers of West, Central and East Portions are within 50m, the rock crusher in the Central Portion will however be located over 100m vertically from the mucking out. Hence, only operations of rock crushers at West Portion and East Portion have been assessed.

Assessment Methodology

Construction airborne noise assessment has been conducted based on the following procedures:

- Determine the assessment area, and identify representative NSRs that may be affected by the works;
- Obtain the construction method and work sequence for the construction period;
- Obtain the plant items for each corresponding construction work sequence;
- Determine the sound power levels of the plant items according to the information stated in the TM-GW or other recognized sources of reference, where appropriate;
- Calculate the correction factors based on the distance between the NSRs and the notional noise source positions of the work sites;
- Apply corrections for façade, distance, barrier attenuation, acoustic reflection where applicable;
- Quantify the level of impact at the NSRs in accordance with TM-GW;
- Predict the cumulative noise impacts by any concurrent construction works in the vicinity; and

- For any exceedance of noise criteria, all practical mitigation measures such as alternative construction methodology, quiet plant, silencer, enclosure, etc, shall be examined to alleviate the predicted noise impacts as much as practicable.

Utilization Rates and SWLs of Powered Mechanical Equipment

Practically, the PMEs will not be operating for all times within a work site. The utilization rates would depend on the construction sequences, work fronts scale and construction nature. In this assessment, the utilization rates for each work front during different periods have been reviewed by the engineer and have been concluded to be practicable for the purpose of this EIA. **Appendix 5.4A** summarizes the adopted utilization rates and the associated SWL for different construction sequences.

Noise Assessment Tool

An in-house program has been used for construction noise calculations. Initially, the program runs were conducted without any mitigation measures (i.e. the "Unmitigated Scenario"). Where noise level exceedance was identified, further runs would be made assuming different combinations of mitigation measures to be incorporated (i.e. the "Mitigated Scenario").

Assessment Results - Unmitigated Scenario

According to the latest engineering design, the construction works would mainly comprise of the activities as described in **Section 3.5**. The corresponding Sound Power Levels (SWLs) of these activities have been estimated according to the PME's SWLs and the assessment methodology in the GW-TM. **Appendices 5.5A** to **5.8A** present the PME inventory adopted in each construction works area, including west portion, central portion and east portion. **Appendices 5.5B** to **5.8B** present the distance between the notional sources and the NSRs, screening effects due to terrains etc. **Appendices 5.5C** to **5.8C** present the monthly unmitigated noise contribution during the construction period. **Appendices 5.5D** to **5.8D** also present the unmitigated construction noise impacts at selected representative NSRs. The predicted construction noise impacts on the NSRs are summarized in the table below.

Table 5.13: Predicted Maximum Unmitigated Construction Noise Levels at NSRs

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Unmitigated Noise Level [2] dB(A)	Exceedance dB(A)
West Portion					
W-N1A	Yau Ma Tei Catholic Primary School (Hoi Wang Road)	E	70 (65)	**82**	12 (17)
W-N2	Charming Garden Block 12	R	75	**80**	5
W-N3	Yau Ma Tei Catholic Primary School (Tung Kun Street)	E	70 (65)	**92**	22 (27)
W-N7	Kum Lam Building	R	75	**95**	20

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Unmitigated Noise Level [2] dB(A)	Exceedance dB(A)
W-N8	Dickson Building	R	75	**94**	19
W-N8A	Tak Cheong Building	R	75	**95**	20
W-N10A	Alhambra Building (North façade)	R	75	**89**	14
W-N10B	Alhambra Building (West façade)	R	75	**88**	13
W-N11	Hong Kong Community College (HKCC) of the HK[3]	E	70 (65)	**85**	15 (20)
W-N15	HKMA David Li Kwok Po College	E	70 (65)	**81**	11 (16)
W-N18	Hydan Place	R	75	**91**	16
W-N19	Methodist College	E	70 (65)	**79**	9 (14)
W-N21	Temple Street No. 56	R	75	**83**	8
W-N22	Kamly Court	R	75	**84**	9
W-N23	Hang Wan House	R	75	**86**	11
W-N24	Prosperous Garden Block 5	R	75	**85**	10
W-N25A	Prosperous Garden Block 1	R	75	**93**	18
W-N31	Shanghai Street No. 217-225	R	75	**95**	20
W-N32	Sing On Building	R	75	**92**	17
W-P6	Refuse Collection Point and Street Sleepers' Shelters (Planned)	R	75	**84**	9
W-P9	The Coronation	R	75	**85**	10
W-P11	The Coronation	R	75	**88**	13
W-P12	The Coronation	R	75	**84**	9
Central Portion					
M-N1	Kar Man House, Oi Man Estate	R	75	**80**	5
M-N2	Carmel on the Hill	R	75	**77**	2
M-N3	SKH Tsoi Kung Po Secondary School	E	70 (65)	**83**	13 (18)
M-N4	Man Fuk House Block A	R	75	**77**	2
M-N5	Cascades Block A	R	75	**76**	1
M-N6	Ko Fai House, Kwun Fai Court	R	75	**86**	11
M-P2	Planned Residential Area B (Planned)	R	75	**88**	13
M-P3	Planned Residential Area B (Planned)	R	75	**90**	15
East Portion					
E-N6	Grand Waterfront Tower 5	R	75	**89**	14
E-N11	Holy Carpenter Primary School	E	70 (65)	**80**	10 (15)
E-N12	Grand Waterfront Tower 3	R	75	**89**	14

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Unmitigated Noise Level [2] dB(A)	Exceedance dB(A)
E-N13	Grand Waterfront Tower 1	R	75	**84**	9
E-N14	Chong Chien Court Block J	R	75	**82**	8
E-N15	Hang Chien Court Block I	R	75	**91**	16
E-N19	Buddhist Chi King Primary School	E	70 (65)	65	-
E-N20	Hing Yan Street No. 29	R	75	**88**	13
E-N21	Hang Chien Court Block J	R	75	**94**	19
E-N22	Hang Chien Court Block H	R	75	**90**	15
E-P20	Site 1I3 (Planned)	R	75	**77**	2
Barging Point					
B-N1	Grand Horizon	R	75	66	-

Notes:

[1] Values in parentheses indicate the noise criterion during examination period of educational institution.

[2] Bolded values mean exceedance of the relevant noise criteria.

[3] Central air-conditioning is provided, result is for indicative purpose.

Mitigation Measures

The predicted construction noise levels show that the unmitigated construction noise impacts would exceed the daytime noise criteria. Mitigation measures are therefore required. The following mitigation measures have been considered:

- Good site practices to limit noise emissions at the source;
- Use of quiet plant and working methods;
- Use of site hoarding as noise barrier to screen noise at ground level of NSRs;
- Use of shrouds / temporary noise barriers to screen noise from relatively static PMEs;
- Use of large full enclosure to screen all the plant, wherever practicable;
- Large full enclosure for mucking out points;
- Scheduling of construction works outside school examination periods in critical area; and
- Alternative use of plant items within one worksite, wherever practicable.

The above mitigation measures would need to be implemented in all work sites as good practices. It should be noted that whilst "Good Practice" mitigation measures would help to alleviate the noise impacts, some of these measures have not be included in the quantitative assessment as discussed in the following sections. This would ensure a more conservative assessment.

Detailed descriptions of these mitigation measures are given in the following sections.

Good Site Practices and Noise Management Techniques

Good site practice and noise management techniques could considerably reduce the noise impact from construction site activities on nearby NSRs. The following measures should be followed during each phase of construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works;
- mobile plant should be sited as far away from NSRs as possible and practicable; and
- material stockpiles, site office and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The benefits of these techniques can vary according to specific site conditions and operations. The environmental noise climate would certainly be improved through these control practices, although the improvement can only be quantified during implementation when specific site parameters are known. The assessment has therefore not taken into account the effectiveness of "Good Site Practices and Noise Management Techniques".

Use of "Quiet" Plant and Working Methods

The use of quiet plant is a feasible solution to tackle adverse noise impacts associated with construction works. It is generally known (supported by field measurement) that particular models of construction equipment are quieter than standard types given in the TM-GW. Whilst it is generally considered too restrictive to specify that the Contractor has to use specific models or items of plant, it is reasonable and practicable to set plant noise performance specifications for specific PME so that some flexibility in selection of plant is allowed. A pragmatic approach would be to request that the Contractor independently verifies the noise level of the plant proposed to be used and demonstrates through furnishing of these results, that the plant proposed to be used on the site meets the requirements.

An inventory of SWLs of quiet plant associated with the construction works is given in EPD's Quality Powered Mechanical Equipment (QPME) and additional reference is made to typical SWLs for international manufacturer. It should be also noted that while various types of silenced equipment could be found in Hong Kong, EPD when processing a CNP application for evening or night time works may apply the noise levels specified in the TM-GW and TM-DA. CNP applications which contain sufficient details of any particularly quiet items of PME or any special noise control measures which the CNP applicant proposes to

employ on the site may be given special consideration by the Noise Control Authority.

A summary of the "Quiet" PMEs adopted and the associated SWLs is given in **Appendix 5.4A**.

Use of Site Hoarding

Purpose built temporary noise barriers (approximately 2.5m high) located on the site boundaries between noisy construction activities and NSRs could generally reduce noise levels at low-level zone of NSRs through partial screening. In general, this would provide minimum 5 dB(A) attenuation for the low level receivers. It would be possible for the Contractor to provide these in the form of site hoardings to achieve this attenuation effect, provided that the barriers have no openings or gaps. Good site practice shall also be adopted by the Contractor to ensure the conditions of the hoardings are properly maintained throughout the construction period. For conservative assessments, however, the site hoarding has not been taken into consideration in the construction noise assessments.

Use of Temporary Noise Barrier & Enclosure (with Sufficient Ventilation)

Movable temporary noise barriers that can be located close to noisy plant and be moved concurrently with the plant along a worksite can be very effective for screening noise from NSRs. A typical design which has been used locally is a wooden framed barrier with a small-cantilevered on a skid footing with 25mm thick internal sound absorptive lining. This measure is particularly effective for low level zone of NSRs. A cantilevered top cover would be required to achieve screening benefits at upper floors of NSRs.

Movable barriers will be used for some PME (e.g. asphalt paver, excavator etc). It is anticipated that suitably designed barriers could achieve at least 5 - 10dB(A) reduction. For a conservative assessment, only a reduction of 5dB(A) is assumed. Acoustic mat will be used for other plant items such as trench cutter, piling, oscillator and drilling rig and a 10 dB(A) noise reduction is anticipated. Barrier material with surface mass at least 7kg/m^2 is recommended to achieve the predicted screening effect. This assumption has been adopted in other approved EIA Reports.

The use of enclosure (with sufficient ventilation and surface mass at least 10 kg/m^2) has been considered in this assessment to shelter relatively static plant including air compressor, generator. The enclosures barriers can provide about 10dB(A) noise reduction.

A summary of the temporary movable barriers and enclosures adopted for various PMEs, and the associated noise reduction is given in **Appendix 5.4A**. **Appendix 5.4B** shows the sketch of typical temporary noise barrier / enclosure.

As mentioned in **Section 3.5.1**, the re-provision of the existing Gascoigne Road Flyover (GRF) at Kansu Street would be carried out in phases. The existing east-west traffic on GRF (with one traffic lane in each direction) will be maintained throughout the construction period by the use of temporary bridge structures to divert the traffic near the demolished YMT multi-storey car-park. Due to the complex construction phasing for the re-provisioned of GRF, it has been found

infeasible to install either semi or full enclosure as a temporary noise mitigation measure for the temporary bridge decking during construction stage. However, a 2-3m tall temporary noise barrier will be applied where applicable on the temporary bridge structures during the construction stage. The exact extent of the temporary noise barriers would be adjusted to suit the need for temporary traffic arrangement as well as the phasing of the permanent re-provisioned GRF. Moreover, subject to no conflicts with the traffic diversion work, the traffic noise barriers could be constructed in an earlier stage of the construction programme in order to provide screening during the construction phase.

Large Full Enclosure for Mucking Out Points

Another possible mitigation measures is large full enclosure for entire construction site will be used during construction of cut-and-cover tunnel and mucking out points. A larger enclosure for the entire construction site of cut-and-cover tunnel would provide better noise attenuation than the use of temporary noise barriers / acoustic mats. However, the height of the enclosure for entire construction site of cut-and-cover tunnel would need to be at least 9m in order to accommodate all the plant. Given the nature of construction works, having such a tall barrier would impose adverse visual impacts to the neighbouring receptors and pedestrians.

In view of the potential nuisance / impacts on the access and engineering feasibility, the use of large enclosure could only be provided for the proposed three mucking out points and is not recommended for the entire construction sites of cut-and-cover tunnel.

According to the current construction methodology, mucking-out points will be located in west, central and east portion as shown in **Figure 3.1.1, Figure 3.1.2 and Figure 3.1.3** respectively. Since the mucking out activities will be located in the vicinity of residential premises, noise enclosures would be provided to screen off these loading/unloading activities. Appropriate design would also be adopted for any openings such as access, vents etc to ensure the acoustic integrity of the enclosures. By adopting full noise enclosures, it would minimize the potential construction noise generated by the construction activities. **Appendix 5.4C** shows the preliminary layout of the mucking out points and the associated noise enclosures.

Sequencing Operation of Construction Plant Equipment

In practice, some plant items will operate sequentially within the same work site, and certain reduction of the predicted noise impacts could be achieved. However, any additional control on the sequencing of plant will impose a restrictive constraint to the Contractor on the operation and planning of plant items, and the implementation of the requirement would be difficult to be monitored. Hence, sequencing operation of PME has not been taken into consideration in the construction noise assessments.

Assessment Results - Mitigated Scenario

With the implementation of the abovementioned mitigation measures, the construction noise levels at the affected NSRs are predicted and presented in the

following tables. The predicted noise levels at most of the NSRs would comply with the corresponding noise criteria, except some NSRs near the works area at Kansu Street and Ferry Street. Non-compliance at these NSRs is due to the shorter separation distance between the worksites. **Appendices 5.5E** to **5.7E** present the mitigated noise contribution on a monthly basis during the construction period. **Appendices 5.5F** to **5.7F** present the predicted mitigated construction noise levels at selected representative NSRs. The predicted construction noise impacts on the NSRs are summarized in the table below.

Table 5.14: Predicted Maximum Mitigated Construction Noise Levels at NSRs

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Mitigated Noise Level [2] dB(A)	Exceedance dB(A)
West Portion					
W-N1A	Yau Ma Tei Catholic Primary School (Hoi Wang Road)	E	70 (65)	**70**	- (5)
W-N2	Charming Garden Block 12	R	75	68	-
W-N3	Yau Ma Tei Catholic Primary School (Tung Kun Street)	E	70 (65)	**80**	10 (15)
W-N7	Kum Lam Building	R	75	**80**	5
W-N8	Dickson Building	R	75	**81**	6
W-N8A	Tak Cheong Building	R	75	**82**	7
W-N10A	Alhambra Building (West façade)	R	75	**77**	2
W-N10B	Alhambra Building (West façade)	R	75	75	-
W-N11	Hong Kong Community College (HKCC) of the HK[4]	E	70 (65)	**73**	3 (8)
W-N15	HKMA David Li Kwok Po College	E	70 (65)	**70**	- (5)
W-N18	Hydan Place	R	75	**78**	3
W-N19	Methodist College	E	70 (65)	65	-
W-N21	Temple Street No. 56	R	75	68	-
W-N22	Kamly Court	R	75	69	-
W-N23	Hang Wan House	R	75	72	-
W-N24	Prosperous Garden Block 5	R	75	72	-
W-N25A	Prosperous Garden Block 1	R	75	**81**	6
W-N31	Shanghai Street No. 217-225	R	75	**80**	5
W-N32	Sing On Building	R	75	**79**	4
W-P6	Refuse Collection Point and Street Sleepers' Shelters (Planned)	R	75	72	-
W-P9	The Coronation	R	75	73	-
W-P11	The Coronation	R	75	**77**	2

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Mitigated Noise Level [2] dB(A)	Exceedance dB(A)
W-P12	The Coronation	R	75	72	-
Central Portion					
M-N1	Kar Man House, Oi Man Estate	R	75	66	-
M-N2	Carmel on the Hill	R	75	63	-
M-N3	SKH Tsoi Kung Po Secondary School	E	70 (65)	**70**	- (5)
M-N4	Man Fuk House Block A	R	75	63	-
M-N5	Cascades Block A	R	75	63	-
M-N6	Ko Fai House, Kwun Fai Court	R	75	73	-
M-P2	Planned Residential Area B (Planned)	R	75	73	-
M-P3	Planned Residential Area B (Planned)	R	75	75	-
East Portion					
E-N6	Grand Waterfront Tower 5	R	75	75	-
E-N11	Holy Carpenter Primary School	E	70 (65)	**66**	- (1)
E-N12	Grand Waterfront Tower 3	R	75	75	-
E-N13	Grand Waterfront Tower 1	R	75	71	-
E-N14	Chong Chien Court Block J	R	75	70	-
E-N15	Hang Chien Court Block I	R	75	**76**	1
E-N19	Buddhist Chi King Primary School	E	70 (65)	51	-
E-N20	Hing Yan Street No. 29	R	75	75	-
E-N21	Hang Chien Court Block J	R	75	**79**	4
E-N22	Hang Chien Court Block H	R	75	75	-
E-P20	Site 1I3 (Planned)	R	75	63	-

Notes:

[1] Values in parentheses indicate the noise criterion during examination period of educational institution.

[2] Bolded values mean exceedance of the relevant noise criteria.

[3] No exceedance is predicted during examination period.

[4] Central air-conditioning is provided, result is for indicative purpose.

Concurrent Project

As discussed in **Chapter 1**, the tentative commencement year for the construction of CKR is 2015, and would take about 5 years for completion. All potential concurrent projects, which may have cumulative environmental impacts during the construction and operational phases of CKR, have been identified based on the latest available information and detailed in **Section 1.8**.

Kai Tak Development (KTD)

As discussed in **Section 1.8**, the construction of Kai Tak Development would be concurrent with the construction of the CKR east portion. Besides, the KTD EIA has shown that there would cause of noise impact to the NSRs at east portion of

CKR, therefore, the cumulative construction noise impacts due to the construction of KTD would be significant.

SCL – Tai Wai to Hung Hom Section

The construction period of the SCL project is expected to overlap concurrently with the Project. However, the construction impacts from SCL at the identified NSRs would be screened by nearby buildings, cumulative impact from construction of SCL and the Project is therefore not anticipated.

Trunk Road T2 and Infrastructure at South Apron

According to the project proponent of Trunk Road T2, the T2 project is scheduled to commence concurrently with the Project. As the construction impacts from Trunk Road T2 will be out of 300m of the NSRs of CKR, cumulative impact from construction of Trunk Road T2 and the Project is therefore not anticipated.

Proposed Road Improvement in West Kowloon Reclamation Development

According to the project proponent of this proposed road improvement project, it is scheduled to commence concurrently with the Project. As most of the construction impacts from this proposed road improvement project will be out of 300m of the NSRs of CKR except the Scheme J of the proposed road improvement project which is approximately 240m away from the nearest NSR (W-N1A). The project is still under studied and its EIA is still under preparation, hence, no available information for assessing the cumulative construction airborne noise. Nevertheless, sensitivity test of cumulative construction airborne has been carried out. Similar activity of CKR (workfront 50d – Road works for re-align Ferry Street at-grade road as in **Appendix 5.5A**) with a SWL of 107 dB(A) is assumed. Given the separation distance between Scheme J and the nearest NSR (W-N1A) is approximately 240m, the SPL at W-N1A is predicted at 53 dB(A) which is 10dB(A) lower than the construction noise impact of 70 dB(A) from CKR, the cumulative impact from construction of this proposed road improvement project and the Project is therefore insignificant.

The Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL)

According to the approved EIA Study "Hong Kong Section of Guangzhou - Shenzhen - Hong Kong Express Rail Link" (AEIAR-143/2009), all the construction works in West Kowloon area is scheduled to be completed by end of 2014. According to the latest VEP-377/2012 approved by EPD on 26 Oct 2012, the location of concrete batching plant for XRL will be revised. This concrete batching plant will remain in the same works area (Works Area V, Zone 1 – WKCD Area). As stated in this VEP, the associated construction programme of (Works Area V, Zone 1 to Zone 3) will be six-month beyond the construction programme stated in the XRL EIA, i.e. June 2015. Cumulative construction airborne noise impact would need to be assessed. However, given the separation distance between the nearest NSR (W-P12 – The Coronation) and (Works Area V, Zone 1 to Zone 3) is greater than 300m, the cumulative construction airborne noise impact is considered insignificant.

Assessment Results - Cumulative Noise Impact with Concurrent Projects

Amongst the NSRs considered, some of them would experience cumulative construction noise impacts from other concurrent projects (see **Section 1.8**). The construction activities related from the construction Kai Tak Development have been included in the assessment. The following table summarizes the results for the selected NSRs.

Table 5.15: Cumulative Noise Impact with Concurrent Projects

NSR ID	NSR Description	Uses	Construction Noise dB(A)		Criterion dB(A)	Total [2] dB(A)	Exceedance [1] dB(A)
			CKR	KTD			
E-N6	Grand Waterfront Tower 5	R	75	**78**	75	**80**	5
E-N11	Holy Carpenter Primary School	E	66	**86**	70 (65)	**86**	16 (21)
E-N12	Grand Waterfront Tower 3	R	75	**78**	75	**80**	5
E-N13	Grand Waterfront Tower 1	R	71	**78**	75	**79**	4
E-N14	Chong Chien Court Block I	R	70	**78**	75	**79**	4
E-N15	Hang Chien Court Block I	R	**76**	**78**	75	**80**	5
E-N19	Buddhist Chi King Primary School	E	51	68	70 (65)	**68**	- (3)
E-N20	Hing Yan Street No. 29	R	75	74	75	**78**	3
E-N21	Hang Chien Court Block J	R	**79**	**78**	75	**82**	7
E-N22	Hang Chien Court Block H	R	75	**78**	75	**80**	5

Notes:

[1] Values in parentheses indicate the noise criterion during examination period (typical examination period in May, June, November and December) of educational institution.

[2] Bolded values mean exceedance of the noise criteria.

From the above table, the cumulative noise impact with a maximum of adverse residual impacts exceeding the construction noise criterion of 1-21 dB(A). The noise impacts due to the Project are only 51-79 dB(A) which were much lower than those contributed by Kai Tak Development (KTD). Adverse residual cumulative impact exceeding the construction noise criterion would be

contributed from the construction activities of KTD. However, the EIA study of KTD indicated that all practicable mitigation measures have been fully explored and exhausted to reduce the noise impact arising from construction activities of KTD.

Adverse Residual Noise Impact from the Project Exceeding the Construction Noise Criterion

As discussed above, even with all practicable construction noise mitigation measures adopted, such as the use of quiet PME, temporary movable noise barrier and enclosure, adverse residual impacts exceeding the construction noise criterion are still expected at some NSRs, as summarized in the table below. Only those NSRs with adverse residual construction noise impact from the Project exceeding the construction noise criterion are shown.

Table 5.16: Adverse Residual Impacts at Noise Sensitive Receivers

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Maximum Mitigated Noise Level dB(A)	Exceedance dB(A)	Duration for Maximum Noise Level (Month) [5]
W-N1A	Yau Ma Tei Catholic Primary School (Hoi Wang Road)	E	70 (65)	**70 (69)**	- (4) [2]	- (1)
W-N3	Yau Ma Tei Catholic Primary School (Tung Kun Street)	E	70 (65)	**80 (80)**	10 (15) [2]	6 (2)
W-N7	Kum Lam Building	R	75	**80**	5	1
W-N8	Dickson Building	R	75	**81**	6	1
W-N8A	Tak Cheong Building	R	75	**82**	7	2
W-N10A	Alhambra Building (North façade)	R	75	**77**	2	1
W-N11	Hong Kong Community College (HKCC) of the HK [6]	E	70 (65)	**73 (73)**	3 (8)	5 (1)
W-N15	HKMA David Li Kwok Po College	E	70 (65)	**70 (69)**	- (4)	- (1)
W-N18	Hydan Place	R	75	**78**	3	1
W-N25A	Prosperous Garden Block 1	R	75	**81**	6	3
W-N31	Shanghai Street No. 217-225	R	75	**80**	5	1
W-N32	Sing On Building	R	75	**79**	4	5
W-P11	The Coronation	R	75	**77**	2	1
M-N3	SKH Tsoi Kung Po Secondary School	E	70 (65)	**70 (68)**	- (3) [2]	- (1)
E-N11	Holy Carpenter	E	70 (65)	**66 (66)**	- (1) [2]	- (2)

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Maximum Mitigated Noise Level dB(A)	Exceedance dB(A)	Duration for Maximum Noise Level (Month) [5]
	Primary School					
E-N15	Hang Chien Court Block I	R	75	**76**	1	6
E-N21	Hang Chien Court Block J	R	75	**79**	4	6

Notes:

[1] Values in parentheses indicate the noise criterion during examination period (typical examination period in May, June, November and December) of educational institution.

[2] Residual impact is only expected during the examination period (typical examination period in May, June, November and December) of the educational institution.

[3] In general practice, examination period should only last for 2 weeks. By scheduling the construction works to avoid the examination period, the adverse residual impact should be minimised.

[4] Values in parentheses indicate the duration of adverse residual impact in consideration of the noise criterion during examination period.

[5] Please refer to **Tables 5.17 to 5.20** for the total impact duration for noise exceedance.

[6] Central air-conditioning is provided, result is for indicative purpose.

The above table indicates that the maximum adverse residual impacts and the associated duration despite of the implementation of all practicable noise mitigation measures.

As discussed in this chapter, extensive mitigation measures have been considered and implemented exhaustively to abate construction noise impacts on neighboring NSRs. These mitigation measures include but not limited to the use of quiet construction plant, movable noise barrier, noise enclosure, acoustic mat etc. With all the mitigation measures implemented, assessment results indicate that the majority of the NSRs would comply with the noise criteria in TM-EIAO. Only a small portion of the NSRs closer to the cut-and-cover tunnel at Kansu Street of West Portion and two NSRs (Hang Chien Court Block I and Block J) of East Portion would have adverse residual construction noise impact and one NSR (Holy Carpenter Primary School) of East Portion would have adverse residual construction noise impact during examination period.

It should be noted that these NSRs near Kansu Street are affected by the construction of the cut-and-cover tunnel (e.g. diaphragm wall installation, excavation, mucking-out etc) and the demolition of the existing GRF. For the construction of the cut-and-cover tunnel in particular, the construction methodology has given prudent considerations at the outset to minimize construction noise as far as practicable to use the top-down approach. By adopting this top-down approach, once the diaphragm walls are completed, cross walls and the ground will be excavated to the tunnel roof level and the tunnel roof slab constructed. This first stage of excavation and roof slab works will be undertaken beneath temporary decking. This decking provides a platform for pedestrian and road traffic whilst also containing the noise and dust produced by the works being carried out beneath. Once the deck is installed, the only noise sources would be the mucking out locations at which full enclosure would be installed. These full enclosure for the mucking out locations could be designed to achieved a minimum noise reduction of 15 dB(A). In order to further mitigate the

noise nuisance, the full enclosure for the mucking out location would be further optimized to accommodate mobile construction plant such as lorries and dump trucks to stay inside during loading and unloading activities. All these would alleviate the noise impacts in terms of both the maximum noise level and the duration of impacts.

However, this top-down approach could still inevitably generate some noise nuisance during the installation of diaphragm-walls, initial excavation and the final reinstatement. Hence, the possibility of adopting a large full enclosure with at least 9m to accommodate all the plant including diaphragm wall rigs etc have been considered. However, in view of the limited space available between the proposed diaphragm wall and the buildings frontage along Kansu Street, it would be impractical to provide a large full enclosure in Kansu Street. Besides, given the setting of Kansu Street, having such a tall enclosure would impose adverse visual impacts to the neighboring receivers and pedestrians. It may also cause lot of inconvenience or disturbance to the neighboring commercial activities at street level. On this basis, it is considered not practicable to install a large full enclosure to enclose the entire cut-and-cover tunnel section in Kansu Street.

For the demolition of the existing GRF, given that the demolition activities have to be conducted on the viaduct, it is not practicable to install any full enclosure to provide noise screening. The use of quiet construction plant, movable noise barrier, noise enclosure, acoustic mat etc are the most practicable approach to minimize construction noise impacts and these measures have been included in the noise assessment. The adverse residual construction noise impacts on a small portion of the NSRs as shown in the following table.

Table 5.17: Adverse residual Noise Impacts (Residential Premises)

NSR-ID	Impact Duration (Month) for Noise Exceedance			
	1 –4 dB(A)	5 dB(A)	6 dB(A)	7 dB(A)
W-N7	26	1	-	-
W-N8	11	4	1	-
W-N8A	26	5	4	2
W-N10A	1	-	-	-
W-N18	10	-	-	-
W-N25A	6	-	3	-
W-N31	38	1	-	-
W-N32	5	-	-	-
W-P11	4	-	-	-
E-N15	6	-	-	-
E-N21	6	-	-	-

It can be noted that most of these receivers would exceeding the relevant noise criteria by less than 5dB(A). There are only five receivers with adverse residual construction noise impacts greater than or equal to 5dB(A) from the criterion. These five receivers include Kum Lam Building (W-N7), Dickson Building (W-N8), Tak Cheong Building (W-N8A), Prosperous Garden (W-N25A) and Shanghai Street No. 217-225 (W-N31).

Evaluation of Adverse Residual Impact

Cut-and-cover tunnel at Kansu Street

Out of these five receivers, the noise impacts on Dickson Building (W-N8) would only exceed the relevant noise criteria up to 6dB(A). The number of months that would be exposed to 5dB(A) or above the relevant criteria would be 5 months. The number of months of noise impact with exceeding the relevant noise criteria by less than 5dB(A) would be 11 months.

The other receiver, Tak Cheong Building (W-N8A), is located closer to the mucking out location and hence would be experiencing higher construction noise impacts. According to the analysis, the noise impacts on Tak Cheong Building (W-N8A) would exceed the relevant noise criteria up to 7dB(A). The number of months that would be exposed to 7dB(A) above the relevant criteria would be 2 months. The number of months of noise impact with exceeding the relevant noise criteria up to 5dB(A) or above would be 11 months and the number of months of noise impact with exceeding the relevant noise criteria by less than 5dB(A) would be 26 months. It should be noticed that construction activity contributing noise impact with exceeding the relevant noise criteria by 5dB(A) or above is the construction of diaphragm wall where located next to this sensitive receiver. Mitigation measures including use of quiet plant, acoustic mat, insulation fabric, movable noise barrier have already been applied on this construction activity. For the period of noise impact with exceeding the relevant noise criteria by less than 5dB(A) would be 26 months, the main construction activity would be the construction of cut-and-cover tunnel.

The other two receivers, Kum Lam Building (W-N7) and Shanghai Street No. 217-225 (W-N31), are located closer to the construction of access shaft and mucking out location and hence would be experiencing higher construction noise impacts. According to the analysis, the noise impacts on Kum Lam Building (W-N7) and Shanghai Street No. 217-225 (W-N31) would exceed the relevant noise criteria up to 5dB(A). Both the number of month of noise impact with exceeding the relevant noise criteria up to 5dB(A) on these two receivers would be 1 month and the number of months of noise impact with exceeding the relevant noise criteria by less than 5dB(A) on Kum Lam Building (W-N7) and Shanghai Street No. 217-225 (W-N31) would be 26 months and 38 months respectively.

The feasibility of having a full enclosure for the entire cut-and-cover tunnel has also been considered. However, in view of the limited space available between the proposed diaphragm wall and the buildings frontage along Kansu Street, it would be impractical to provide a large full enclosure in Kansu Street. Besides, given the setting of Kansu Street, having such a tall enclosure would impose adverse visual impacts to the neighboring receivers and pedestrians. It may also cause lot of inconvenience or disturbance to the neighboring commercial activities at street level. On this basis, it is considered not practicable to install a large full enclosure to enclose the entire cut-and-cover tunnel section in Kansu Street. All practicable mitigation measures including the top-down approach along the cut-and-cover tunnel along Kansu Street, traffic deck, avoidance of unloaded activity above traffic deck and full enclosure for mucking out location have been applied and exhausted.

Gascoigne Road Flyover (Ferry Street)

The other receiver, Prosperous Garden (W-N25A), is located closer to the re-aligned Ferry Street (at-grade) and hence would be experiencing higher construction noise impacts. According to the analysis, the noise impacts on Prosperous Garden (W-N25A) would exceed the relevant noise criteria up to 6dB(A). The number of months of noise impact with exceeding the relevant noise criteria up to 5dB(A) or above would be 3 months and the number of months of noise impact with exceeding the relevant noise criteria by less than 5dB(A) would be 6 months. It should be noticed that construction activity contributing noise impact with exceeding the relevant noise criteria by 6dB(A) is the construction of foundation for noise enclosure on GRF Flyover (Ferry Street Section) where located next to this sensitive receiver. The number of PME used has been reviewed as practicable for the construction programme, the dominate noise source would be concrete lorry mixer, bored piling and vibratory compactor for the construction of noise enclosure foundation, mitigation measures including use of quiet plant, acoustic mat, insulation fabric and movable noise barrier have already been applied on this construction activity. However given the short separation distance of around 25m, W-N25A would be experiencing higher construction noise impacts. For the period of noise impact with exceeding the relevant noise criteria by less than 5dB(A) would be 26 months, the main construction activity would be the construction of cut-and-cover tunnel.

The feasibility of having a full enclosure for the entire Gascoigne Road Flyover has been considered. However, in view of the limited space available on the Gascoigne Road Flyover, it would be impractical to provide a large full enclosure on the existing structure. As explained in the above paragraphs, all the practicable mitigation measures (including moveable barrier/ enclosure, quiet PME and scheduling of works) have been implemented. Hence, the adverse residual noise impacts have been minimized.

The magnitude of the residual impacts is assessed in accordance with Section 4.4.3 of the TM-EIAO below.

Table 5.18: Assessment of Residual Impacts

Criteria	Assessment
Effects on public health and health of biota or risk of life.	The extent of noise nuisance would be unlikely to induce public health concern.
Magnitude of the adverse environmental impacts.	Residual impacts exceeding the construction noise criterion of between 1-4 dB(A) could occur at up to most of the NSRs, while there are receivers will have 5-7 dB(A) exceedance during the construction phase upon worse case scenarios.
Geographic extent of the adverse environmental impacts.	The geographic extent of the adverse impacts from noise is anticipated to be limited to within about 50m from the CKR project works area.
Duration and frequency of the adverse environmental impacts.	The adverse residual construction noise impacts of CKR will be from 1 to 39 months and are, therefore, temporary and reversible.
Likely size of the community or the environmental that may be affected	About 650 flats would be affected. In addition, pedestrians within immediate vicinity will be

Criteria	Assessment
by the adverse impacts.	temporarily affected.
Degree to which the adverse environmental impacts are reversible or irreversible.	Construction phase impacts should be reversible.
Ecological context.	Not Applicable
Degree of disruption to sites of cultural heritage.	Very minimal as there would be appropriate mitigation measures, e.g. proposed underpinning scheme, for protecting the Yau Ma Tei Police Station as described in **Section 12.6**.
International and regional importance.	The impacts are localized and not of international and regional importance.
Likelihood and degree of uncertainty of adverse environmental impacts	The impacts predicted are based upon worst case assumptions and as such, would not occur to the extent predicted on all occasions. However, the assessment has been made using approved modelling techniques and the degree of certainty on the results is high.

The adverse residual impacts exceeding the construction noise criterion on school during examination and non-examination periods are presented in **Table 5.19** and **Table 5.20**. For assessment purpose, it is assumed that examination periods would be in May, June, November and December and they are considered to exceed the noise criterion for school examination periods.

Table 5.19 shows the adverse residual impacts exceeding the construction noise criterion on school during their normal period. Most of the schools during their normal period (i.e. non-examination period) would be subject to construction noise impacts complying with the criterion, except the Yau Ma Tei Catholic Primary School (Tung Kun Street) (W-N3) and Hong Kong Community College (HKCC) of the HK (W-N11).

Yau Ma Tei Catholic Primary School (Tung Kun Street) (W-N3) is at around 15m from Road works for re-align Ferry Street at-grade road (Worksite S50d) which involves the construction of road and piling works for the noise barrier. The number of PME used has been reviewed as practicable for the construction programme, the dominate noise source would be concrete lorry mixer and bored piling for the construction of noise enclosure foundation. However given the short separation distance of around 15m, W-N3 would be experiencing higher construction noise impacts. The predicted exceedance on W-N3 would be up to 10 dB(A) for 6 months and the number of months of noise impact with exceeding the relevant noise criteria would be 9 months. The feasibility of having a full enclosure for the Ferry Street at-grade road has been considered. However, since the construction work is located between Ferry Street at-grade road and Ching Ping Street, a full enclosure that could allow machinery to work safety would likely occupy certain areas onto the existing road and hence would affect the existing traffic. On this basis, it is considered not practicable to install a large full enclosure to enclose the Ferry Street at-grade road.

Hong Kong Community College (HKCC) of the HK (W-N11) is at around 80m from the filling embankment works and construction of retaining wall (Worksite S12) and around 60m from the Construct Noise Barrier and Diversion of Hoi

Wang Road (Worksite S24b) which involves the construction of Hoi Wang Road and piling works for the semi-enclosure. The number of PME used has been reviewed as practicable for the construction programme, however given the separation distance of around 60m and W-N11 would be experiencing higher construction noise impacts. The predicted exceedance on W-N11 would be up to 3dB(A) for 5 months and the number of months of noise impact with exceeding the relevant noise criteria would be 14 months. The feasibility of having a full enclosure for the Hoi Wang Street has been considered. However, since Hoi Wang Road should be maintained operating during the construction, temporary traffic management (TTM) will be required and hence the full enclosure is not feasible.

All the practicable mitigation measures including use of quiet plant, acoustic mat, insulation fabric, movable noise barrier and scheduling of works have already been applied and exhausted on these construction activity. Hence, the adverse residual noise impacts have been minimized. To further reduce the noise impacts, it is proposed the Contractor should closely liaise with the school to avoid noisy construction works during examination period. The construction works should be carried out at summer holiday as far as possible. Furthermore, W-N11 has already provided with central conditioning, no further mitigation measures are required.

Table 5.19: Adverse residual Noise Impacts (Educational Institution During Normal Period)

NSR-ID	Impact Duration (Month) for Noise Exceedance							
	1dB(A)	2dB(A)	3dB(A)	4dB(A)	5dB(A)	6dB(A)	7dB(A)	>=8 dB(A)
W-N3	-	3	-	-	-	-	-	6
W-N11[1]	9	-	5	-	-	-	-	-

Note:

[1] Central air-conditioning is provided, result is for indicative purpose.

Further analysis has also been conducted to evaluate the potential noise impacts by adopting the noise criterion for examination period. It can be seen that a number of the schools along the alignment would be affected by construction noise during their examination periods. For assessment purpose, it is assumed that examination periods would be in May, June, November and December. The duration for construction noise impacts with exceedance during the school examination periods is shown in the table below.

Table 5.20: Adverse Residual Noise Impacts (Educational Institution During Examination Period) [1]

NSR-ID	Impact Duration (Month) for Noise Exceedance							
	1dB(A)	2dB(A)	3dB(A)	4dB(A)	5dB(A)	6dB(A)	7dB(A)	>=8dB(A)
W-N1A	2	3	-	1	-	-	-	-
W-N3	2	2	-	-	-	-	1	2
W-N11[2]	-	1	1	3	-	3	-	1

NSR-ID	Impact Duration (Month) for Noise Exceedance							
	1dB(A)	2dB(A)	3dB(A)	4dB(A)	5dB(A)	6dB(A)	7dB(A)	>=8dB(A)
W-N15	-	-	1	1	-	-	-	-
M-N3	3	4	1	-	-	-	-	-
E-N11	2	-	-	-	-	-	-	-

Note:
[1] Typical examination period in May, June, November and December.
[2] Central air-conditioning is provided, result is for indicative purpose.

5.4.2 Construction Groundborne Noise

Construction Groundborne Noise Sources

Potential construction groundborne noise impacts on NSRs during the construction phase will arise mainly from the operation of PME (hydraulic breaker, handheld breaker and drilling rig/ rock drill) for drill-and-blast (D&B) activities within the tunnel. As construction activities will be conducted during daytime, i.e. 0700-1900 on any day not being Sundays or general holidays unless there is a need to extend the working sessions to the restricted hours defined under the NCO. In such case, the Contractor will apply for CNP for the carrying out of the works. Hence, construction groundborne noise assessment will only be carried out during daytime only.

Construction Groundborne Noise Assessment Methodology

The method used to predict construction groundborne noise is based on the U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 1998. The vibration level $L_{v,rms}$ at a distance R from the source is related to the vibration source level at a reference distance R_o. The conversion from vibration levels to groundborne noise levels is determined by the following factors:

C_{dist}: Distance attenuation

$C_{damping}$: Soil damping loss across the geological media

$C_{building}$: Coupling loss into building foundation

C_{floor}: Coupling loss per floor

C_{noise}: Conversion factor from floor vibration levels to noise levels

C_{multi}: Noise level increase due to multiple sources

C_{cum}: Cumulative effect due to neighbouring sites

The predicted groundborne noise level L_p inside the noise sensitive rooms is given by the following equation.

$$L_p = L_{v,rms} + C_{dist} + C_{damping} + C_{building} + C_{floor} + C_{noise} + C_{multi} + C_{cum}$$

Reference Vibration Sources

The reference vibration sources of the PME were extracted from Kowloon Southern Link EIA which is the in-situ measurements. The geology consists of mainly granite, which is considered similar to the geology along the alignment. The measurements records are considered the most appropriate available information for the purpose of assessing construction groundborne noise. The reference vibration sources of the PME are listed in the table below.

Table 5.21: Reference vibration sources of PME

PME	Construction Site	Vibration (rms) at the reference distance (5.5m) from the source	Vibration (ppv) at distance (2m) from source
Drilling Rig	Salisbury Road Overrun Tunnel	0.536 mm/s	-
Handheld breaker	New World Centre site	0.279 mm/s	-
Hydraulic breaker	TST site	0.298 mm/s	-
Pipeline	MTRC TST Modification	-	19.3 mm/s

Sources: Appendix 7-1 of KSL EIA

Soil Damping Loss

Internal losses of soil would cause the vibration amplitude to decay against the propagation distance and the decay relationship is based on the equation set out in the Transportation Noise Reference Book:

$$V(R) = V(R_o) \times e^{-2\pi f \eta R / 2c}$$

The velocity amplitude V is dependent on the frequency f in Hz, the soil or rock loss factor η, the wave speed c in m/s, the distance R from the source to the NSR. The properties of soil materials are based on Ungar and Bender and reproduced in the table below.

Table 5.22: Wave propagation properties of soils

Soil Type	Longitudinal Wave Speed c, m/s	Loss Factor, η	Density, g/cm^3
Rock	3500	0.01	2.65
Clay, clayey soil	1500	0.5	1.7

Coupling Loss into Building Structures

This represents the change in the incident ground-surface vibration due to the presence of the piled building foundation. The empirical values based on the guidance set out in the Transportation Noise Reference Book are given in the table below.

Table 5.23: Loss factor for coupling into building foundation

Frequency	Octave Band Frequencies, Hz					
	16	**31.5**	**63**	**125**	**250**	**500**
Loss factor for coupling into building foundation, dB	-7	-7	-10	-13	-14	-14

Coupling Loss Per Floor

This represents the floor-to-floor vibration transmission attenuation. In multi-storey buildings, a common value for the attenuation of vibration from floor-to-floor is approximately 1dB attenuation in the upper floor regions at low frequencies and greater than 3dB attenuation at lower floors at high frequencies. Coupling loss of –1 dB reduction per floor is assumed for conservative assessment.

Conversion from Floor Vibration to Noise Levels

Conversion from floor vibration levels to indoor reverberant noise levels is based on standard acoustic principles. The conversion factor is dependent on the surface area S of the room in m^2, the radiation efficiency η, the volume of the room V in m^3 and the room reverberation time RT in seconds. These values are summarized in the table below and will be adopted for the present study.

Table 5.24: Conversion factors from floor vibration levels to indoor reverberant noise levels

NSR Description	Conversion C_{noise} (dB re $1x10^{-6}$ mm/s)
Hotel guestrooms and residential units	-27
School classrooms	-27

Evaluation of Construction Ground-borne Noise Impacts

Detailed assessments have been conducted for three construction equipment (hydraulic breaker, hand-held breaker and drill rig/ rock drill), for tunneling works including drill-and-blast and mechanical excavation along the tunnel, the results are summarised in the table below. The detailed assessment results were shown in **Appendix 5.9**.

Table 5.25: Unmitigated Construction Groundborne Noise

NSR ID	Use	Predicted Noise Level, dB(A)	Daytime Noise Criteria, dB(A)[1]	Mitigation measure required?
W-N10A	Residential	46	65	No
W-N19	Education	28	60 (55)	No
M-N1	Residential	28	65	No
M-N3	Education	<20	60 (55)	No
M-N6	Residential	<20	65	No
E-N13	Residential	25	65	No
E-N14	Residential	29	65	No

Notes:

[1] Values in parentheses indicate the noise criterion during examination period (typical examination period in May, June, November and December) of educational institution.

Based on the assessment result as shown in the table above, the predicted construction groundborne noise levels from the tunneling work will not exceed the daytime construction groundborne noise criteria and hence no mitigation measures are required.

5.5 Operational Noise Impact Assessment

5.5.1 Road Traffic Noise Assessment

Study Area and Project Road Extent

The CKR will be mainly underground based on the current design. Road traffic noise from the open road sections near both ends of the tunnel portals is therefore anticipated. There are no open road sections of CKR in Central Portion.

Since the Central Portion of CKR would not have any slips, traffic noise impact assessment for the Project will be separated into two areas, namely the West Portion and East Portion. With reference to the EIA Study Brief for this Project (ESB-156/2006), the study area for noise impact assessment should generally be defined by a distance of 300m from the boundary of the Project.

For the purpose of this assessment, roads will be classified as the following categories in the table below. **Figures 5.4** and **5.5** illustrate the extent of project roads in West Portion and East Portion respectively.

Table 5.26: Road Category

Category	Road
West Portion	
New road (By CKR)	All part of CKR including main and slip roads
Material changes to existing road (By CKR)	1. Re-provisioning of Gascoigne Road Flyover (GRF) 2. Section of Gascoigne Road Flyover (Ferry Street section) and at-grade road next to Prosperous Garden 3. Re-alignment of Hoi Wang Road 4. Widening of Lai Cheung Road
Planned roads (By others)	Road D1(A)N, D1A(S), Road Works in West Kowloon and Proposed Road Improvement Works in West Kowloon Reclamation Development Phase 1
Existing roads	West Kowloon Highway, Nathan Road, etc
East Portion	
New road (By CKR)	All part of CKR including main and slip roads, Re-aligned Kai Fuk Road
Planned roads (By others)	D2, D3, D4 and T2
Existing roads	Kai Cheung Road, Kwun Tong Bypass, etc

Assessment Methodology

Determination of Assessment Year and Traffic Flow

During the operational phase, operation of the CKR could cause traffic noise impact on the nearby NSRs. The road carriageways involved within the assessment area, including the proposed CKR, existing roads and roads of other committed projects have been included for assessment.

The calculation method stated in the UK Department of the Transport "Calculation of road Traffic Noise" (CRTN) will be adopted. The predicted noise levels at the building facades include 2.5 dB(A) facade reflection and correction factors for effects due to gradient, distance, view angle, road surface and barriers.

In the preparation for noise prediction, the project road scheme and surrounding road networks within the Study Area have been included in the model with parameters of road width, surface type and traffic condition.

According to Clause 3.4.7.2 (vi) (a1) of the EIA Study Brief for the Project, three scenarios would need to be carried out as followings:

1) Unmitigated scenario at assessment year;
2) Mitigated scenario at assessment year; and
3) Prevailing scenario for indirect technical remedies eligibility assessment.

The assessment year for unmitigated and mitigated scenarios which is the future road traffic noise shall be calculated based on the peak hour traffic flow in respect of maximum traffic projection within the next 15 years upon commencement of operation of the Project.

Based on the current programme, the CKR main works is planned for completion by late 2020. The ultimate year is then 2035 (i.e. 15 years upon commissioning). However, traffic forecast at 2036 has been predicted for conservation assumption for unmitigated and mitigated scenarios. The noise assessment for prevailing year would adopt the year before the works to construct the road (i.e. 2014/2015).

Noise Model Setup

The road networks within the Study Area and the traffic flow within 300m assessment area have been summarised in **Appendix 5.10**. The extent of road sections paved with friction course materials have been provided by Highways Department and are shown in **Appendix 5.11**. The use of noise absorptive paving materials on project roads can theoretically reduce the traffic noise impact. As per the values specified in CRTN, the use of pervious road surface on road surface can reduce the basic noise level by 3.5 dB(A), as compared to that of 1.0 dB(A) for common impervious paving. This information has been included in the road traffic noise model accordingly.

In accordance with HyD Guidance Notes RD/GN/032, the extent of friction course has been considered in the unmitigated scenario and will cover the main road with design speed greater than 80 km/hr.

The standard 0.8m solid parapet along main road and slip road of CKR has also been included in the assessment. The graphic plot of the road traffic noise model is shown in **Appendix 5.12**.

Consideration of Noise Mitigation Measures

Consideration of noise mitigation measures will follow Annex 13 of TM-EIAO and EIAO Guidance Note "Road Traffic Noise Impact Assessment under the Environmental Impact Assessment Ordinance" [GN 12/2010].

Where the predicted noise impacts exceed the noise criteria, direct mitigation measures shall be considered on the proposed road to reduce the noise from the project road to a level such that:

- It is not higher than the standard; and
- It has no significant contribution to the overall noise from other existing roads, if the cumulative noise level, i.e. noise from the new road together with other existing roads exceeds the standard (i.e. not more than 1.0 dB(A))

According to EPD's Guidance Note 12/2010, in the case where NSRs are still exposed to noise levels exceeding the relevant noise criteria after the implementation of all direct mitigation measures, the total number of existing dwellings, classrooms and other noise sensitive elements which may qualify for indirect technical remedies, the associated costs and any implications for such implementation should be identified and estimated. The eligibility of the affected premises for indirect technical remedies is determined with reference to the following three criteria:

- the predicted overall noise level must be above a specified noise level (e.g. 70 dB(A) for domestic premises and 65 dB(A) for education institutions, all in $L_{10,1hr}$);
- the predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, i.e. the total traffic noise level existing before the works to construct the road were commenced; and
- the contribution to the increase in the predicted overall noise level from the road project must be at least 1.0dB(A).

For planned noise sensitive uses are also subject to potential road traffic noise impacts and hence the overall noise levels for maximum projected traffic within 15 years will be predicted. In the case where the planned NSRs are exposed to excessive noise levels, direct mitigation measures shall be proposed to ensure compliance of the relevant noise criteria.

Evaluation of Unmitigated Road Traffic Noise Impact

The predicted road traffic noise levels at the representative NSRs for both the West Portion and East Portion of CKR are summarized in the table below.

Appendix 5.13 and **Appendix 5.14** show the detailed breakdown of road traffic noise impacts of West Portion and East Portion respectively.

Table 5.27: Unmitigated Road Traffic Noise Impact in Year 2036

NSR ID	Uses [1]	Noise Criteria, $L_{10(1\ hr)}$ dB(A)	Predicted Project Road Noise Level, $L_{10\ (1hr)}$ dB(A) [2]	Predicted Overall Noise Level, $L_{10\ (1hr)}$ dB(A) [3]	Contribution from Project Roads, $L_{10\ (1hr)}$ dB(A)	Affected Floor	No. of dwellings/ classroom per floor assumed [4]
West Portion							
W-N1A	E	65	**66 – 67**	**73 – 74**	**1.0 – 1.2**	**1/F – 8/F**	**1**
W-N1B	E	65	61	68	0.8 – 0.9	**-**	**-**
W-N2	R	70	64 - 68	**71 – 72**	**0.7 – 2.2**	**6/F – 23/F**	**5**
W-N3	E	65	**69 – 71**	**77 – 78**	**0.8 – 0.9**	**1/F – 7/F**	**4**
W-N6	R	70	63 – 69	**72 – 73**	**0.6 – 2.2**	**6/F – 18/F**	**6**
W-N6A	R	70	58 - 67	**74 – 77**	**0.1 – 1.0**	**18/F**	**6**
W-N7	R	70	**75 – 78**	**79**	**2.4 – 5.1**	**1/F – 12/F**	**2**
W-N8	R	70	68 – **81**	**79 – 82**	**0.4 – 6.9**	**2/F – 18/F**	**2**
W-N8A	R	70	69 – **82**	**80 – 83**	**0.3 – 6.5**	**2/F – 18/F**	**2**
W-N9A	H	55	**65 – 75**	**74 – 77**	**0.5 – 4.2**	**1/F – 10/F**	**-**
W-N9B	H	55	**67 – 77**	**72 – 78**	**1.9 – 7.4**	**1/F – 10/F**	**-**
W-N10A	R	70	67 – **79**	**72 – 79**	**1.7 – 9.6**	**1/F – 15/F**	**6**
W-N10C	R	70	67 - **82**	**75 – 84**	**0.7 – 4.0**	**2/F – 15/F**	**6**
W-N11[5]	E	65	**75 – 76**	**78 – 79**	**2.2 – 4.1**	**1/F – 19/F**	**3**
W-N14	R	70	62 – 63	77	0.1 – 0.2	-	-
W-N15	E	65	57	73	0.1	-	-
W-N18	R	70	**73 – 76**	**77 – 78**	**1.8 – 4.9**	**1/F – 17/F**	**1**
W-N19	E	65	**67 – 68**	**79 – 81**	**0.2 – 0.3**	**1/F – 6/F**	**3**
W-N20	R	70	63 – **71**	**78 – 80**	**0.1 – 0.9**	**8/F – 15/F**	**3**
W-N21	R	70	62 – 69	76 – 77	0.1 – 0.9	-	-
W-N22	R	70	63 – 70	**76 – 77**	**0.2 – 1.2**	**8/F – 10/F**	**2**
W-N23	R	70	60 – **73**	**75 – 78**	**0.1 – 2.9**	**10/F – 23/F**	**3**
W-N24	R	70	62 – **74**	**73 – 76**	**0.3 – 4.3**	**3/F – 27/F**	**14**
W-N25A	R	70	**71 – 77**	**76 – 79**	**1.7 – 4.8**	**1/F – 28/F**	**3**
W-N25B	R	70	70 – **74**	**75 – 77**	**1.8 – 3.5**	**1/F – 28/F**	**2**
W-N26A	R	70	**71 – 75**	**75 – 77**	**2.0 – 4.0**	**1/F – 28/F**	**2**
W-N26B	R	70	**71 – 75**	**76 – 78**	**1.9 – 3.3**	**1/F – 28/F**	**2**
W-N27	R	70	69 – **72**	**75 – 77**	**1.2 – 1.7**	**1/F – 28/F**	**4**
W-N28	R	70	65 – 68	78 – 79	0.2 – 0.4	-	-
W-N29	W	65	**66**	**74**	**0.7**	**1/F**	**N/A**

NSR ID	Uses [1]	Noise Criteria, $L_{10(1\ hr)}$ dB(A)	Predicted Project Road Noise Level, $L_{10\ (1hr)}$ dB(A) [2]	Predicted Overall Noise Level, $L_{10\ (1hr)}$ dB(A) [3]	Contribution from Project Roads, $L_{10\ (1hr)}$ dB(A)	Affected Floor	No. of dwellings/ classroom per floor assumed [4]
W-N30	R	70	58 – 60	73 – 75	0.1 – 0.3	-	-
W-P6A	R	70	60	73 – 74	0.2 – 0.3	-	-
W-P6C	R	70	70 – **72**	**72 – 74**	**4.2 – 5.7**	**1/F – 5/F**	**N/A**
W-P7A	E	65	58 – **68**	**72 – 78**	**0.2 – 0.6**	**5/F – 8/F**	**N/A**
W-P7B	E	65	60 – **70**	**72 – 75**	**0.3 – 1.7**	**5/F – 8/F**	**N/A**
W-P7C	E	65	49 – 59	57 – 62	0.9 – 3.0	-	-
W-P7D	E	65	54 – 64	**66 – 68**	**0.3 – 1.6**	**6/F – 8/F**	**N/A**
W-P7E	E	65	57 – 65	**67 – 70**	**0.4 – 1.9**	**5/F – 8/F**	**N/A**
W-P7F	E	65	**66 – 71**	**68 – 73**	**4.0 – 6.0**	**1/F – 8/F**	**N/A**
W-P7G	E	65	62 – **68**	**72 – 75**	**0.5 – 1.1**	**5/F – 8/F**	**N/A**
W-P8	W	65	65 – **70**	**76 – 77**	**0.4 – 1.1**	**2/F – 10/F**	**N/A**
W-P9	R	70	63 – 65	**68 – 71**	**1.4 – 2.0**	**29/F – 38/F**	**2**
W-P10	R	70	66 – 67	**72**	**1.2 – 1.7**	**1/F – 30/F**	**3**
W-P11	R	70	**75 – 77**	**76 – 78**	**7.0 – 9.5**	**1/F – 30/F**	**2**
W-P12	R	70	67 – 68	**72 – 73**	**1.3 – 1.7**	**1/F – 30/F**	**1**
W-P13	R	70	**73 – 74**	**75 – 76**	**5.3 – 5.9**	**1/F – 30/F**	**2**
W-P14	R	70	**74 – 75**	**75 – 76**	**6.2 – 7.4**	**1/F – 30/F**	**2**
East Portion							
E-N19	E	65	15	73 – 76	0.0	-	-
E-P1	R	70	41 – 64	68 – 71	0.0 – 0.9	-	-
E-P6	CDA	70	55 – 57	63	0.9 – 1.4	-	-
E-P7	CDA	70	55 – 62	63 – 65	0.5 – 3.7	-	-
E-P8	R	70	41 – 53	67 – 72	0.0 – 0.1	-	-
E-P13A	H	55	**68 – 70**	**79 – 81**	**0.4 – 0.7**	**1/F – 14/F**	**N/A**
E-P13B	H	55	**63 – 65**	**78 – 80**	**0.1 – 0.2**	**1/F – 14/F**	**N/A**
E-P14A	E	65	**75 – 76**	**76 – 77**	**8.6 – 9.9**	**1/F – 10/F**	**N/A**
E-P14B	E	65	**78**	**79**	**7.7 – 8.6**	**1/F – 10/F**	**N/A**
E-P14C	E	65	**74 – 75**	**76**	**5.4 – 6.5**	**1/F – 10/F**	**N/A**
E-P14D	E	65	46 – 55	46 – 55	7.9 – 9.6	-	-
E-P14E	E	65	62	64 – 65	2.5 – 4.2	-	-
E-P14F	E	65	64 – **66**	65 – **67**	**5.5 – 6.2**	**4/F – 10/F**	**N/A**
E-P14G	E	65	47 – 50	47 – 50	17.8 – 25.6	-	-
E-P16	R	70	42 – 60	70	0.0 – 0.5	-	-
E-P20	R	70	64 – 66	68 – 70	1.7 – 2.7	-	-

Notes:
[1] R – residential; E – educational; H – clinic/ home for the aged/hospital; W – worship; GIC – government, institution and community; CDA – Comprehensive Development Area
[2] Bold figure denotes the noise level from Project Roads is over the relevant TM-EIAO noise criteria.
[3] Bold figure denotes the noise exceedance which is over the relevant TM-EIAO noise criteria and the contribution from new roads to the overall noise level is equal to or higher than 1.0 dB(A) / noise levels from Project Road is over the relevant TM-EIAO noise criteria.
[4] N/A denotes the number of dwellings / classroom cannot be determined due to planned uses.
[5] Central air-conditioning is provided, result is for indicative purpose.

West Portion

The predicted cumulative road traffic noise level for the residential NSRs at W-N2, W-N6, W-N6A, W-N7, W-N8, W-N8A, W-N10A, W-N10C, W-N18, W-N20, W-N22, W-N23, W-N24, W-N25A, W-N25B, W-N26A, W-N26B, W-N27, W-P6C, W-P9, W-P10, W-P11, W-P12, W-P13 and W-P14 is 68 – 84 dB(A) which exceed the stipulated noise criterion of 70dB(A) and significant contribution from project roads is predicted. Noise mitigation measures are required for these receivers.

The predicted cumulative road traffic noise level for the educational institutions NSRs at W-N1A, W-N3, W-N11, W-N19, W-P7A, W-P7B, W-P7D, W-P7E, W-P7F and W-P7G is 57 – 81 dB(A) which exceed the stipulated noise criterion of 65dB(A) and significant contribution from project roads is predicted. The predicted noise levels from project roads at W-N1A, W-N3, W-N11, W-N19, W-P7A-B and W-P7F-G has already exceed the noise criterion of 65dB(A). Noise mitigation measures are required for these receivers.

The predicted noise levels from project roads for the place of public worships NSRs at W-N29 and W-P8 has already exceed the stipulated noise criterion of 65dB(A). Noise mitigation measures are required for these receivers.

The predicted cumulative road traffic noise level for the clinic at W-N9A and W-N9B is 72 – 78 dB(A) which exceed the stipulated noise criterion of 55dB(A) and significant contribution from project roads is predicted. Noise mitigation measures are required for these receivers.

East Portion

The predicted cumulative road traffic noise level for the Site 3C1 – Hospital (EP13A-B) is 78 – 81 dB(A) which exceed the stipulated noise criterion of 55 dB(A). Although the contribution from Project Roads is lesser than 1.0 dB(A) which is considered insignificant, the noise level from the Project Roads itself exceed the noise criteria of 55 dB(A). Nevertheless, according to the Kai Tak Development EIA (KTD EIA), the hospital will be noise insulated and will not rely on opened windows for ventilation. Hence, no direct mitigation measure is required.

The predicted cumulative road traffic noise level for the Site 3B1 – School (EP14A-G) is 46 – 79 dB(A) which exceed the stipulated noise criterion of 65 dB(A). The contribution from Project Roads is greater than 1.0 dB(A) which is considered significant, the noise level from the Project Roads itself also exceed the noise criteria of 65 dB(A). Hence, mitigation measure is required.

Recommended Noise Mitigation Measures

Exceedance of noise criteria are found in various sensitive receivers for both existing and planned uses, noise mitigation measures should therefore be required. According to the Section 6.1, Annex 13 of TM-EIAO, noise mitigation measures starting from direct ones should be considered and evaluated. Direct mitigation measures as listed below are recommended in the proposed CKR:

- Low-noise road surfacing;
- Noise barrier/ enclosure; and
- Building orientation.

The mitigation measures in form of low-noise road surfacing and noise barrier/ enclosure above are at-source mitigation measures and were further elaborated in the following paragraphs.

When all practicable at-source mitigation measures have been exhausted, at-receiver mitigation measures would be considered in terms of building orientation, modification of layout plan and setback requirement for the planned NSRs, and consideration of provision of noise insulation for the existing NSRs where justified and eligible and liaise with relevant stakeholders.

West Portion

Use of low noise road surfacing (LNRS)

There are two areas of roads which are already paved with LNRS which are Gascoigne Road Flyover and Ferry Street at-grade road. Under the CKR project, it is also still recommended that these two areas should be paved with LNRS. The extent of LNRS is showed in **Figure 5.6a-b**.

Noise barrier/enclosure

In view of practicability, the erection of noise barrier/ semi-enclosure along the new road sections are considered as effective mitigation measures in tackling the road traffic noise impact to sensitive receivers.

Permanent noise mitigation measures including noise barrier/ semi-enclosure/ full noise enclosure will be provided on the permanent structures prior to operation. The location of noise mitigation measures are described in the following paragraphs.

Given the high traffic flow of CKR, around total of 8000 veh/hr for both bounds, a full enclosure at the west portal is proposed. Since The Coronation (W-P11, W-P13 and W-P14) would have a full view of the CKR main road and slip roads, noise mitigation measures apart from the full enclosure (F01) for the CKR is recommended to erect along the slips road. Six 5m with 3m cantilevered section type noise barriers (C01 to C06) are recommended to erect at slip roads of CKR including Connection A, C2, D and E and Lin Cheung Road. A semi-enclosure (S01) covering south bound of Lin Cheung Road is recommended. A 3.8m vertical barrier (V02) is recommended to erect at Connection D. A 5.8m vertical barrier (V03) is recommended to erect at Connection E. All the above mitigation

measures are proposed to protect The Coronation (W-P11, W-P13 and W-P14), YMT Catholic Primary School (W-N1), Charming Garden (W-N2), the planned Street Sleepers' Shelters (W-P6) and planned school (W-P7). Another 4m vertical barrier (V01) at Lin Cheung Road is recommended to protect the planned Hindu Temple (W-P8).

For the re-aligned Hoi Wang Road, given the close proximity to high-rising The Coronation (W-P11, W-P13 and W-P14) and the planned Street Sleepers' Shelters (W-P6) and planned school (W-P7). A semi-enclosure (S02) covering both south bound and north bound with opening at west is recommended.

For the re-provisioned Gascoigne Road Flyover (Kansu Street section), given the close proximity to high-rising buildings on both side and high traffic flow, around total of 4000 veh/hr of both bound, exceedance of road traffic noise criteria is anticipated. However, taken into consideration of ventilation system and the fire safety requirement, a 200m full enclosure (F03) covering both south bound and north bound is recommended. Moreover, there is a semi-enclosure (S03) covering south bound with opening at south and an extension of 5m from the central divider located at the west of full enclosure to protect Prosperous Garden (W-N25A). There is another semi-enclosure (S04) covering both south bound and north bound with opening at south located at the west of full enclosure to protect Prosperous Garden (W-N25A). A 3.3m vertical barrier (V05) is recommended to protect The Coronation and Dickson Building. A 3.8m vertical barrier (V06) at the central divider underneath the semi-enclosure is recommended to protect The Coronation. There is another semi-enclosure (S05) covering both south and north bounds with opening at north located at the east of full enclosure to protect the high-rising building (W-N10A) at south. A 4.3m vertical barrier (V07) and 2.8m vertical barrier (V08) on the central divider are also recommended to protect the YMT Jockey Club Polyclinic (W-N9B) due to a more stringent noise criteria of 55dB(A).

For the Gascoigne Road Flyover (Ferry Street section), about 110m full enclosure (F02) is recommended to protect Prosperous Garden, The Coronation and the planned school (W-P7).

For the Ferry Street at-grade road, a 5m with 1m cantilevered section barrier (C07) is recommended to protect the Prosperous Garden and YMT Catholic Primary School.

For the Widening of Lai Cheung Road, one 4m vertical barrier (V04) is recommended to protect the planned Sleepers' Shelter (W-P6) and the planned school (W-P7).

The extent of noise barrier, semi-enclosure and full enclosure is summarized in table below and showed in **Figure 5.6c-e**. The noise reduction could also be further enhanced by installing absorptive material on the noise barrier, semi-enclosure and full enclosure. Cross-section drawings of the noise mitigation measures are shown in **Figure 5.6f-n**.

Building orientation

For W-P7, since there is no building layout of this sensitive receiver during the preparation of this study, the sensitive facades are selected at the boundary of a typical building layout block for worst-case scenario. To avoid noise impact from the project roads, it is recommended to avoid any sensitive facade facing the re-aligned Hoi Wang Road as shown in **Figure 5.6c**.

Table 5.28: Recommended Noise Mitigation Measures

Noise Mitigation Measures ID	Location	Type of Noise Mitigation Measures [1]	Height above road level (m)	Approximate mPD	Approximate Length (m)	Benefited NSRs	
						Representative Existing NSR	Representative Planned NSR
F01	West portal of CKR	Full enclosure including landscape deck	9	5.9 – 22.5	250	W-N1A, W-N2	W-P6, W-P7, W-P11, W-P13, W-P14
F02	Gascoigne Road Flyover (Ferry Street section)	Full enclosure	10	22	110	W-N3, W-N25B, W-N26A, W-N26B, W-N27,	W-P6, W-P7, W-P10, W-P12
F03	Gascoigne Road Flyover (Kansu Street section) (NB+SB)	Full enclosure	7	19.5 – 21	200	W-N7, W-N8, W-N8A, W-N9A, W-N9B, W-N18, W-N32	-
S01	Lin Cheung Road	Semi-enclosure with opening at west	10	11.5 – 12.6	120	-	W-P11, W-P13
S02	Re-aligned Hoi Wang Road	Semi-enclosure with opening at west	10	10.5 – 17.7	270	W-N2	W-P6, W-P7, W-P11, W-P13, W-P14
S03	Gascoigne Road Flyover (Ferry Street section) (SB)	Semi-enclosure with opening at south	7	19.8 – 20.1	85	W-N9A, W-N24, W-N25A	-
S04	Gascoigne Road Flyover (Kansu Street section) (NB+SB)	Semi-enclosure with opening at south	7	18.1 – 19.5	45	W-9A, W-N24, W-N25A	-
S05	Gascoigne Road Flyover (Kansu Street section) (NB+SB)	Semi-enclosure with opening at north	7	21	60	W-N10A, W-N10C	
C01	Connection E	5m high with 3m cantilever at 45^{o}	7.1	12.8 – 16.1	155	-	W-P11, W-P13, W-

Noise Mitigation Measures ID	Location	Type of Noise Mitigation Measures [1]	Height above road level (m)	Approximate mPD	Approximate Length (m)	Benefited NSRs	
						Representative Existing NSR	Representative Planned NSR
		cantilevered barrier					P14
C02	Lin Cheung Road	5m high with 3m cantilever at 45^{o} cantilevered barrier	7.1	12.6 – 17.1	85	-	W-P11, W-P13, W-P14
C03	Lin Cheung Road	5m high with 3m cantilever at 45^{o} cantilevered barrier	7.1	11.8 – 12.7	85	-	W-P11, W-P13, W-P14
C04	Connection D	5m high with 3m cantilever at 45^{o} cantilevered barrier	7.1	14.1 – 20.6	190	-	W-P11, W-P13, W-P14
C05	Connection C2	5m high with 3m cantilever at 45^{o} cantilevered barrier	7.1	22.8 – 24.9	120	-	W-P11, W-P13, W-P14
C06	Connection A	5m high with 3m cantilever at 45^{o} cantilevered barrier	7.1	12.9 – 13.9	170	-	W-P11, W-P13, W-P14
C07	Ferry Street Road (At-grade)	5m high with 1m cantilever at 45^{o} cantilevered barrier	5.7	9.5 – 9.6	160	W-N3, W-N25B, W-N26A, W-N26B, W-N27	-
V01	Lin Cheung Road	4m vertical barrier	4	7.9 – 9.7	120	-	W-P8
V02	Connection D	3.8m vertical barrier	3.8	10.8 – 17.3	190	W-N2	-
V03	Connection E	5.8m vertical barrier	5.8	11.7 – 14.6	100	W-N2	-
V04	Widening of Lai Cheung	4m vertical barrier	4	8.5 – 8.6	50	-	W-P6, W-P7

Noise Mitigation Measures ID	Location	Type of Noise Mitigation Measures [1]	Height above road level (m)	Approximate mPD	Approximate Length (m)	Benefited NSRs	
						Representative Existing NSR	Representative Planned NSR
	Road						
V05	Gascoigne Road Flyover (Ferry Street section) (SB)	3.3m vertical barrier	3.3	15.3 – 16.3	110	W-N8	W-P10, W-P12
V06	Gascoigne Road Flyover (Ferry Street section) (central divider)	3.8m vertical barrier	3.8	15 – 15.8	100	-	W-P10, W-P12
V07	Gascoigne Road Flyover (Kansu Street section) (SB)	4.3m vertical barrier	4.3	19.3	60	W-N9B	-
V08	Gascoigne Road Flyover (Kansu Street section) (central divider)	2.8m vertical barrier	2.8	17.8	60	W-N9B	-

Notes:
[1] The side(s) of noise mitigation measures facing to the road traffic will be installed with absorptive materials/ panels.

East Portion

Use of low noise road surfacing (LNRS)

In accordance with HyD Guidance Notes RD/GN/032, the extent of friction course has been considered in the unmitigated scenario and will cover the main road with design speed greater than 80 km/hr. The extent of LNRS is showed in **Figure 5.7a-b**.

Building orientation

According to KTD EIA, the layout of noise sensitive uses, e.g. planned schools may be arranged in a way to avoid the sensitive facades of the classrooms facing Project Roads or as the last resort all the classrooms should be noise insulated with air-conditioners to avoid unacceptable traffic noise impacts from the surrounding road network. In this principle, a sensitive test for selecting sensitive facades of the classrooms (E-P14D-E) not facing Project Roads has been carried out and discussed in the following.

The recommended noise mitigation measures for West Portion and East Portion were shown in **Figure 5.6a-n** and **Figure 5.7a-c** respectively.

Evaluation of Mitigated Road Traffic Noise Impact

With the implementation of recommended noise mitigation measures for West Portion as shown in the table above, the predicted road traffic noise levels at the representative NSRs in the vicinity of both West Portion and East Portion of CKR are summarized in the table below. **Appendix 5.15** and **Appendix 5.16** show the detailed breakdown of road traffic noise impacts of West Portion and East Portion respectively. **Appendix 5.17** shows the sample calculation of road traffic noise.

Table 5.29: Mitigated Road Traffic Noise Impact in Year 2036

NSR ID	Uses [1]	Noise Criteria $L_{10(1\ hr)}$ dB(A)	Predicted Project Road Noise Level $L_{10\ (1hr)}$ dB(A) [3]	Predicted Overall Noise Level $L_{10\ (1hr)}$ dB(A) [3]	Contribution from Project Roads, $L_{10\ (1hr)}$ dB(A)
West Portion					
W-N1A	E	65	63 – 64	72 – 73	0.4 – 0.6
W-N1B	E	65	60	68	0.8 – 0.9
W-N2	R	70	53 – 62	70 – 71	0.0 – 0.8
W-N3	E	65	53 – 63	74 – 77	0.1 – 0.2
W-N6	R	70	50 – 58	70 – 72	0.0 – 0.3
W-N6A	R	70	50 – 58	72 – 77	0.0 – 0.1
W-N7	R	70	47 – 60	74 – 76	0.0 – 0.2
W-N8	R	70	46 – 65	73 – 79	0.0 – 0.7
W-N8A	R	70	44 – 64	74 – 80	0.0 – 0.5
W-N9A	H	55	39 – 45	73 – 74	0.0
W-N9B	H	55	41 – 55	70	0.0 – 0.1

NSR ID	Uses [1]	Noise Criteria $L_{10(1\ hr)}$ dB(A)	Predicted Project Road Noise Level $L_{10\ (1hr)}$ dB(A) [3]	Predicted Overall Noise Level $L_{10\ (1hr)}$ dB(A) [3]	Contribution from Project Roads, $L_{10\ (1hr)}$ dB(A)
W-N10A	R	70	39 – 54	69 – 70	0.0 – 0.1
W-N10C	R	70	39 – 53	75 – 79	0.0
W-N11[4]	E	65	**71 – 72**	**75 – 78**	**1.2 – 1.9**
W-N14	R	70	62 – 63	77	0.1 – 0.2
W-N15	E	65	57	73	0.1
W-N18	R	70	45 – 58	72 – 76	0.0 – 0.2
W-N19	E	65	61 – 63	79 – 81	0.0 – 0.1
W-N20	R	70	50 – 58	78 – 80	0.0 – 0.1
W-N21	R	70	47 – 50	76 – 77	0.0
W-N22	R	70	47 – 50	75 – 77	0.0
W-N23	R	70	41 – 53	73 – 78	0.0 – 0.1
W-N24	R	70	42 – 56	72 – 73	0.0 – 0.1
W-N25A	R	70	53 – 63	71 – 74	0.0 – 0.6
W-N25B	R	70	49 – 62	64 – 70	0.1 – 0.9
W-N26A	R	70	51 – 62	67 – 69	0.1 – 1.2
W-N26B	R	70	51 – 63	65 – 71	0.1 – 0.9
W-N27	R	70	56 – 63	71 – 74	0.1 – 0.5
W-N28	R	70	62 – 64	78	0.1 – 0.2
W-N29	W	65	53	73	0.0
W-N30	R	70	58 – 60	73 – 75	0.1 – 0.2
W-P6A	R	70	60	73 – 74	0.1 – 0.3
W-P6C	R	70	67	69 – 70	2.6 – 3.4
W-P7A	E	65	39 – 52	70 – 77	0.0
W-P7B	E	65	40 – 54	62 – 67	0.0 – 0.2
W-P7C	E	65	40 – 49	53 – 58	0.1 – 0.6
W-P7D	E	65	39 – 50	59 – 61	0.0 – 0.4
W-P7E	E	65	41 – 52	58 – 63	0.1 – 0.4
W-P7F	E	65	61 – 63	65 **– 68**	**2.1 – 2.6**
W-P7G	E	65	59 – 63	71 – 74	0.2 – 0.3
W-P8	W	65	58 – 65	75 – 76	0.1 – 0.4
W-P9	R	70	54 – 60	64 – 69	0.4 – 0.7
W-P10	R	70	56 – 62	70	0.2 – 0.7
W-P11	R	70	63 – 65	68 – 70	1.3 – 1.6
W-P12	R	70	56 – 62	70 – 71	0.2 – 0.7
W-P13	R	70	58 – 63	70	0.3 – 0.9

NSR ID	Uses [1]	Noise Criteria $L_{10(1\ hr)}$ dB(A)	Predicted Project Road Noise Level $L_{10\ (1hr)}$ dB(A) [3]	Predicted Overall Noise Level $L_{10\ (1hr)}$ dB(A) [3]	Contribution from Project Roads, $L_{10\ (1hr)}$ dB(A)
W-P14	R	70	59 – 64	68 – 70	0.5 – 1.1
East Portion					
E-P14A	E	65	**75 – 76**	**76 – 77**	**8.6 – 9.9**
E-P14B	E	65	**78**	**79**	**7.7 – 8.6**
E-P14C	E	65	**74 – 75**	**76**	**5.4 – 6.5**
E-P14D	E	65	46 – 55	46 – 55	7.9 – 9.6
E-P14E	E	65	62	64 – 65	2.5 – 4.2
E-P14F	E	65	64 – **66**	65 – **67**	**5.5 – 6.2**
E-P14G	E	65	47 – 50	47 – 50	17.8 – 25.6

Notes:
[1] R – residential; E – educational; H – clinic/ home for the aged/hospital; W – worship; GIC – government, institution and community
[2] Bold figure denotes the noise level from Project Roads is over the relevant TM-EIAO noise criteria.
[3] Bold figure denotes the noise exceedance which is over the relevant TM-EIAO noise criteria and the contribution from new roads to the overall noise level is equal to or higher than 1.0 dB(A) / noise levels from Project Road is over the relevant TM-EIAO noise criteria.
[4] Central air-conditioning is provided, result is for indicative purpose.

Given there are three full noise enclosures (F01, F02 and F03) recommended for mitigating the road traffic noise, it should be noted that road traffic noise generated inside the full noise enclosures would however reverberates within the structure. Nevertheless, according to research findings, the noise emission from enclosure portal would not be significant provided that a tunnel length equivalent to approximately 2-3 times of diameter are installed with absorptive panels [1, 2&3]. For the proposed full enclosures, absorptive panels would be installed along the entire length except at locations such as daylight panels and for safety reason.

West Portion

With the implementation of recommended noise mitigation measures, all NSRs except Hong Kong Community College (HKCC) of the HK (W-N11) and the planned school (W-P7F) will comply with the TM-EIAO noise criteria.

However, W-N11 has already provided with central conditioning, no further mitigation measures are required.

For W-P7, since there is no building layout of this sensitive receiver during the preparation of this study, the sensitive facades are selected at the boundary of a typical building layout block for worst-case scenario. To avoid noise impact from the project roads, it is recommended to avoid any sensitive facade facing the re-aligned Hoi Wang Road as shown in **Figure 5.6c**. Relevant government

[1] Woehner, H.. (1992). *Sound Propagation at Tunnel Openings*
[2] Road Works at West Kowloon EIA, 2009 – Traffic Noise Impact Assessment (Portal and Openings of Underpass)
[3] Kiyoshi Nagakura, Dr. Eng. (2005). *Prediction and Mitigation of Noise form Shinkansen Tunnel Portals*. Quarterly Report OF RTRI. Vol. 46 (1). Railway Technical Research Institute.

authorities including the Education Bureau, Planning Department and Architecture Service Department have no objection on this recommendation (**Appendix 5.18**). Relevant document from Education Bureau is shown in **Appendix 5.18**. Nevertheless, during the design stage of this planned school, appropriate school layout could be revised for agreement with EPD.

The noise reduction of the noise mitigation measures is presented in table below.

Table 5.30: Noise Reduction of Noise Mitigation Measures

Location	Noise Mitigation Measures ID.	Existing NSRs		Planned NSRs	
		NSR ID.	Approximate Noise Reduction, dB(A)	NSR ID.	Approximate Noise Reduction, dB(A)
West Portion Portal	F01, S01, S02, C01, C02, C03, C04, C05, C06, V01, V02, V03, V04	W-P11, W-P13, W-P14	5-9	W-P8	1
		W-N1A, W-N1B, W-N2	1-2	W-P6, W-P7	1-10
Gascoigne Road Flyover (Kansu Street Section)	F03, S04, S05, V07, V08	W-N6, W-N6A, W-N7, W-N8, W-N8A, W-N9A, W-N9B, W-N10A, W-N10C, W-N18, W-N19, W-N24	1-8	-	-
Gascoigne Road Flyover (Ferry Street Section)	F02, S03, C07, V06	W-N3, W-N25A, W-N25B, W-N26A, W-N26B, W-N27, W-P10; W-P12	1-10	W-P6, W-P7	1-10

East Portion

With the sensitive facade of the classroom not facing the Project Roads (E-P14D-E, G), although the noise contribution from the project roads is greater than 1.0dB(A), the predicted overall road traffic noise level is 47 – 65 dB(A) which do not exceed the stipulated noise criterion of 65 dB(A) as shown in **Figure 5.7a-c**. Hence, no further mitigation measure is required. Relevant government authorities including the Education Bureau, Planning Department and Architecture Service Department have no objection on this recommendation (**Appendix 5.18**). Relevant document from Education Bureau is shown in **Appendix 5.18**. Nevertheless, during the design stage of this planned school, appropriate school layout could be revised for agreement with EPD.

Evaluation of Eligibility of Indirect Technical Remedies

As mentioned in **Section 5.5.1**, in the case where NSRs are still exposed to noise levels exceeding the relevant noise criteria after the implementation of all direct mitigation measures, the total number of existing dwellings, classrooms and other noise sensitive elements which may qualify for indirect technical remedies should

be identified. However, except for the planned schools in West Portion (W-P7F) and East Portion (E-P14A, E-P14B, E-P14C & E-P14F), for those NSRs with cumulative noise level exceed the relevant noise criteria, i.e. 70 dB(A) for residential and 65 dB(A) for educational institutions, the noise contribution from "Project Road" would be lesser than 1.0 dB(A). The assessment results of the prevailing scenarios of West Portion and East Portion are shown in **Appendix 5.15A** and **Appendix 5.16A** respectively. Hence, irrespective of the prevailing noise level, all the NSRs would not satisfy the eligibility assessment criteria.

For the two planned schools, it has been agreed with Education Bureau that non-sensitive façade facing to CKR would be incorporated into the design to abate the noise impacts.

Evaluation of Protected and Benefitted Noise Sensitive Uses with the Noise Mitigation Measures

To study the noise performance of the project, traffic noise levels at the residential, schools and other noise sensitive uses including hospital/ clinic and place of worship which have a direct line of sight to the Project have been predicted. The numbers of dwellings, classrooms and other noise sensitive uses that would be benefited from and be protected by the provision of noise mitigation measures have been calculated. The definition of "exposed", "benefited" and "protected" noise sensitive uses are defined as follow:

- Exposed – Noise sensitive uses with unmitigated noise level greater than relevant noise criteria
- Benefited – Exposed noise sensitive uses with a noise reduction of 1.0 dB(A) or greater in overall noise level with the noise mitigation measures in place
- Protected – Exposed noise sensitive uses with an overall noise level not greater than relevant noise criteria with the noise mitigation measures in place

Number of dwellings and classrooms that would be benefited from and be protected by the provision of noise mitigation measures will be identified for existing residential and schools respectively, while hospital/ clinic and place of worship will be identified as number of floors. Moreover, the planned noise sensitive uses do not have detailed numbers of dwellings/ classrooms, the benefitted/ protected will be identified as the number of floors. Results of existing and planned noise sensitive uses are presented in tables below.

Table 5.31: Summary of Protected and Benefitted Noise Sensitive Uses (Existing Uses)

Noise Sensitive Uses	Total No. of Dwellings/ Classrooms/ Noise Sensitive Uses Considered	Unmitigated Scenario	Mitigated Scenario		
		No. of Exposed Dwellings/ Classrooms/ Noise Sensitive Uses	No. of Exposed Dwellings/ Classrooms/ Noise Sensitive Uses	Protected Dwellings/ Classrooms/ Noise Sensitive Uses	Benefitted Dwellings/ Classrooms/ Noise Sensitive Uses
West Portion					
Dwellings	2218	2176	1532	644	1586
Classrooms	159	159	159	0	85
Hospital/ Clinic [1]	20	20	20	0	18
Place of Worships [1]	1	1	1	0	0
East Portion					
Classrooms	40	40	40	0	0

Notes:
[1] Number of floors

Table 5.32: Summary of Protected and Benefitted Noise Sensitive Uses (Planned Uses)

Noise Sensitive Uses	Total No. of Floors of Dwellings/ Classrooms/ Noise Sensitive Uses Considered	Unmitigated Scenario	Mitigated Scenario		
		No. of Exposed Floors of Dwellings/ Classrooms/ Noise Sensitive Uses	No. of Exposed Floors of Dwellings/ Classrooms/ Noise Sensitive Uses	Protected Floors of Dwellings/ Classrooms/ Noise Sensitive Uses	Benefitted Floors Dwellings/ Classrooms/ Noise Sensitive Uses
West Portion					
Dwellings [1]	8	8	4	4	4
Classrooms [1]	56	48	25	23	40
Place of Worships [1]	10	10	10	0	0
East Portion					
Dwellings [1]	166	26	26	0	0
Classrooms [1]	70	37	37	0	0
Hospital/ Clinic [1]	28	28	28	0	0

Notes:
[1] Number of floors

5.5.2 Fixed Plant Noise Assessment

Noise Sources

Ventilation buildings

Potential noise impacts from operation of planned fixed plant including ventilation buildings of the CKR on the nearby NSRs have been assessed quantitatively.

Cumulative impact from the ventilation buildings for planned projects including the Express Rail Link (XRL) and Kai Tak Development (KTD) would also been considered in the fixed plant noise assessment. A summary of the fixed noise sources for CKR is summarized in table below and the locations of fixed noise sources are shown in **Figures 5.8** to **5.10**.

Table 5.33: Summary of Fixed Plant Noise Sources

Fixed Plant Noise Source	Fixed Plant Noise ID.
West Portion	
West Ventilation Building (by CKR)	WVSF 1-5
Ventilation Building (by XRL)	XRL10A-C, XRLMKA-B
Sub Station (by XRL)	XRLS1
Central Portion	
Central Ventilation Building (by CKR)	CVSF 1-9
East Portion	
West Ventilation Building (by CKR)	EVSF 1-5
Ventilation Building (existing Kai Tak Tunnel Ventilation Building)	KTD-KTT
Sewage Pumping Station (by KTD)	KTD-PS1A, KTD-PS2
Sub-station (by KTD)	KTD-1P4
Ventilation Building (by T2) [1]	T2-VB

Note:
[1] The location of ventilation building of T2 is out of 300m of fixed noise sensitive receivers under CKR, therefore, it has considered not including in this assessment.

Permanent Kowloon City Ferry Pier Public Transport Interchange (PTI)

Construction Phase

Section 3.2.8 has explained that the existing PTI would need to be temporarily relocated to allow for the construction of the section of cut-and-cover tunnel underneath. Given the tight site constraints and the need to maintain the PTI operational to serve the local communities, it is required to relocate the temporary PTI with different construction stages to suit construction sequence.

However, the need to allow satisfactory operation of the temporary PTI and the need for associated temporary traffic management at different stages require decking over of the site in order that most of the construction activities (except the

mucking out activities) are conducted underneath the temporary steel decking. Hence, not until the very late stage when most of the underground structures are completed, it would not be practicable to install temporary foundations structures to support a temporary roof to cover the temporary PTI.

Nevertheless, although a temporary roof is not feasible for the temporary PTI, it is still recommended to erect some noise barriers along works areas as much as practicable. A tentative extent is shown in **Figure 5.11**. It should be noted that the exact extent of the temporary noise barriers would need to be adjusted to suit the need for temporary traffic management.

Under the site situation, it would be practicable to adopt temporary noise barrier with about 4m tall which is taller than typical site hoarding. The surface density of the noise barrier should also be enhanced to improve its sound insulation. It is recommended that the material to be used for the noise barrier should achieve a minimum surface density of 7kg/m^2. In order to maximize the possibility of enhancing its performance in noise screening, it is further recommended to have the top section cantilevered towards the temporary PTI. A typical section of this 4m tall temporary noise barrier is illustrated in **Figure 5.11**.

Operational Phase

Based on the current design of CKR, the existing Ma Tau Kok bus terminus will be re-provisioned to the south of the Grand Waterfront and the existing Ma Tau Kok Public Pier will also be re-located. The location of permanent PTI and the Ma Tau Kok Public Pier is shown in **Figure 5.12**. Two deck options (Option A - Landscape Deck Open for Public Access and Option B - Landscape Deck not Open for Pedestrian Access) have been developed and the final decision will depend on the outcome from public consultation activities which is not available during the preparation of this EIA. The potential noise impact from operation of this PTI has been assessed qualitatively.

The re-provisioned PTI will design to no direct line-of-sight of the noise sources at the noise sensitive uses in accordance to the HKPSG. The potential noise impacts at NSRs due to the operation of the PTI is subject to design and could be avoided by providing rooftop of PTI and proper mitigation measures such as barrier, silencer, louvers orientation, etc. The proposed accessible landscape deck and solid wall with pedestrian access for the permanent PTI is shown in **Figure 5.13**. The design for the pedestrian access would be subject to detailed design. Therefore, adverse noise impacts on existing NSRs are not anticipated.

Assessment Methodology

The following general procedures have been adopted for the operation noise assessment.

- Identify and locate representative NSRs that may be affected by the noise sources;
- Determine the noise criteria for both daytime and nighttime;
- Use standard acoustic principle for attenuation and directivity; and

- Determine the maximum sound power levels (SWLs) of the fixed noise sources.

If exceedance to the noise criteria is found for one NSR, the initial SWL of the dominant sources to that NSR would be gradually lowered until the corrected SPL at that NSR meets the acceptable level. The process would be repeated for other representative NSRs with exceedance of the noise criteria until all corrected SPLs at the representative NSRs meet the noise criteria. The maximum allowable SWLs of the proposed fixed plant have been predicted by this approach.

Evaluation of Fixed Plant Noise Impact

The predicted maximum allowable Sound Power Level (SWL) is summarized in the table below. Detailed calculations are presented in **Appendix 5.19**.

Table 5.34: Maximum Allowable SWL for the Ventilation Buildings

Location	Plant Item	Plant ID	Maximum allowable Sound Power Level, dB(A)	
			Daytime	Night-time
West Portion	Ventilation Building	WVSF-1	104	104
		WVSF-2	104	104
		WVSF-3	104	104
		WVSF-4	104	104
		WVSF-5	104	104
Central Portion	Ventilation Building	MVSF-1	90	80
		MVSF-2	88	78
		MVSF-3	88	78
		MVSF-4	90	80
		MVSF-5	95	85
		MVSF-6	90	80
		MVSF-7	90	80
		MVSF-8	90	80
		MVSF-9	90	80
East Portion	Ventilation Building	EVSF-1	105	95
		EVSF-2	110	100
		EVSF-3	110	100
		EVSF-4	110	100
		EVSF-5	110	100

The equipment should be free of the characteristics of tonality, impulsiveness and intermittency. If the selected equipment could not be free of characteristics of tonality, impulsiveness and intermittency, the maximum SWL should be reduced in accordance with the correction factors, in the range of 3 to 6 dB(A), as given in Section 3.3 of TM-IND.

It should be noted that the detailed design of the ventilation buildings (e.g. the louver details) are yet to be developed. Hence, the Contractor shall review the

latest design and update the noise assessment to ensure that the stipulated facade noise levels in **Table 5.12** can be achieved.

The Contractor shall install acoustic silencers, noise barriers and acoustic louvers where appropriate to ensure that the specified maximum SWLs shown in the table above will not be exceeded.

Mitigation Measures

The detailed design should incorporate the following good practice in order to minimize the nuisance on the neighboring NSRs. In case the Contractor would change the design and locations of the vents, they would need to comply with the legislative maximum impacts at the receivers.

- Louvres should be orientated away from adjacent NSRs, preferably onto main roads which are less sensitive.
- Direct noise mitigation measures including silencers, acoustic louvers and acoustic enclosures should be allowed for in the design for the ventilation building.
- The façade for these ventilation shafts should have adequate sound insulation properties to minimise the noise emanating through the building fabric.

5.6 Conclusion

Construction airborne noise assessment has been conducted. All practicable mitigation measures have been exhausted to minimise the noise impacts. These mitigation measures include the optimisation of construction methodology (i.e. schedule of using PME), quiet plant, temporary noise barrier and good site practices. However, given the site constraints, some of the receivers (See **Table 5.16**) would still be subject to adverse residual impacts exceeding the construction noise criterion.

Residual impacts exceeding the construction noise criterion have been assessed and considered the impacts are temporary and reversible. With all the proposed mitigation measures, the adverse residual impact exceeding the construction noise criterion has been reduced to be minimal.

Construction groundborne noise assessment has also been conducted. No exceedance of noise criteria is predicted and hence no mitigation measures are required.

For the operational phase, mitigation measures with low noise road surface, noise barrier, semi-enclosure and full enclosure are required to fulfill the EIAO criteria. After implemented all these proposed mitigation measures, it is anticipated an approximate number of 1600 existing dwellings and 90 existing classrooms will be benefited from and 640 existing dwellings will be protected by the noise mitigation measures, an approximately of 4 floors of planned dwellings and 40 floors of planned classrooms will be benefitted from and an approximately of 4 floors of planned dwellings and 20 floors of planned classrooms protected by the noise mitigation measures.

Maximum sound power levels allowed to be emitted from louvers of fixed noise sources at ventilation buildings at West Portion, Central Portion and East Portion were predicted. The re-provisioned PTI will also designed to no direct line-of-sight of the noise sources at the noise sensitive uses. With the proper selection of plant and adoption of noise control measure such as acoustic silencers, noise barriers, acoustic louvers, the NSRs located in the vicinity of these fixed noise sources would not be affected.