4. Noise Impact

4.1 Introduction

This section presents the assessment of the potential noise impacts associated with the construction and operation phases of the proposed WKCD. Noise generated from various construction activities is the primary concern during the construction phase. Road traffic noise from the adjacent roads and fixed plant noise from ventilation shafts are major noise impacts during the operation phase. Representative Noise Sensitive Receivers (NSRs) within 300m of the subject site have been identified and the worst case impacts on these receivers have been assessed. Suitable mitigation measures, where necessary, have been recommended accordingly to reduce the identified noise impacts to acceptable levels.

4.2 Noise Legislations, Standards and Guidelines

4.2.1 Construction Phase

Control over the generation of construction noise in Hong Kong is governed by the Noise Control Ordinance (NCO) and the Environmental Impact Assessment Ordinance (EIAO) and their subsidiary requirements. Various Technical Memoranda (TMs) have been issued under the NCO and the EIAO to stipulate control approaches and criteria. These TMs prescribe the maximum permitted noise levels for the use of Powered Mechanical Equipment (PME) and certain construction activities and processes, according to the type of equipment or activity, the perceived noise climate of the area, and the working hours of equipment operation and usage. The TMs applicable to the control of noise from construction activities of proposed construction works are:

- TM on Environmental Impact Assessment Process (EIAO-TM)
- TM on Noise from Construction Work other than Percussive Piling (GW-TM)
- TM on Noise from Construction Work in Designated Areas (DA-TM)

4.2.1.1 General Construction Activities during Non-Restricted Hours

Noise impacts arising from general construction activities other than percussive piling during the daytime period (07:00-19:00 hours of any day not being a Sunday or general holiday) are assessed against the noise standards tabulated in **Table 4.1** below.

Table 4.1: Noise Standards for Daytime Construction Activities

Noise Sensitive Uses	0700 to 1900 hours on any day not being a Sunday or general holiday, $L_{eq\ (30\ min)}$, dB(A)
All domestic premises including temporary housing accommodation	75
Hotels and hostel	
Educational institutions including kindergarten, nurseries and all others where unaided voice communication is required	70 65 during examination

Source: EIAO-TM, Annex 5, Table 1B - Noise Standards for Daytime construction Activities

Note: The above noise standards apply to uses, which rely on opened windows for ventilation
The above standards shall be viewed as the maximum permissible noise levels assessed at 1m from the external facade
The above standards shall be met as far as possible. All practicable mitigation measures shall be exhausted and the residual impacts are minimised

4.2.1.2 General Construction Activities during Restricted Hours

Noise impacts arising from general construction activities (excluding percussive piling) conducted during the restricted hours (19:00-07:00 hours on any day and anytime on Sunday or general holiday) and percussive piling during anytime are governed by the NCO.

For carrying out of any general construction activities involving the use of any Powered Mechanical Equipment (PME) within restricted hours, a Construction Noise Permit (CNP) is required from the Authority under the NCO. The noise criteria and the assessment procedures for issuing a CNP are specified in the GW-TM under the NCO.

The use of Specified PME (SPME) and/or the carrying out of Prescribed Construction Work (PCW) within a Designated Area (DA) under the NCO during the restricted hours are also prohibited without a CNP. The relevant technical details in Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM) under NCO can be referred.

Designated areas, in which the control of SPME and PCW shall apply, are established through the Noise Control (Construction Work Designated Areas) Notice made under Section 8A(1) of the NCO. According to the Designated Area defined under the NCO, all part of the works area of this project will fall within these areas where construction works would be carried out.

Regardless of any description or assessment made in this section, in assessing a filed application for a CNP the Authority will be guided by the relevant Technical Memoranda. The Authority will consider all the factors affecting their decision taking contemporary situations/ conditions into account. Nothing in this Report shall pre-empt the Authority in making their decisions, and there is no guarantee that a CNP will be issued. If a CNP is to be issued, the Authority may include any conditions they consider appropriate and such conditions are to be followed while the works covered by the CNP are being carried out. Failing to do so may lead to cancellation of the permit and prosecution action under the NCO.

According to the construction programme, the proposed construction works would be carried out during non-restricted hours. In case of any construction activities during restricted hours, it is the Contractor's responsibility to ensure compliance with the NCO and the relevant TMs. The Contractor will be required to submit CNP application to the Noise Control Authority and abide by any conditions stated in the CNP, should one be issued.

4.2.1.3 Ground-borne Construction Noise

Basement design is involved in the proposed Project. The underground construction works will be carried out by cut and cover method. No tunnelling works would be involved in the basement construction. Hence potential ground-borne noise impact to existing NSRs is not anticipated. As all basement construction works will be completed in Phase 1 of the proposed Project, no underground works will be carried out after completion of the venues with noise sensitive use above the basement. In view of this situation, ground-borne noise impact arising from the construction works of the proposed Project to the planned NSRs is not anticipated. Therefore, no ground-borne noise impact is expected during the construction phase of the Project.

4.2.2 Operation Phase

4.2.2.1 Road Traffic Noise

The EIAO-TM published under Section 16(5) of the EIAO is the fundamental legislation of noise criteria for evaluating noise impact of designated projects. The summary of noise criteria is given in **Table 4.2**.

Table 4.2: Relevant Road Traffic Noise Standards for Planning Purposes

Uses	Road Traffic Noise Peak Hour Traffic $L_{10\ (1hour)}$, dB(A)
All domestic premises including temporary housing accommodation	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65

Notes: (i) The above standards apply to uses which rely on opened windows for ventilation
(ii) The above standards should be viewed as the maximum permissible noise levels assessed at 1m from the external facade

Outdoor performance venues have been proposed in the latest design layout of WKCD. As road traffic noise criterion for outdoor performance theatre has not been specified in the EIAO-TM, reference has been made to the Noise Abatement Criteria[1] adopted in United States i.e. $L_{10\ (1\text{-}hr)}$ 70 dB(A) for amphitheatre. However, it is proposed to adopt the local road traffic noise criterion for educational institution i.e. 65 dB(A) for this outdoor performance theatre as a conservative approach.

4.2.2.2 Fixed Plant Noise

For the fixed plant noise assessment, the Acceptable Noise Levels (ANLs) for the NSRs are determined based on the Area Sensitivity Rating (ASR).

ASR is defined in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM). The ASR depends on the type of area and the degree of impact that Influencing Factors (IFs) have on the NSRs and is determined from **Table 4.3** below. Industrial area, major road or the area within the boundary of Hong Kong International Airport shall be considered to be an IF.

Table 4.3: Area Sensitivity Rating

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

[1] Procedures for Abatement of Highway Traffic Noise and Construction Noise, 2010, Federal Highway Administration, Department of Transportation, US

The ANLs laid down in the Table 2 of the IND-TM is shown in **Table 4.4** below.

Table 4.4: Acceptable Noise Level for Fixed Noise Source

Time Period	Area Sensitivity Rating (ASR)		
	A	B	C
Day (0700 to 1900 hours)	60	65	70
Evening (1900 to 2300 hours)			
Night (2300 to 0700 hours)	50	55	60

As stipulated in Annex 5 of the EIAO-TM, the noise standard for planning purposes for fixed noise source are (a) 5 dB(A) below the appropriate ANL, or (b) the prevailing background noise levels (For quiet areas with level 5 dB(A) below the ANL).

The criteria to be adopted for the planned NSRs within WKCD are dependent on the background noise measurement results. Should the measured prevailing background noise level be lower than the ANL by more than 5dB(A), the background noise level would be adopted as the criteria.

The whole WKCD is located in urban area. According to **Table 4.3**, the ASR of the area in West Kowloon for most identified NSRs shall be "B", while the ASRs for NSR P3b, VT1, LCS and CRGPS are identified as "C" due to directly and indirectly affected by nearby major road, namely Canton Road which is considered as Influencing Factor according to the IND-TM. The noise criteria of the fixed plant noise at different locations of the Project are summarised in **Table 4.5** and **Table 4.6** below.

Table 4.5 Noise Criteria of Fixed Plant Noise

NSR ID.	Time Period	ASR[#]	ANL – 5, dB(A)	Background Noise Level, dB(A)*	Fixed Plant Noise Criteria, dB(A)
P3b, VT1, LCS and CRGPS	Daytime (0700 to 1900)	C	65	71	65
	Evening Time (1900 to 2300)		65	72	65
	Night-time (2300 to 0700)		55	69	55
P16a, P17c, P19, P27b, P29a&b and P32a-c	Daytime (0700 to 1900)	B	60	60	60
	Evening Time (1900 to 2300)		60	57	57
	Night-time (2300 to 0700)		50	51	50
P10, P11a&b, P13a-e	Daytime (0700 to 1900)	B	60	63	60
	Evening Time (1900 to 2300)		60	58	58
	Night-time (2300 to 0700)		50	51	50
P2, P3a, P5c, P6a&b, P7, P9b, P9c	Daytime (0700 to 1900)	B	60	65	60
	Evening Time (1900 to 2300)		60	60	60
	Night-time (2300 to 0700)		50	51	50
P5a, P5b and P9a	Daytime (0700 to 1900)	B	60	65	60
	Evening Time (1900 to 2300)		60	65	60
	Night-time (2300 to 0700)		50	67	50
P16b, P17a and P17b	Daytime (0700 to 1900)	B	60	68	60
	Evening Time (1900 to 2300)		60	67	60

NSR ID.	Time Period	ASR[#]	ANL – 5, dB(A)	Background Noise Level, dB(A)*	Fixed Plant Noise Criteria, dB(A)
	Night-time (2300 to 0700)		50	62	50
P24, P27a and P28	Daytime (0700 to 1900)	B	60	64	60
	Evening Time (1900 to 2300)		60	63	60
	Night-time (2300 to 0700)		50	61	50

Notes: (#) Type of area containing NSR inside study area is classified as "Urban Area". The Influencing Factor (IF) inside study area is Canton Road which with an annual average daily traffic flow in excess of 30,000.
(*) Refer to Appendix 4.1 for the background noise measurement results.

The proposed Outdoor Theatre in the WKCD would also be affected by fixed noise sources in proximity. As fixed noise criterion for outdoor theatre has not been specified in the EIAO-TM, reference has been made to the Community Noise Exposure Level as proposed in the State of California General Plan Guidelines 2003[2], in which a level greater than 65 dB(A) in terms of L_{dn} is defined as normally unacceptable for amphitheatre. In considering the Area Sensitive Rating at the proposed Outdoor Theatre should be B and the corresponding ANL should be 65 dB(A) during 0700 to 2300, it is proposed to adopt the noise criterion 5 dB(A) below the ANL or the prevailing background level which is lower for the proposed Outdoor Theatre.

For the Outdoor Theatre proposed in the WKCD site, the current background noise levels measured at the locations of the proposed Outdoor Theatre during daytime and evening are lower than the ANL by more than 5 dB(A). Hence, the current background noise levels are adopted for the establishment of the fixed source noise criteria for that Outdoor Theatre.

Table 4.6 Noise Criteria of Fixed Plant Noise for the Outdoor Performance Venues

NSR ID.	Time Period	ASR[#]	ANL – 5, dB(A)	Background Noise Level, dB(A)*	Fixed Plant Noise Criteria, dB(A)
P50** Outdoor Theatre	Daytime (0700 to 1900)	B	60	59	59
	Evening Time (1900 to 2300)		60	58	58

Notes: (#) Type of area containing NSR inside study area is classified as "Urban Area".
(*) Refer to Appendix 4.1 for the background noise measurement results.
(**) No activity would be held at the venue during night time.

4.2.2.3 Noise from Open Air Entertainment Activities

An outdoor theatre is included in the current layout design of the proposed WKCD development. For the operation of the proposed Outdoor Theatre in WKCD, the Noise Control Guidelines for Holding Open Air Entertainment Activities stipulated by EPD has been followed. The noise level from open air activity (including set up, rehearsal, main event and stage dismantling etc.) should not be more than 5 dB(A) above the background noise level, as measured at one metre from the exterior building facade of the most affected noise sensitive receivers, during day time and evening period, i.e. 0700 – 2300 hours. For the night time, i.e. 2300 – 0700 hours, noise should not be audible within nearby noise sensitive receivers.

2 Figure 2 of Appendix C, State of California General Plan Guidelines 2003, published by the California Governor's Office of Planning and Research, US

As the proposed Project is a newly planned regional development, the background noise level at the time of the operation of the Project is uncertain. However, as a conservative approach, it is proposed to adopt the current background noise level for the establishment of the noise control requirement for the open air entertainment activities.

4.2.2.4 Ground-borne Rail Noise

Three existing underground railways, namely West Rail (known as Kowloon Southern Link in EIA study (AEIAR-083/2005)), Airport Expressway Rail Link (AEL) and Tung Chung Line (TCL) and the future Express Rail Link (XRL) railway are located underneath the WKCD development. Ground-borne noise from rail operation should comply with the acceptable noise level criteria determined from the IND-TM.

Since ground-borne noise is transmitted through the building structure and will affect the NSR inside the building, ground-borne noise assessment should be carried out at an internal location representative of normal occupancy of the building. Hence, the propose ground-borne noise criteria should be 10 dB(A) less than the Acceptable Noise Level (ANL) for the airborne noise assessment.

Based on the above and WKCD is in urban area with no influencing factor (IF) affecting the NSRs (as the assessment point is inside the building), the ground-borne operational noise level criteria for the Project are summarised in **Table 4.7** below:

Table 4.7: Ground-borne Operational Noise Level Criteria

	Ground-borne Noise Level Criteria L_{Aeq}(30mins), dB(A)
Area Sensitivity Rating	**B**
Day (0700 to 1900 hours)	55
Evening (1900 to 2300 hours)	
Night (2300 – 0700)	45

In accordance with the IND-TM, the above ground-borne noise level criteria are applicable to domestic premises, hotels and hostels, hospitals and educational institutions and performing art centres. As confirmed with the WKCDA, some of the planned NSRs in the WKCD development are special venues for performing art activities with low background noise requirements, including Xiqu Centre, Centre for Contemporary Performance (CCP), Lyric Centre, Music Centre, Musical Theatre and the Museum M+ (Phase I & II). These venues should therefore be subject to more stringent noise level assessment than the statutory requirement outlined in the IND-TM. Upon the planning stage, the ground-borne noise criteria for other CACF mainly designed for the performance of popular or amplified music including Proscenium Theatre, Thrust Theatre, Great Theatre and Freespace will follow the IND-TM as given in the above **Table 4.7**. Exact noise requirement will be subjected to further detailed design study.

As the design criteria for the above-mentioned special venues have not been confirmed when preparing the EIA report, $L_{A\ max}$ ground-borne noise level limits are proposed by the Project Proponent and subsequently agreed by the EIAO Authority for the special venues in WKCD with reference to the FTA Guidance Manual[3] as shown in **Table 4.8** below. Museum M+ (Phases I & II) is assigned with a criterion for “Theatres” (35dB(A)) as suggested in the FTA Guidance Manual since WKCDA has confirmed that the Museum M+

[3] Transit Noise and Vibration Impact Assessment, 2006, Federal Transit Administration, Department of Transportation, US.

will not have live performance as in art performance venues which usually require much a very low background noise level. Museum M+ is mainly for visual culture such as motion picture shows which is same as in theatre. The propose criteria is consistent with other international standard recommendation including AS2107[4]. The potential ground-borne rail noise impacts on different venues of WKCD are discussed case by case in **Section 4.6.5**.

Table 4.8: Proposed Ground-borne Operational Noise Level Criteria for Special Venues in WKCD

Noise Sensitive Use Venue	Ground-borne Noise Level Criteria $L_{A\,max}$, dB(A)
Xiqu Centre, CCP, Lyric Centre, Music Centre and Musical Theatre	25
Museum M+	35

4.2.2.5 Helicopter Noise

No helipad has been planned inside WKCD. The operation of an existing helipad at the Shun Tak Centre, which is located more than 1.1km from the Project site, may possess potential impact of helicopter noise to the residential premises, commercial premises and proposed Outdoor Theatre in the Project site.

According to Table 1A of EIAO-TM Annex 5 “A Summary of Noise Criteria”, the criteria for helicopter noise is L_{max} 90 dB(A) for offices and L_{max} 85 dB(A) for domestic premises, hotels, hostels, education institutes, place of worship, hospital and clinics during 0700-1900 hours. The standards apply to uses which rely on openable windows for ventilation and should be viewed as the maximum permissible noise levels assessed at 1m from the external façade.

4.2.2.6 Marine Traffic Noise

Potential marine traffic noise from the manoeuvring of vessels during the operational phase of WKCD is anticipated. There is no specific control on noise from general vessel movements under either the Noise Control Ordinance or the objective noise criteria in the EIAO-TM for evaluating noise impact of marine traffic. No objective noise standard for marine traffic noise (including noise from typhoon shelters) is proposed in this EIA.

For assessment purpose, prevailing background noise levels at the NSRs have been adopted for identifying the potential nuisance raised by marine traffic.

4.3 Baseline Conditions

4.3.1 Study Area

The Study Area is defined as within 300m of the site boundary of the Project for noise impact assessment. This study area is identified and shown in **Figure 4.1**.

[4] Australian Standard AS2107:2000 Acoustics – Recommended design sound levels and reverberation time for buildings.

4.3.2 Description of the Environment

Site visits were conducted in June, July and August 2011 to understand the existing environment in the vicinity of the Project site. This Project site is surrounded by the areas with residential, commercial and recreational uses. The existing noise environment is dominated by the road traffic noise from Austin Road West, Lin Cheung Road, Canton Road and the West Kowloon Highway.

4.3.3 Identification of Noise Sensitive Receivers

Noise Sensitive Receivers (NSRs) have been identified in accordance with Annex 13 of the EIAO-TM. The NSRs have included existing, planned/committed noise sensitive developments and relevant uses identified on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans, Layout Plans and other relevant published land use plans, including plans and drawings published by Lands Department.

For the purpose of noise assessment, the first layer of residential premises located close to the site boundary have been selected as assessment points/ identified representative NSRs within the Assessment Area for prediction of noise impact levels.

According to the Outline Zoning Plans ("the Approved South West Kowloon OZP No. S/K20/28" gazetted on 8 January 2013 and "the Draft Tsim Sha Tsui OZP No. S/K1/27" gazetted on 11 January 2013), the assessment area mainly comprises zoning of Other Specified Uses and Comprehensive Development Area (CDA). Part of the assessment area is within Residential zoning adjacent to the Canton Road. Existing NSRs in the Residential and CDA zones located close to the site boundary have been identified and selected as representative NSRs.

Based on the approved EIA of Road Works at West Kowloon (AEIAR-141/2009), topside development at West Kowloon Terminus (Site A) is planned for commercial use and remains unchanged based on the latest information provided by MTRCL. Hence, no planned NSR is identified within Site A of West Kowloon Terminus. The topside developments of the Sites C and D were planned for residential use. Based on the latest information provided by the MTRCL, the tentative population intake of the planned NSR at Site D will be in June 2015 and hence it is also included in the assessment. The development layout of Site D and building heights are based on the latest layout approved and provided by the Planning Department.

As this Project includes residential development, planned NSRs are also identified within the Project site area for assessment of the potential noise impact on residential premises within the WKCD development. The boundary of all residential parcels have set back distance from land use zone as shown in **Figure 4.1** to avoid potential noise impact. The minimum set back distance from site boundary at Austin Road West and Canton Road site are 26m and 49m respectively.

Central air conditioning will be proposed for all CACFs except Outdoor Theatre within the WKCD, and therefore, will not rely on open windows for ventilation. Hence, no assessment point is proposed for the CACFs except Outdoor Theatre under the airborne noise impact assessment. In view that some of the CACFs will be subject to ground-borne noise impact from the existing/planned railways, they will be selected in the ground-borne noise impact assessment.

Descriptions and locations of all selected representative NSRs are shown in **Table 4.9** and **Figure 4.1**. The representative NSRs for construction noise impact assessment are shown in **Figures 4.2a to 4.2l**. The representative NSRs for road traffic noise impact assessment are shown in **Figure 4.3**. The

representative NSRs for fixed plant noise impact assessment are shown in the **Figures 4.4a and 4.4b**. Photos of existing noise sensitive receivers are shown in **Figure 4.5**. The representative NSRs for ground-borne noise impact assessment are shown in **Figure 4.7a**.

Table 4.9: Representative Noise Sensitive Receivers

No.	NSR ID	Description	Use	Existing/ Planned	No. of Storeys (Sensitive use only)	1st Assessment Level (mPD)	Area Sensitivity Rating	Noise Impact Assessment				
								Construc-tion (*)	Road Traffic	Fixed Source	Rail (Ground-borne)	Marine Traffic
1	HT1	The Harbourside Tower 1	Residential	Existing	65	40	N/A	√	√			
2	HT3	The Harbourside Tower 3	Residential	Existing	65	40	N/A	√	√			
3	AST	The Arch - Sun Tower	Residential	Existing	52	40	N/A	√				
4	RD	Development next to Austin Station	Residential	Planned	20	47	N/A	√				
5	WOB	Wai On Buiding	Residential	Existing	15	7	N/A	√				
6	VT1	The Victoria Towers - Tower 1	Residential	Existing	52	47	C	√	√	√		
7	VT2	The Victoria Towers - Tower 2	Residential	Existing	52	47	N/A	√				
8	LCS	Lai Chack Middle School	Educational	Existing	5	8	C	√	√	√		
9	CRGPS	Canton Road Government Primary School	Educational	Existing	6	7	C	√		√		
10	FQ	Fire Services Department Staff Quarter	Residential	Existing	7	24	N/A	√				
11	CUL	The Cullinan I	Residential	Existing	33	40	N/A	√				
12	P1	Parcel 1 in WKCD	Xiqu Centre	Planned	N/A	N/A	B				√	
13	P2	Parcel 2 in WKCD	Residential	Planned	13	22	B			√		√
14	P3	Parcel 3 in WKCD	Residential	Planned	6	19	B/C	√	√	√		√
15	P5	Parcel 5 in WKCD	Residential	Planned	9	33	B		√	√		
16	P6	Parcel 6 in WKCD	Residential	Planned	8	33	B	√		√		
17	P7	Parcel 7 in WKCD	Residential	Planned	8	33	B	√		√		
18	P9	Parcel 9 in WKCD	Residential	Planned	9	33	B		√	√		

No.	NSR ID	Description	Use	Existing/ Planned	No. of Storeys (Sensitive use only)	1st Assessment Level (mPD)	Area Sensitivity Rating	Noise Impact Assessment				
								Construc-tion (*)	Road Traffic	Fixed Source	Rail (Ground-borne)	Marine Traffic
19	P10	Parcel 10 in WKCD	Residential	Planned	10	33	B			√		√
20	P11	Parcel 11 in WKCD	Residential	Planned	13	22	B			√		√
21	P13	Parcel 13 in WKCD	Residential	Planned	9	37	B	√		√		√
22	P14	Parcel 14 in WKCD	Centre for Contemporary Performance (CCP)	Planned	N/A	N/A	B				√	
23	P16	Parcel 16 in WKCD	Residential	Planned	10	33	B		√	√		
24	P17	Parcel 17 in WKCD	Residential	Planned	11	22	B	√	√	√		
25	P19	Parcel 19 in WKCD	Residential	Planned	10	33	B		√	√		
26	P21	Parcel 21 in WKCD	Residential	Planned	8	33	N/A	√				√
27	P22	Parcel 22 in WKCD	Residential	Planned	12	29	N/A		√			
28	P24	Parcel 24 in WKCD	Residential	Planned	11	33	B		√	√		
29	P26	Parcel 26 in WKCD	Residential	Planned	10	40	N/A	√				√
30	P27	Parcel 27 in WKCD	Residential	Planned	9	42	B		√	√		
31	P28	Parcel 28 in WKCD	Residential	Planned	14	40	B		√	√		
32	P29^	Parcel 29 in WKCD	Residential	Planned	16	37	B	√	√	√		
33	P32^	Parcel 32 in WKCD	Residential	Planned	10	22	B	√		√		√
34	P35	Parcel 35 in WKCD	Lyric Theatre	Planned	N/A	N/A	N/A				√	
35	P40	Parcel 40 in WKCD	Museum M+ (Phase I)	Planned	N/A	N/A	N/A				√	
36	P50#	Parcel 50 in WKCD	Outdoor Theatre	Planned	N/A	6	B		√	√		√
37	P51	Parcel 51 in WKCD	Freespace	Planned	N/A	N/A	N/A				√	

Note: (*) Some of the planned NSRs within WKCD would become NSRs of construction noise in different phases of the Project which is subject to the construction programme of the Project
(#) Potential helicopter noise impact to this NSR has been addressed. In addition, the operation of Outdoor Theatre will be after completion of the key construction work of Parks, Hotel and M+ Phase 1. No major construction works within 300m will overlap with the operation phase of this NSR and so it is not included in construction noise impact assessment.
(^) Potential open air entertainment noise impact to this NSR has been assessed
(N/A) Not Applicable
All residential floors inside WKCD will be mixed with retail, dining and entertainment (RDE) and / or office at lower floor below 1st assessment level to minimize the noise impacts.

4.3.4 Background Noise Condition

Noise surveys were carried out in June, July and August 2011 to investigate the background noise condition of the surrounding environment and the Project site. The baseline noise measurement locations are shown in **Figure 4.6**.

Nine noise surveys were carried out in the Project site. The noise surveys were undertaken using Type 1 sound level meters, namely Rion NL-18 and Rion NL-31. During each survey, the sound level meter was checked using an acoustic calibrator generating a sound pressure level of 94.0 dB(A) at 1kHz immediately before and after noise measurement. The measurements were accepted as valid only if the calibration levels before and after the noise measurement were agreed to be within 1.0 dB(A). The sound level meters and acoustic calibrators are calibrated in accredited laboratories yearly to ensure reliable performance. The measurement results are shown in **Appendix 4.1**.

4.4 Identification of Pollution Sources

4.4.1 Construction Noise

The major construction activities of the Project will involve site formation, construction of the proposed basement structure, underpass, flyover and superstructures within WKCD. It should be noted that although the Xiqu Centre is one development, it is intended to be constructed in 2 phases. The relocation of Tsim Sha Tsui (TST) Fire Station is expected to be between year 2022 and 2025 and there is no solid programme/schedule for such arrangement during the preparation of this Report. However, demolition of existing TST Fire Station and construction of new residential buildings within the same site will also be assessed in the assessment scenario of year between 2022 and 2030. The remaining part of the underpass will be constructed after the demolition of the existing TST Fire Station and it is expected to be completed for operation by 2030. The construction noise impact associated with the underpass will also be assessed in the assessment scenario of year between 2022 and 2030. The Kowloon Park footbridge (West) and (South) are expected to be constructed after 2030.

As mentioned in **Section 2.8**, the construction programme of this WKCD Project would overlap with other several construction projects including Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL), Road Works at West Kowloon (RWWK) and Proposed Road Improvement Works in West Kowloon Reclamation Development Phase 1. Construction noise from these projects was also identified as key noise sources to the identified NSRs under this Project.

4.4.2 Road Traffic Noise

During the operational phase, noise sensitive facades may be impacted by road traffic noise from roads surrounding WKCD. Austin Road West, Canton Road, other existing roads, proposed flyover and underpass of the WKCD development and roads of other committed projects are potential sources of the road traffic noise impact.

As the proposed flyover will be of limited traffic flow while the proposed underpass i.e. the major road network serving the West Kowloon Cultural District area will be fully enclosed by the above ground structures with only short exposed sections at the access portal at Austin Road West (under interim scheme) and Canton Road (under permanent scheme), it is anticipated that the Project roads of the WKCD development would only have relatively small contribution to the overall traffic noise in the area. On the

contrary, the planned noise sensitive receivers of the WKCD development would be subject to potential traffic noise impacts that are largely generated by the existing/planned road traffic in the area.

4.4.3 Fixed Noise Sources

Operation of planned fixed plant such as air intake/exhaust openings for ventilation of underpass section and basement facilities located above ground within WKCD would likely generate noise impacts. Some other facilities are proposed within the WKCD development including a district cooling system, sewage pump sumps, electricity substation and wind turbines, mentioned in **Section 2.2**, are also considered as fixed noise sources within the WKCD. The district cooling system and sewage pump sumps will be located at basement level served by the basement ventilation system with above-ground ventilation openings, which are taken into account in the fixed plant noise impact assessment.

Other existing and planned fixed plant noise sources which could impact on the noise sensitive uses in WKCD as well as all existing nearby NSRs are also identified. Those sources include openings of ventilation shafts serving the Kowloon Station, Austin Station, Airport Railway, Western Harbour Crossing Tunnel, China Harbour City and the XRL West Kowloon Terminus (under construction). The operation of the existing China Harbour Ferry Terminal in the vicinity of the east of the Project site is also considered as fixed noise source. Measurements of these fixed noise sources have been conducted in order to identify their sound power levels for the fixed plant noise impact assessment. The methodology for identification of the sound power levels is presented in **Appendix 4.1a**. Details of the identified sound power levels and locations of the noise measurements are presented in **Appendices 4.1b to 4.1d.** The locations of identified fixed noise sources including ventilation openings of the West Kowloon Terminus as proposed in the approved EIA and updated available information of the XRL project are shown in **Figures 4.4a and 4.4b**. All identified fixed noise sources are subject to change based on the best and latest available information for the assessment.

The potential noise impact from the proposed electricity substation has also been taken into account in the assessment. Installation of wind turbines is an optional component of WKCD, subject to funding and final decision making. The potential noise impact from wind turbines has also been included in the assessment based on currently best available information, adopting a conservative approach.

The existing TST fire station is located at the east part of the WKCD. The distance between the nearest planned residential parcel (NSR P7) to TST fire station is 105m and there is no direct line of sight to the entrance of the fire station. Noise from fire stations would be related to emergency duties which are short duration and infrequent. Adverse noise impact due to TST fire station is not expected. In addition, the relocation of TST Fire Station is expected to be around year 2022 to 2025 and thus no long term noise impact, if any, is anticipated.

Optional automatic refuse collection system would be built in WKCD if technically feasible and financially viable. Major noise sources generally are related to air blowers, refuse compactor, refuse separator and the collection point, which are highly depend on detail design layout plan which subject to further study. Preventive measures such as careful siting of noisy equipment like air blowers, refuse compactor, de-odorising facilities and exhaust should be adopted in first place. Further mitigation measures such as silencers, acoustic enclosure and shielding should be considered if necessary in order to comply with noise standards. Most of the system could be underground or located in shielded areas and associated impacts could be controlled. Adverse impacts are not expected.

4.4.4 Open Air Entertainment Activity Noise

Outdoor performance venue, namely Outdoor Theatre, is proposed in the concept plan of the WKCD. The major noise source come from such venue includes the use of sound amplification systems and the crowd noise.

4.4.5 Ground-borne Noise

Part of the WKCD development is directly above or in close proximity to the existing railway tunnels including West Rail - Kowloon Southern Link (WR-KSL), Airport Expressway Rail Link (AEL) and Tung Chung Line (TCL), and the West Kowloon Terminus of the proposed Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) which is currently under construction. All these identified railways are built underground within the site of WKCD. During the operation phase of the proposed Project, these railway lines have potential ground-borne noise impact on planned NSRs within WKCD.

4.4.6 Helicopter Noise

According to the latest available information of the master layout plan design of the proposed Project, no helicopter pads would be involved in WKCD. However, the current layout design does not preclude the inclusion of helicopter pads in individual developments e.g. hotel or the Mega Performance Venue, within WKCD at the detailed design stage. As there are no details of any possible future helicopter pads at this stage, further noise impact assessment will be carried out at the detailed stage should the occasion arise.

However, the operation of the existing helipad at Shun Tak Centre, which is located at more than 1.1km from the closest WKCD site boundary may possess potential impact of helicopter noise to the residential premises, commercial premises and the proposed Outdoor Theatre in the Project site.

On-site noise measurement was carried out at the location of the proposed Outdoor Theatre to the west of the Project site where is the place within the WKCD site nearest to the existing helipad with scheduled flight (Shun Tak Centre) to determine the potential helicopter noise impact. Details of the helicopter noise assessment are shown in **Appendix 4.3a** and **4.3b**. According to the on-site noise measurement results, the maximum measured helicopter noise level L_{max} 73 dB(A) was recorded at Outdoor Theatre which is well within the criteria for helicopter noise stated in EIAO-TM Annex 5 “A Summary of Noise Criteria”, which are L_{max} 90 dB(A) for offices and L_{max} 85 dB(A) for domestic premises and hotels. In this regard, adverse impact of helicopter noise to the residential premises and commercial premises is not anticipated.

The activities to be conducted in the Outdoor Theatre, such as popular music concerts, will rely on public address (PA) system and are expected to have high sound levels. Based on the measurement results of previous music events conducted in October 2011 within WKCD, the sound levels of such types of music performance have been identified in a range of 76 to 89 dB(A) to the audience. Details of noise measurement results are presented in **Appendix 4.7b**. Given the helicopter noise observed at the location of the proposed Outdoor Theatre was just noticeable and transient in nature (lasting for about 20s), it is expected that there will be no adverse helicopter noise impact to the audience of the Outdoor Theatre.

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4.4.7 Marine Traffic Noise

Under the current development of marine traffic planning at the WKCD site, it is intended that marine services at WKCD will primarily be provided for visitor or leisure activities. No precedence case or similar scale of development as the WKCD has been developed in the Victoria Harbour and therefore no definite marine traffic forecast can be developed at this stage of the Project. However, as the possible piers would only be used by visitors or for leisure purposes without any planning for routine uses, it is anticipated that the marine traffic to be generated at the two possible piers would be insignificant when compared to the existing marine activities at the China Ferry Terminal. No vessel landing steps will be included at the optional viewing platform and it is designed as features of the development and will not serve the purpose of marine traffic. In addition, WKCDA will exercise management control on the possible piers, e.g., restrict night-time activities and restrict the usage by small vessel only. As a result, it is anticipated that the potential marine traffic noise impact due to the operation of the two possible piers and the viewing platform of WKCD shall be insignificant.

Potential marine traffic noise impact from the movement of ferries to and from the existing China Ferry Terminal in the vicinity of the east of the WKCD site are anticipated.

The operation of the New Yau Ma Tei Typhoon Shelter may generate noise impact to the planned NSRs in WKCD.

4.5 Assessment Methodology

4.5.1 Construction Noise

Assessment approach to the noise impact is in line with the Guidance Note titled “Preparation of Construction Noise Impact Assessment under the Environmental Impact Assessment Ordinance” (GN 9/2010).

In addition, the assessment of construction noise impact is based on standard acoustic principles, and the guidelines given in GW-TM issued under the NCO where appropriate. Where no sound power level (SWL) can be found in the relevant TM, reference has been made to BS 5228 Part 1:2009 or noise emission levels measured for PME used in previous projects in Hong Kong. The general approach is summarized below:

i. Formulate a typical construction schedule/ programme;

ii. Identify a typical project-specific equipment inventory for each work stage together with the number;

iii. Obtain from GW-TM, the Sound Power Level (SWL) for each PME assumed in the equipment inventory;

iv. Select representative NSRs for the construction noise impact assessment;

v. Calculate the unmitigated Predicted Noise Level (PNL) and correct it for facade reflection to obtain the Corrected Noise Level (CNL) at any NSRs;

vi. If necessary, re-select typical project-specific silenced equipment and calculate the mitigated noise impact;

vii. Compare the mitigated CNL with the noise standards to determine acceptability and the need for further mitigation.

The calculation methodology is estimated with the following standard formula (1):

$$SPL = SWL - DC + FC \quad (1)$$

where

Sound Pressure Levels, SPL in dB(A)

Sound Power Levels, SWL in dB(A)

Distance Attenuation, DC in dB(A) = $20 \cdot \log(D)+8$ (where D is the distance between NSRs and noise source in meters)

Façade Correction, FC in dB(A) = 3dB(A)

For the cumulative noise impact during construction phase, projects which included Express Rail Link, Road Works at West Kowloon and Road Improvement Works in West Kowloon Reclamation Development were considered in the noise assessment. The Central Kowloon Route project as listed in **Section 2.8** was not taken into account as it is outside the 300m study area.

In addition, a current concrete batching plant (CBP) of XRL at east of Project area as shown in **Figures 4.2b to 4.2e** will be handed over to WKCDA in year 2014. The operation, demolition and relocation of that CBP have been taken into account in the construction noise impact assessment accordingly. It is assumed that the CBP will be relocated to the west of Project area in year 2017 for worst case scenario consideration as shown in **Figures 4.2f to 4.2i**.

4.5.2 Road Traffic Noise

Road traffic noise levels at the representative assessment points will be calculated based on the peak hour traffic flow within a 15 years period upon commencement of operation of the road project i.e. the assessment year. Traffic noise will be predicted using the model "RoadNoise", which has been used before in other similar EIA studies. The model has fully incorporated the procedures and methodology documented in "Calculation of Road Traffic Noise (CRTN)" (1988) published by the U.K. Department of Transport.

The planned noise sensitive use facades within WKCD and vicinity NSRs may have potential road traffic noise impact from major roads surrounding WKCD. The peak hour traffic flows of the surrounding road links and the locations of the road links are shown in **Appendix 4.2a**. As the PM peak hour traffic flows of those dominant surrounding road links are higher than that during the AM peak hour, the PM peak hour traffic flow will be adopted in the assessment. The key plans for WKCD external and internal road links for the design year and prevailing scenario are shown in **Appendices 4.2b**, **4.2c, 4.2d and 4.2e**.

The proposed underpass will be connected to the Austin Road West in interim scheme before permanently connected to the Canton Road upon relocation of the existing TST Fire Station. The traffic noise impact to the identified NSRs will be assessed under both the interim and permanent schemes to identify the worst traffic noise impact within a 15 years period upon commencement of operation of the road project.

As a large portion of the proposed underpass of the Project will be fully enclosed by the above ground structures, it is anticipated that the contribution from the underpass to overall road traffic noise impact shall be minimal. Noise from the open road sections of the access to the underpass have been taken into account in the assessment of the road traffic noise impact.

An assessment of the unmitigated road traffic noise levels at the representative NSRs under both interim and permanent scheme in the assessment year has been carried out. If exceedance of the relevant road traffic noise criteria is predicted and which is contributed significantly by the proposed road sections under this Project, direct noise mitigation measures will be considered. In case the proposed direct noise mitigation measures could not be implemented due to site constraints and other uncertainties, indirect noise mitigation measures have also been considered.

Other than the existing road sections paved with low noise surfacing, the extent of low noise road surfacing, barriers and semi-enclosures proposed in the Road Works at West Kowloon project have also been considered in the unmitigated scenario of the road traffic noise impact assessment.

4.5.3 Fixed Plant Noise

In the absence of any detailed information and noise specification for the proposed fixed plant, the maximum allowable noise emission levels at the shaft/ exhaust openings have been determined for future detailed design of the fixed plant.

For the assessment of noise from the fixed plant, the maximum allowable sound power levels (Max SWLs) of the identified fixed noise sources were determined by adopting standard acoustics principles. The following formula was used for calculating the Max SWLs of the fixed plant:

SPL = Max SWL – DC + FC - BC

where

SPL:	Sound Pressure Level in dB(A)
Max SWL:	Maximum Allowable Sound Power Level in dB(A)
DC:	Distance Attenuation in dB(A) = 20 log D + 8 [where D is the distance in m]
FC:	Façade Correction in dB(A) = +3 dB(A)
BC:	Barrier Correction in dB(A)

For those fixed plant noise sources falling within the view angle of the NSR but with no direct line of sight to the opening, a 5 dB(A) attenuation would be applied. For the case where the NSR with no direct line of sight to the source/opening which is located on the other side of the building or completely blocked by other building(s), a 10 dB(A) attenuation would be applied. If the noise sources do not fall within the view angle of the representative NSR under assessment, it is assumed that these noise sources are insignificant to that NSR. However, these noise sources are still taken into account in the assessment for conservative approach but a 10 dB(A) attenuation would be applied.

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 plants have been predicted by this approach.

For those proposed fixed plant of Express Rail Link (XRL) West Kowloon Terminus, the locations and maximum allowable sound power levels were made reference to latest information in the Environmental Review Report for the application of variation of Environmental Permit conditions (VEP) of the approved XRL project. For those existing fixed plant noise sources, the design information were made reference to the relevant approved EIA Reports or obtained from the relevant authorities. Should information of certain sources which was not available during the course of preparing this assessment, site visits and noise

measurements were carried out to determine the locations of the fixed sources and regarding sound power levels. The noise impact from these sources would then be assessed with the use of the same methodology as stated above for the planned sources.

Corrections of tonality, intermittency or impulsiveness are not considered in the assessment. If the noise exhibits any of these characteristics during the operation of the plant, the maximum allowable sound power level should be reduced in accordance with the recommendation given in Section 3.3 of the IND-TM.

4.5.4 Open Air Entertainment Activity Noise

The potential noise impact from the open air entertainment activity at the NSR has been assessed by basic acoustic principle with reference to noise measurement results of a former outdoor event held in WKCD.

4.5.5 Ground-borne Noise

The assessment methodology of the ground-borne noise impact to the identified ground-borne noise sensitive receivers (GBNSRs) from the operation of the identified underground railways is detailed in the following sections.

4.5.5.1 Express Rail Link (XRL)

Potential ground-borne noise impact from the operation of the proposed XRL to the planned NSRs of WKCD is addressed with reference to the findings detailed in the approved XRL EIA report (AEIAR-143/2009). The assessment has been reviewed in conjunction with the latest information available from WKCDA and MTRCL during the course of the EIA study.

4.5.5.2 West Rail - Kowloon Southern Link (WR-KSL)

Vibration measurements were conducted at foundations (G/F) of the Austin Station near the rail alignment to determine the likely ground-borne vibration level at the Xiqu Centre (NSR P1) on a “like-to-like” basis which have similar railway trackform depth and geological condition as shown in **Appendix 4.11**. This measurement was used to assess a worst case ground-borne noise scenario as the Austin Station have direct coupling to the railway tunnels. The proposed ground-borne vibration monitoring location is shown in **Figure 4.7b (Location 1)**. Geological profile of monitoring locations and nearby NSR is shown in **Appendix 4.11**. The approach to the monitoring is detailed in **Section 4.5.5.4**.

The vibration measurement result was used as input for assessing the potential ground-borne noise impact on the noise sensitive use portion 1st floor of planned Xiqu Centre. The method to convert ground-borne vibration to ground-borne noise is discussed in detail in **Section 4.5.5.5**. Peak railway frequency and double pass event has been considered in the assessment to shown the worst case scenario. MTRCL has confirmed that there is no potential change in the operation mode including operation hours, train length, train type and train speed of West Rail upon commissioning of the Shatin-Central Link.

4.5.5.3 Airport Express and Tung Chung Line (AEL/TCL)

Vibration measurements were conducted at foundations (G/F) of the Kowloon Station Tunnel Ventilation Building and the ground level of The Elements in proximity of the rail alignment, to determine the likely vibration level at the nearby venue(s) on a “like-to-like” basis which have similar railway trackform depth and geological condition as shown in **Appendix 4.11**. Measurements at Kowloon Station Tunnel Ventilation

Building represent the worst case scenario as the building structure is direct coupling to the railway tunnels. The proposed ground-borne vibration monitoring locations are shown in **Figure 4.7b (Locations 2 to 3)**. Geological profile of monitoring locations and nearby NSR is shown in **Appendix 4.11**. The approach of the monitoring is detailed in **Section 4.5.5.4**.

The findings from the measurement were used as input for assessing the potential ground-borne noise impact on the noise sensitive use portion 1st floor of planned Museum M+, Lyric Theatre and ground floor of Freespace. The method to convert ground-borne vibration to ground-borne noise is discussed in detail in **Section 4.5.5.5**. Peak railway frequency and double pass event has been considered in the assessment to shown the worst case scenario.

4.5.5.4 Proposed Ground-borne Vibration Monitoring

Vibration levels from the rail pass-by were measured at foundations of selected buildings near the rail alignment to determine the likely vibration level on a “like-to-like” basis.

As the measurement locations are in close proximity to the XRL construction site, measurements were carried out in the evening period to minimise the effect of the nearby construction works. In order to predict the worst scenario, the measurements were carried out during the PM peak hours of normal weekday when the loads of the train are at their peak. Attention was paid to ensure that no construction works of XRL would be on-going during the measurements. Sufficient data has been collected to cover different loading and wheel/rail condition so as to show the worst case scenarios at each monitoring location.

The assessment was conducted for each of the 1/3 octave band frequency between 16Hz and 500Hz. This approach allows for both low frequency and high frequency noise to be addressed. The single number descriptors such as overall vibratory acceleration level or overall vibratory velocity level do not adequately describe the low frequency noise effect especially for performance art venues with stringent acoustic design requirements.

4.5.5.5 Conversion from Ground-borne Vibration to Noise

In general, operational train noise is predicted in accordance with the methodology detailed in the FTA Guidance Manual[5]. The assessment procedure based on an earlier version (1995) of this manual has been adopted by various EIA projects in Hong Kong, including the West Rail, Kowloon Southern Link and West Island Line, etc.

Based on the FTA Guidance Manual, the proposed assessment method to be adopted in this assessment is as below:

$$L_{A,max} = L_v + C_{trackform} + C_{speed} + C_{building} + CTN$$

where

L_v	Maximum ground-borne vibration level for single train pass-by (dB ref 1 μin/s)
$C_{trackform}$	Adjustment for trackform attenuation between the measurement location and the ground-borne noise sensitive receiver location
C_{speed}	Adjustment for train speed between the measurement location and the

[5] Transit noise and vibration impact assessment, 2006, Federal Transit Administration, Department of Transportation, US.

	ground-borne noise sensitive receiver location
$C_{building}$	Adjustment for Building Foundation Coupling Loss (**BCF**), Building Structure Attenuation (**BSA**) and Building Structure Resonance (**BSR**)
CTN	Adjustment for converting building element vibration to A-weighted noise level inside the building
$L_{A, max}$	Maximum A-weighted Ground-borne Noise Level for single train pass-by (dB(A))

The $L_{A,max}$ ground-borne noise level represents the maximum noise level for the pass-by event. The ground-borne noise level can be converted into $L_{A,eq}$ (30mins) noise level for comparison with the ground-borne ANL criteria using equation below:

$L_{A,eq}$ (30mins) noise level = $L_{A,max}$ + 10 log (pass-by duration in second) + Tailing Effect + 10 log (number of pass-by per 30mins period) – 10 log (1800 seconds)

The pass-by duration is determined by equation below:

Pass-by Duration = Train Length / Train Speed

Worst case scenarios were considered in the assessment for the cases with train pass-by at both northbound and southbound for different railway lines.

The tailing effect correction represents the noise/vibration level arrived at the NSR before and after the pass-by event and is dependent on the distance between the line source and the NSR. Tailing corrections of 3dB is adopted for conservation approaches.

The abovementioned adjustment factors are discussed in detail in sections below.

Adjustment for Trackform Type

Track form attenuation represents attenuation due to installation of trackside mitigation measure, e.g. resilient base plate, Low Vibration Trackform (LVT), Isolate Slab Trackform (IST), Floating Slab Trackform (FST) etc. The trackform attenuation represents the minimum insertion loss required for the detailed design to achieve compliance with the noise criteria. Based on the latest available information, should the section of trackform underneath or near the planned NSR be different to that of the like-to-like measurement location, adjustment will be applied as necessary.

$C_{trackform}$ = Trackform Insertion Loss $_{NSR}$ - Trackform Insertion Loss $_{Monitoring\ Location}$

For the area near the XRL terminus, a review was taken to account for the difference in rail support design and adjusted the amount of insertion loss if necessary.

For the WR-KSL and AEL/TCL assessments, the on-site vibration measurement included the performance of the trackform supports and therefore no TIL adjustment would be required for like-to-like comparison. An exception is for Measurement Location 3 where floating track was installed to mitigate the vibration transmission into the building structure of the "Kowloon Station Development". In this situation, an adjustment (based on the difference in insertion loss between the trackforms) will be made to account for the different trackform installation. Relevant trackform information is shown in **Appendix 4.12**.

Adjustment for Train Speed

Based on the latest available information, should the section of train speed underneath or near the planned NSR be different to that of the like-to-like measurement location, adjustment will be applied as necessary.

$$C_{speed} = 20 \log (\text{Train Speed}_{NSR} / \text{Train Speed}_{\text{Monitoring Location}})$$

Adjustment for NSR Building Structure

Building Coupling Loss (BCF)

Interaction between the building foundation and the soil will cause some reduction in the vibration level. The correction factors shown in **Table 4.10** are based on Saurenman (1982)[6].

Table 4.10: Adjustment Factor for Building Coupling Loss (BCF)

Building Type	Building Coupling Loss (dB)															
	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Large Masonry Building on Pile	-6	-6.7	-7.3	-8	-9	-10	-11	-11.7	-12.3	-13	-13.3	-13.7	-14	-13.3	-12.7	-12
Large Masonry Building on Spread Footings	-12	-12.7	-13.3	-14	-14	-14	-14	-13.7	-13.3	-13	-12.3	-11.7	-11	-10.7	-10.3	-10
1 to 2 Storey Residential	-4	-4.2	-4.3	-4.5	-4.5	-4.5	-4.5	-4.2	-3.8	-3.5	-3.3	-3.2	-3	-2.3	-1.7	-1
Building Foundation on Rock Layer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Building Structure Attenuation (BSA)

Vibration generally reduces in level as it propagates through a building. On the other hand, amplification occurs due to building element resonance. The following correction factors are based on Saurenman (1982)[7].

Table 4.11: Adjustment Factor for Building Structure Attenuation (BSA)

Building Type	Building Coupling Loss (dB)															
	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
1	-2	-2	-2	-2	-2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-4	-4
2	-1	-1	-1	-2	-2	-2	-2	-2	-3	-3	-3	-3	-3	-3	-3	-4
3	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-3	-3	-3	-3	-3
4 to5	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-3	-3	-3	-3	-3
6 to 7	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-3	-3	-3	-3	-3
8 to 9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-3	-3	-3
10 and above	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-3	-3

[6] Handbook of Urban Rail Noise and Vibration Control (Figure 8.12), 1982, Saurenman, H., Nelson, J., Wilson G., Urban Mass Transportation Administration, Department of Transportation, US.

[7] Handbook of Urban Rail Noise and Vibration Control (Figure 8.7), 1982, Saurenman, H., Nelson, J., Wilson G., Urban Mass Transportation Administration, Department of Transportation, US.

Since the foundation structure and buildings have not yet been designed for WKCD development, a conservative building structure attenuation factor of 1 to 3 dB per octave band is proposed for the WKCD study.

Table 4.12: Building Structure Attenuation (BSA) for WKCD Study

1/3 Octave Band Centre Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Floor Attenuation Factor (dB)	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-3	-3

Ground vibration level may increase within the building due to resonance of individual building element. The amount of amplification will depend on building construction method and the dimension of the slab and columns. For typical concrete based building construction, a 6 dB increase will be adopted for the WKCD study based on the FTA Handbook recommendation.

Table 4.13: Building Structure Resonance (BSR) for WKCD Study

1/3 Octave Band Centre Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Floor and Wall Resonance (dB)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

Conversion from Vibration to Noise (CTN)

The level of radiated noise inside a room can be estimated from the average vibration on the room surfaces, the radiation efficiency of the vibrating panel, and the amount of acoustic absorption inside the room.

The reverberant noise level inside a room due to ground-borne vibration is estimated from the following equation:

$$L_p \text{ (dB)} = L_{v1} \text{ (dB ref 1}\mu\text{ in/s)} + K_{rad}$$

Where

L_p = Reverberant noise level due to ground-borne vibration, dB

L_{v1} = Averaged vibration level on the vibrating surface, dB ref 1 μ in/s

K_{rad} = Correction to convert vibration into noise, dB

$$K_{rad} = L_p - L_{v1} = L_p - L_v + 28$$

Where

L_v = Averaged vibration level on the vibrating surface, dB ref 1 μ mm/s
$= L_{v1} + 20\log(25.4) = L_{v1} + 28$

Refer to approved WR-KSL EIA report Appendix 7-4 (Register No. AEIAR-083/2005) about the calculation of conversion factors from floor vibration to noise levels, the Lp - Lv for different room type is as follows:

Table 4.14: K_{rad} (dB) at Different Location

Room type	Input Data		$L_p - L_v$ dB(A)	K_{rad} ($L_p - L_{v1}$)
	H (m)	RT, s		
Residential	2.2	0.5	-26	2
Concert Hall	7	1.8	-26	2
Auditorium	7	1.4	-27	1

From the above, it can be shown that 1 to 2dB K_{rad} correction previously adopted for Hong Kong Cultural Centre, Hong Kong Space Museum and residential area in the approved WR-KSL EIA reports would be applicable to the WKCD development.

Given the uncertainty of the design, a conservative approach would be adopted for the ground-borne noise impact assessment and a conversion factor of +2dB has been adopted. The following conversion to noise factors (CTN) are used.

Table 4.15: Conversion to Noise Factors

1/3 Octave Band Centre Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
K_{rad} (dB)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
A-weighting	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
CTN	-54.7	-48.5	-42.7	-37.4	-32.6	-28.2	-24.2	-20.5	-17.1	-14.1	-11.4	-8.9	-6.6	-4.6	-2.8	-1.2
For Lv vibration level reference to 1 μ in/s																

4.5.6 Marine Traffic Noise

Potential marine traffic noise impacts arising from the ferries using the existing China Ferry Terminal were assessed to evaluate any potential nuisance or disturbance to the planned NSRs. Noise measurements were carried out at the site boundary close to the China Ferry Terminal in the vicinity of the site to obtain the source noise level of a ferry pass-by event for the prediction of the potential marine traffic noise at the NSRs. The locations of noise measurements are presented in **Figure 4.8**.

The selected locations are within the site of the Express Rail Link West Kowloon Terminus which is currently under construction. To avoid the influence from construction noise, the marine traffic noise monitoring were carried out on a Sunday and confirmation from MTRCL was sought to ensure no construction works would be in progress during the noise measurement period.

The measurement was carried out for a period of time at the monitoring locations during the morning peak hours in order to capture the worst case scenario according to the ferry schedule.

The marine traffic noise impacts, in terms of equivalent noise levels during the peak operation hour of the China Ferry Terminal and maximum pass-by noise levels of the ferries, were predicted at the representative NSRs using standard acoustic principles and practices. Sample marine traffic noise calculation is given in **Appendix 4.9**.

The potential noise impact from the operation of the typhoon shelter at the NSR has been assessed qualitatively taking into account of the separation between the typhoon shelter and the planned NSRs in WKCD.

4.6 Evaluation of the Noise Impacts

4.6.1 Construction Noise

The type and quantity of Powered Mechanical Equipment (PME) likely to be used for the site formation, excavation and construction of the superstructure and their Sound Power Levels (SWLs) are shown in **Appendices 4.4a to 4.4i**.

According to the tentative construction programme, it is likely that there will be an overlap of this Project with some other potentially concurrent projects including "Express Rail Link", "Road Works at West Kowloon" and "Road Improvement Works in West Kowloon Reclamation Development". These projects are described in **Section 2.8**. MTRCL has recently confirmed that the assumptions adopted in the approved Road Works at West Kowloon and XRL EIA reports remained valid during the preparation of this EIA Report except for construction programme of West Kowloon Terminal have been delayed for 6 months and the revised assumptions in "Environmental Review for Proposed West Kowloon Terminus Concrete Batching Facility" (i.e. update in construction commencement date from Dec 2009 to Jun 2010 for Works Area V WKT Zone 1 to 3 and Work Area W and updated plant inventory associated with the concrete batching plant) which have been considered in this construction impact assessment. Since the EIA of "Road Improvement Works in West Kowloon Reclamation Development" project was still in-progress at the time of preparing this EIA, the relevant findings of the Preliminary Environment Review (PER) for that project have been adopted in the cumulative construction noise impact assessment. The findings in relevant approved EIA, revised construction programme and PER reports have been referenced in the assessment for the cumulative construction noise impact.

The unmitigated noise levels from this Project are predicted and presented in **Table 4.16** below. Details of the construction noise impact at the representative NSRs are shown in **Appendices 4.4a to 4.4i**.

The prediction results indicate that the noise impact of unmitigated construction activities from this Project would cause exceedance of the relevant daytime construction noise criteria. Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts generated during the construction phase.

Table 4.16: Unmitigated Construction Airborne Noise Impact from this Project

NSR ID	Use	Predicted Noise Level dB(A)*										Noise Criteria dB(A)	Exceedance of Noise Criteria?	Mitigation Measure required?
		2013	2014	2015	2016	2017	2018	2019	2020	2021 and after	Overall			
HT1	Residential	72	**79-85**	**79-81**	**79-81**	**77-79**	**77-78**	73-**78**	71-73	60-72	60-**85**	75	Yes	Yes
HT3	Residential	73	**78-83**	**79-80**	**79-80**	**76-78**	**76-77**	72-**76**	70-72	59-73	59-**83**	75	Yes	Yes
AST	Residential	71	**79-84**	**79-81**	**79-81**	**77-79**	**77**	73-**77**	72-73	61-71	61-**84**	75	Yes	Yes
RD[#]	Residential	-	-	**76-77**	75-**77**	72-74	71-72	69-71	64-69	68-74	64-**77**	75	Yes	Yes
WOB	Residential	72	**76-79**	75-**76**	73-**76**	70-73	69-70	68-69	63-68	68-73	63-**79**	75	Yes	Yes
VT1	Residential	75	**78-81**	**77-78**	75-**78**	71-74	69-71	69-71	64-71	74-**79**	64-**81**	75	Yes	Yes
VT2	Residential	74	**77-80**	**76-77**	74-**77**	71-74	71	69-71	63-69	72-**76**	63-**80**	75	Yes	Yes
LCS	Educational	**74**	**77-80**	**76-78**	**75-78**	**72-75**	**72-73**	**72-73**	64-**72**	74-**83**	64-**83**	70/65*	Yes	Yes
CRGPS	Educational	**73**	**76-79**	**75-77**	**75-77**	**71-75**	**71-73**	**71-73**	64-**71**	**73-90**	64-**90**	70/65*	Yes	Yes
FQ	Residential	**77**	**81-84**	**80-82**	**81-82**	**77-81**	**77-82**	**80-82**	66-**80**	**78-80**	66-**84**	75	Yes	Yes
CUL	Residential	69	72-**76**	73-74	73-74	71-73	71-72	69-71	67-69	57-**78**	57-**78**	75	Yes	Yes
P3	Residential	-	-	-	-	-	-	-	-	**84**	**84**	75	Yes	Yes
P6	Residential	-	-	-	-	-	-	-	-	69-**84**	69-**84**	75	Yes	Yes
P7	Residential	-	-	-	-	-	**84**	**83-84**	68-**83**	73-**83**	73-**84**	75	Yes	Yes
P13	Residential	-	-	-	-	-	**83**	**76-83**	**76**	73-**83**	73-**83**	75	Yes	Yes
P17	Residential	-	-	-	-	-	-	**84**	**83-84**	67-**81**	67-**84**	75	Yes	Yes
P21	Residential	-	-	-	-	-	**84**	**83-84**	**82-83**	63-73	63-**84**	75	Yes	Yes
P26	Residential	-	-	-	-	-	-	**82-83**	**82**	62-**76**	62-**83**	75	Yes	Yes
P29	Residential	-	-	-	-	-	-	73-74	72-73	59-**77**	59-**77**	75	Yes	Yes
P32	Residential	-	-	-	-	-	-	75-**76**	74-75	59-**84**	59-**84**	75	Yes	Yes

Note: **Bold** figures denotes the predicted noise level is higher than the relevant daytime construction noise criteria

(*) Criteria for examination period

([#]) MTR confirmed that the residential development next to Austin Station will be occupied in middle of 2015.

4.6.2 Road Traffic Noise

The proposed road works of the WKCD Project are scheduled to be opened in 2017. According to the projection of the traffic impact assessment, the year with maximum traffic flow within a 15-year period upon commencement of operation of the road is determined to be 2032. Therefore, the peak hour traffic data for year 2032 has been adopted for the assessment.

Traffic data is provided by the Traffic Consultant, and are presented in **Appendix 4.2a**. The traffic forecast data has been reviewed by the Transport Department (TD) and TD has no objection in principle to the traffic data. The correspondence from TD is provided in **Appendix 4.2f** for reference.

After reviewing both the morning and afternoon peak hour flow data, the afternoon peak hour flow data was chosen for the assessment as greater noise impact will be predicted at the NSRs in WKCD.

As the proposed underpass of the Project will be fully enclosed by the above ground structures with only short exposed section, the contribution from the underpass to overall road traffic noise impact is anticipated to be insignificant.

The potential unmitigated road traffic noise impacts on the NSRs for the Project at Year 2032 due to operation of the proposed road sections of the Project, existing roads and committed RWWK project nearby are summarised in **Table 4.17** and **Table 4.18** below for the scenario with interim access at Austin Road West and the scenario with permanent access at Canton Road respectively. Detailed breakdowns of road traffic noise impacts including scenario with Project and scenario without Project are shown in **Appendices 4.5a, 4.5b and 4.5c** respectively. An assessment of the prevailing scenario has been conducted and the results are shown in **Appendix 4.5d** for reference. Locations of road plots are shown in **Appendix 4.5e**. The sample calculations of the road traffic noise impact modelling are shown in **Appendix 4.5f**.

Table 4.17 Unmitigated Road Traffic Noise Impact in Year 2032 – Scenario with Interim Access at Austin Road West

NSR ID	Noise Criteria, $L_{10(1\ hr)}$ dB(A)	Predicted Road Traffic Noise Level, $L_{10\ (1hr)}$ dB(A)		
		Project Roads	Overall	Contribution from Project Roads
HT1	70	49 - 52	69 - **72**	0.0 - 0.1
HT3	70	50 - 56	69 - **71**	0.0 - 0.2
VT1	70	22 - 42	**72** - **78**	0.0 - 0.1
LCS	65	N/A*	**81** - **84**	0.0
P3a	70	N/A*	54 - 63	0.0
P3b	70	N/A*	65 - **72**	0.0
P5	70	58 - 59	**71** - **72**	0.2 - 0.3
P9	70	54	70 - **71**	0.1
P16	70	44 - 45	67 - 68	0.0 - 0.1
P17	70	47	68	0.0 - 0.1
P19	70	49	69	0.0
P22	70	51 - 52	70	0.0 - 0.1
P24	70	53	70 - **71**	0.0 - 0.1

NSR ID	Noise Criteria, $L_{10(1\ hr)}$ dB(A)	Predicted Road Traffic Noise Level, $L_{10\ (1hr)}$ dB(A)		
		Project Roads	Overall	Contribution from Project Roads
P27	70	54	**71**	0.0 - 0.1
P28	70	55	**72**	0.0 - 0.1
P29	70	55 - 56	**72**	0.1
P50	65	32	40	0.7

Note: * Road traffic noise level of Project roads is negligible.

Bold figures denotes the predicted noise level is exceeded the relevant traffic noise criteria.

Table 4.18 Unmitigated Road Traffic Noise Impact in Year 2032 – Scenario with Permanent Access at Canton Road

NSR ID	Noise Criteria, $L_{10(1\ hr)}$ dB(A)	Predicted Road Traffic Noise Level, $L_{10\ (1hr)}$ dB(A)		
		Project Roads	Overall	Contribution from Project Roads
HT1	70	49 - 52	69 - **72**	0.0 - 0.1
HT3	70	50 - 56	69 - **71**	0.0 - 0.2
VT1	70	51 - 55	**72** - **78**	0.0 - 0.1
LCS	65	56 - 59	**81** - **84**	0.0
P3a	70	N/A*	54 - 63	0.0
P3b	70	41 - 51	65 - **72**	0.0
P5	70	35 - 36	**71** - **72**	0.0
P9	70	36	70	0.0
P16	70	38	67 - 68	0.0 - 0.1
P17	70	45	68	0.0 - 0.1
P19	70	48 - 49	69	0.0
P22	70	51	70	0.0 - 0.1
P24	70	53	70 - **71**	0.0 - 0.1
P27	70	54	**71**	0.0 - 0.1
P28	70	55	**72**	0.1
P29	70	55 - 56	**72**	0.1
P50	65	32	40	0.7

Note: * Road traffic noise level of Project roads is negligible.

Bold figures denotes the predicted noise level is exceeded the relevant traffic noise criteria.

Based on the results shown in the table above, the existing NSRs HT1, HT3, VT1 and LCS exceeded the relevant noise criteria with the Project roads in place. The exceedances were identified as dominantly contributed by the existing roads and the committed RWWK project. The predicted noise contributions to the overall traffic noise levels from the proposed roads of this Project are less than 1.0 dB(A) and the road traffic noise levels of the proposed roads at these NSRs are all below the relevant noise criteria. Hence, direct noise mitigation measures on the Project road sections are considered not necessary as they would not be effective in improving the noise environment at the sensitive receivers.

Exceedances of noise criteria also have been found at NSRs within WKCD including P3b, P5, P9, P24, P27, P28 and P29. The exceedances were also identified as dominantly contributed by the existing roads and the committed RWWK project. The predicted noise contributions to the overall traffic noise levels from the proposed roads of this Project are less than 1.0 dB(A) at these affected NSRs and the road traffic noise levels of the proposed roads are all below the relevant noise criteria. Direct noise mitigation measures on the Project road sections are deemed not necessary as they would not be effective in improving the noise environment at the sensitive receivers. As a result, at-receiver mitigation measures should be considered in terms of self-protecting building design such as shielding by balcony. The Project Proponent, WKCDA has confirmed that at-receiver mitigation measures would be adopted since no effective direct noise mitigation measures could be implemented. Details of the at-receiver mitigation measures are presented in **Section 4.7.2**.

The traffic noise generated inside the underpass might reverberate within the structure and emit through the portals, resulting in increase of traffic noise level at the identified NSRs. However, according to research findings, the noise from portal would not be significant provided that a tunnel length equivalent to approximately 2-3 times of diameter is installed with sound-absorbing materials. To address the potential portal noise problem, mitigation measures in form of installing sound-absorbing materials on the inner walls and ceiling of the portals are recommended where necessary. Details of the mitigation measures are briefed in **Section 4.7.2**.

4.6.3 Fixed Plant Noise

According to the preliminary design information, noise from fixed plant of the Project would mainly be associated with the above ground ventilation openings serving the underground facilities. Sixty-six locations were identified within WKCD for these openings. These 66 openings and other identified major fixed plant noise sources are summarized in **Table 4.19** below and the regarding locations are shown in **Figures 4.4a and 4.4b**.

Table 4.19: Summary of Fixed Plant Noise Sources

Fixed Noise Source	Existing/ Planned	Number of Source Facade	Opening ID[#]
Louvres along the Austin Road West (ICC, The Harbourside and The Element)	Existing	4	N3 to N6*
Louvres along the Lin Cheung Road	Existing	5	N7 to N11*^
Louvres from XRL West Kowloon Terminus	Planned	19	N12 to N15***
Louvres from Austin Station	Existing	4	N16 to N19**
Fixed Plants from Austin Station	Existing	3	N20 to N22**
Fixed Plants from Kowloon Station Tunnel Ventilation Building	Existing	4	N23 to N26*
Western Harbour Crossing Tunnel Ventilation Building	Existing	4	N27 to N30*
Louvres of China Harbour City	Existing	1	N31*^
China Ferry Terminal	Existing	1	N32*^
Canton Road Plant Building	Existing	4	N33 to N36**
Ventilation Openings within WKCD for Underpass Section and Basement Facilities (including District Cooling System and Sewage Pump Sumps)	Planned	43	01D to 04D, 05D1 to 05D3, 06D1 to 06D2, 07D, 08D1 to 08D2, 10D1 to 10D4, 11D, 12D1 to 12D3, 13D1 to 13D4, 14D1 to 14D2, 15D1

Fixed Noise Source	Existing/ Planned	Number of Source Facade	Opening ID#
			to 15D3, 17D to 20D, 26D to 27D, 29D to 32D, 39D1 to 39D2, 40D1 to 40D2
West Kowloon Terminus Ventilation Opening	Planned	15	09VS7, 13TVS1, 14VS6, 14PVS6***
Ventilation Openings for CLP Electricity Substation	Planned	4	42D1 to 42D4
Proposed Wind Turbine	Planned	38	W1 to W38

Notes: (#) Noise Source Opening ID N1 and N2 are not used.

(*) The sound power levels were determined from on-site measurements (details given in **Appendix 4.1a**)

(**) The sound power levels were made reference to the approved KSL EIA report Table 6-22.

(***) The sound power levels were made reference to the latest information in VEP of XRL project.

(^) Fixed plant is not in operation during night time period.

According to the noise measurements for existing fixed noise sources as shown in **Appendix 4.1b,** KSL EIA and latest information in VEP of XRL project. The other identified major fixed plant noise sources are summarized in **Table 4.20** below.

Table 4.20: SWLs of the Existing Fixed Plant and Fixed Plant from XRL Projects

Fixed Noise Source	Source ID#	SWL, dB(A)		
		Daytime	Evening Time	Night time
Louvres along the Austin Road West* (ICC, The Harbourside and The Element)	N3	95	93	93
	N4	93	92	88
	N5	93	92	89
	N6	88	88	85
Louvres along the Lin Cheung Road*^	N7	92	88	--
	N8	96	96	--
	N9	95	99	--
	N10	95	101	--
	N11	107	104	--
Louvres from XRL West Kowloon Terminus***	N12a-d	88	88	78
	N12e-f	89	89	79
	N13a-b	88	88	78
	N14a-g	89	89	79
	N15a-d	89	89	79
Louvres from Austin Station**	N16	78	78	68
	N17	72	72	62
	N18	72	72	62
	N19	78	78	68
Fixed Plants from Austin Station**	N20	73	73	63
	N21	73	73	63
	N22	73	73	63
Fixed Plants from Kowloon Station Tunnel Ventilation Building*	N23	99	99	99
	N24	99	99	99

Fixed Noise Source	Source ID#	SWL, dB(A)		
		Daytime	Evening Time	Night time
	N25	99	99	99
	N26	99	99	99
Western Harbour Crossing Tunnel Ventilation Building*	N27	97	97	97
	N28	97	97	97
	N29	97	97	97
	N30	97	97	97
Louvres of China Harbour City*^	N31	95	95	--
China Ferry Terminal*^	N32	99	99	--
Canton Road Plant Building**	N33	105	105	95
	N34	110	110	100
	N35	105	105	95
	N36	104	104	96
West Kowloon Terminus Ventilation Opening at Parcel 9 of WKCD***	VS7-1	77	77	67
	(1&2)	77	77	67
	VS7-2	77	77	67
	VS7-3	77	77	67
	(1&2)	77	77	67
	VS7-4	77	77	67
	(1&2)	77	77	67
	VS7-5	77	77	67
	(1&2)	77	77	67
West Kowloon Terminus Ventilation Opening at Parcel 13 of WKCD***	TVS1-1	83	83	73
West Kowloon Terminus Ventilation Opening at Parcel 14 of WKCD***	VS6-1	80	80	70
	VS6-2	80	80	70
	VS6-3	80	80	70
	PVS6-1	78	78	68
	PVS6-2	77	77	67

Notes: (#) Noise Source Opening ID N1 and N2 are not used.

(*) The sound power levels were determined from on-site measurements (details given in **Appendix 4.1a**)

(**) The sound power levels were made reference to the approved KSL EIA report Table 6-22.

(***) The sound power levels were made reference to the latest information in VEP of XRL project.

(^) Fixed plant is not in operation during night time period.

Based on the methodology mentioned in **Section 4.5.3,** the maximum allowable SWLs of the proposed fixed plants during daytime and night-time are predicted as summarized in **Table 4.21** below.

Table 4.21: Maximum Allowable SWLs of the Fixed Plant within WKCD

Fixed Noise Source	Source ID	Maximum Allowable SWL, dB(A)		
		Daytime	Evening Time	Night time
Ventilation Openings of Parcel 1 within WKCD for Underpass Section and Basement Facilities	01D	85	85	69

Fixed Noise Source	Source ID	Maximum Allowable SWL, dB(A)		
		Daytime	Evening Time	Night time
Ventilation Openings of Parcel 2 within WKCD for Underpass Section and Basement Facilities	02D	82	76	69
Ventilation Openings of Parcel 3 within WKCD for Underpass Section and Basement Facilities	03D	80	80	70
Ventilation Openings of Parcel 4 within WKCD for Underpass Section and Basement Facilities	04D	85	85	70
Ventilation Openings of Parcel 5 within WKCD for Underpass Section and Basement Facilities	05D1	83	82	70
	05D2	83	82	70
	05D3	83	82	70
Ventilation Openings of Parcel 6 within WKCD for Underpass Section and Basement Facilities	06D1	85	80	75
	06D2	85	80	75
Ventilation Openings of Parcel 7 within WKCD for Underpass Section and Basement Facilities	07D	87	87	65
Ventilation Openings of Parcel 8 within WKCD for Underpass Section and Basement Facilities	08D1	80	80	70
	08D2	80	80	70
Ventilation Openings of Parcel 10 within WKCD for Underpass Section and Basement Facilities	10D1	78	74	65
	10D2	78	74	65
	10D3	78	74	65
	10D4	78	74	65
Ventilation Openings of Parcel 11 within WKCD for Underpass Section and Basement Facilities	11D	77	73	66
Ventilation Openings of Parcel 12 within WKCD for Underpass Section and Basement Facilities	12D1	85	83	69
	12D2	85	83	69
	12D3	85	83	69
Ventilation Openings of Parcel 13 within WKCD for Underpass Section and Basement Facilities	13D1	79	76	70
	13D2	79	76	70
	13D3	79	76	70
	13D4	79	76	70
Ventilation Openings of Parcel 14 within WKCD for Underpass Section and Basement Facilities	14D1	85	82	72
	14D2	85	82	72
Ventilation Openings of Parcel 15 within WKCD for Underpass Section and Basement Facilities	15D1	85	82	72
	15D2	85	82	72
	15D3	85	82	72
Ventilation Openings of Parcel 17 within WKCD for Underpass Section and Basement Facilities	17D	87	84	78
Ventilation Openings of Parcel 18 within WKCD for Underpass Section and Basement Facilities	18D	87	87	80
Ventilation Openings of Parcel 19 within WKCD for Underpass Section and Basement Facilities	19D	86	86	75
Ventilation Openings of Parcel 20 within WKCD for Underpass Section	20D	86	86	84

Fixed Noise Source	Source ID	Maximum Allowable SWL, dB(A)		
		Daytime	Evening Time	Night time
and Basement Facilities				
Ventilation Openings of Parcel 26 within WKCD for Underpass Section and Basement Facilities	26D	87	87	70
Ventilation Openings of Parcel 27 within WKCD for Underpass Section and Basement Facilities	27D	87	87	78
Ventilation Openings of Parcel 29 within WKCD for Underpass Section and Basement Facilities	29D	87	85	70
Ventilation Openings of Parcel 30 within WKCD for Underpass Section and Basement Facilities	30D	84	81	74
Ventilation Openings of Parcel 31 within WKCD for Underpass Section and Basement Facilities	31D	86	85	75
Ventilation Openings of Parcel 32 within WKCD for Underpass Section and Basement Facilities	32D	85	80	72
Ventilation Openings of Parcel 39 within WKCD for Underpass Section and Basement Facilities	39D1	98	96	87
	39D2	98	96	87
Ventilation Openings of Parcel 40 within WKCD for Underpass Section and Basement Facilities	40D1	98	96	87
	40D2	98	96	87
Ventilation Openings of Parcel 42 within WKCD for CLP Electricity	42D1	98	96	80
	42D2	98	96	80
	42D3	98	96	80
	42D4	98	96	80
Proposed Wind Turbine	W1 to W38	82	82	82

With the adoption of the proposed maximum allowable SWLs of the proposed fixed plants, the fixed plant noise impacts to the NSRs within or in the vicinity of the WKCD are presented in **Appendix 4.6**. The impact noise levels at all selected NSRs complied with the relevant noise criteria for the daytime, evening time and night time periods. Therefore, no adverse fixed plant noise impact to the existing NSRs is anticipated.

4.6.4 Open Air Entertainment Activity Noise

According to the current layout of the Concept Plan, an outdoor theatre is located on the south-west portion of the WKCD which is about 500m away from the planned NSRs. The major noise source come from such venue includes the use of sound amplification systems and the crowd.

Noise measurement for a music concert held in the WKCD was carried out in October 2011 (details are presented in **Appendix 4.7b**). With reference to the noise levels measured for such outdoor activities, which is of similar scale as the one held in the future Outdoor Theatre, the potential noise impact at the nearest NSRs have been predicted as shown in below **Table 4.22** and the details are shown in **Appendix 4.7a**.

Table 4.22 Predicted Outdoor Air Activity Noise Impact without Mitigation Measures

NSR ID	Noise Source	Distance to the source	Predicted Noise Level Leq (15 min), dB(A)	Daytime/Evening Noise Criteria, dB(A)	Exceedance of Criteria, dB(A)	Mitigation Measure required?
P29	Outdoor Theatre (Parcel 50)	585	56	65/62	No	No
P32	Outdoor Theatre (Parcel 50)	500	57	65/62	No	No

Note: Reference made to the results of a noise measurement carried out in WKCD for a music concert held in October 2011. The largest Leq(5 min) of about 88 dB(A) at about 34m has been adopted in the assessment.
The criteria is proposed as not more 5 dB(A) above the background noise during daytime and evening time. Please refer to **Appendix 4.1** Point F for the background noise measurement results.

The impact noise levels at all selected NSRs complied with the relevant noise criteria for the daytime, and evening time periods. Since no operation of Outdoor Theatre will be anticipated at night-time period (i.e. after 11pm), significant open air entertainment noise impact to the nearby NSRs during night time is not anticipated.

4.6.5 Ground-borne Noise

4.6.5.1 Express Rail Link (XRL)

The XRL is currently under construction and hence the assessment for operation impact of XRL was based on the review of the approved XRL EIA report and the latest information regarding on XRL made available. As confirmed by MTRCL, the trackform and train speed information in the XRL EIA report is considered as the latest information available. According to the XRL EIA report, low noise trackform is recommended as ground-borne noise mitigation measures for the rail section in WKT.

With reference to the findings in the XRL EIA report, the ground-borne noise impact without mitigation measures and with provision of IST for the planned NSRs identified within WKCD are summarised in **Table 4.23** below. The locations of these NSRs are shown in **Figure 4.7a**.

Table 4.23 Predicted Ground-borne Noise Impact from XRL EIA

NSR ID	Location	Down Track Calculated Distance, m	*Predicted Ground-borne Noise Level (Unmitigated / Mitigated), dB(A)			
			Lmax	Leq (30min) Day	Leq (30min) Night	Leq (24hr)
GN1	West Kowloon Cultural District	20	36 / 23	25 / <15	20 / <15	22 / <15
GN2	West Kowloon Cultural District	40	21 / <15	<15 / <15	<15 / <15	<15 / <15
GN2a	WKT Topside Development	27	48 / 34	38 / 27	34 / 23	36 / 25

Note:(*) Results extracted from Tables 6.5 & 6.17 of the approved XRL EIA report (AEIAR-143/2009).

As discussed in **Section 4.2.2.4**, the ground-borne noise criteria for residential use and CACF not classified as special venues, including Proscenium Theatre, Thrust Theatre, Great Theatre and Freespace, would be $L_{eq\ (30min)}$ 55dB(A) and 45 dB(A) for daytime and night time respectively while that for the special venues including Music Centre, Musical Theatre and Xiqu Centre would be L_{max} 25 dB(A).

According to Section 6.75 of the approved XRL EIA report, low noise trackform will be provided at WKT to minimise the noise impact. With the provision of low noise trackform at WKT, the L_{max} levels at area within the WKCD site and outside the WKT boundary were predicted to be in general lower than 25 dB(A).

Therefore, for parcels not located directly above the XRL West Kowloon Terminus (WKT) while locating around the WKT boundary such as NSR P2, P3, P5, P16, P17, P19, P21, P22, Proscenium Centre, Music Centre, Musical Theatre and Xiqu Centre, the ground-borne noise impact from XRL should not be higher than L_{max} 25 dB(A) and should be equal to or lower than that perceived by NSR GN1 and GN2 in the XRL EIA report. From the results in **Table 4.23**, exceedance in relevant criteria is not anticipated at these NSRs.

According to the current layout design of WKCD, the parcels including P6, P7, P9, P10, P11, P13, CCP and Thrust Theatre are located either partially or directly above the XRL WKT. The foundation and basement of these parcels most likely would be integrated with the WKT. Hence, it is anticipated that the potential ground-borne noise impact due to operation of XRL on these parcels would be similar to GN2a in the XRL EIA report which the foundation of the parcel is directly coupled to the WKT basement structure and with similar train speed and downtrack distance. In view that the predicted unmitigated ground-borne noise levels under the worst case scenario at location GN2a, is $L_{eq\ (30min)}$ 38 / 34 dB(A) for daytime / night-time respectively and are lower than the night time criteria of NSR P6, P7, P9, P10, P11, P13, CCP and Thrust Theatre, adverse ground-borne noise impact to these NSRs is therefore not anticipated. Mitigation measures such as with provision of IST or other types of low noise trackform for the XRL project will be subjected to MTRCL decision. No matter which types of low noise trackform will be used, the predicted ground-borne noise level with provision of low noise trackform will be lower than that of the unmitigated scenario.

In considering the proposed ground-borne noise criteria for the NSR CCP is L_{max} 25 dB(A), exceedance in ground-borne noise impact is expected given the predicted ground-borne noise level at GN2a in the XRL project is L_{max} 34 dB(A) even with the provision of IST and hence mitigation measures is considered necessary. Subject to the final design of low noise trackform in the XRL project, the exceedance over the L_{max} 25 dB(A) criterion will be varied. In any event, the ground-borne noise impact at the CCP would not be more than L_{max} 48 dB(A), which is the unmitigated predicted ground-borne noise level at GN2a in accordance with the XRL EIA report.

4.6.5.2 West Rail - Kowloon Southern Link (WR-KSL)

Ground-borne vibration measurements were carried out at the foundation (G/F) of the Austin Station near the rail alignment (i.e. monitoring location 1) to determine the likely ground-borne vibration level at the Xiqu Centre (NSR P1) on a like-to-like basis. The measurement result has been adopted in the assessment of the ground-borne noise impact from WR-KSL by following the methodology discussed in **Section 4.5.5**.

As advised by MTRCL, the trackform and train speed information in the WR-KSL EIA report should be considered as the latest information available. Plain bearing 12.5Hz floating slab trackform has been installed between Austin Station and Tsim Sha Tsui East Station. Since the west rail will be connected to the planned Shatin to Central Link (Tai Wai to Hung Hom Section) (SCL project) in the future, the maximum train frequency stipulated in the Environmental Permit of the SCL project (EP-438/2012/C), (I.e. 12 trains and 6 train per 30 minutes in each direction for day time and night time respectively) has been adopted in the assessment. It should be noted that such train frequency is higher than the current operation mode of the west rail.

The predicted ground-borne noise impact levels at these GBNSRs are presented in **Table 4.24** below and **Appendix 4.8**.

Table 4.24 Predicted Ground-borne Noise Impact from WR-KSL

GBNSR	Predicted Ground-borne Noise Level at GBNSR, dB(A)			
	Lmax / Criterion	Leq (30min) / Criterion Day & Evening	Leq (30min) / Criterion Night	Leq (24hr)
Xiqu Centre[#]	**32** / 25	23 / 55	20 / 45	20

Note: (#) like-to-like monitoring location building structure with connection to rail tunnel structure underneath

Bold figures denotes the predicted noise level is exceeded the relevant ground-borne noise criteria.

According to the results of the ground-borne noise prediction, the predicted ground-borne noise level L_{max} 32 dB(A) at Xiqu Centre based on like-to-like measurement result would exceed the proposed ground-borne noise criteria for special venues i.e. L_{max} 25 dB(A). As shown in the current layout design, part of the footprint of the Xiqu Centre is above the alignment of the WR-KSL. It is understood that part of this future development would be constructed above the box structure extending from the Austin Station. There will be no direct structural connection between the foundation of this future development and the railway structure due to railway protection requirement. Nevertheless, it is anticipated that the potential ground-borne noise impact at Xiqu Centre (L_{max} 32 dB(A)) due to WR-KSL operation would exceed the proposed ground-borne noise criteria L_{max} 25 dB(A) by 7 dB(A). Mitigation measures are therefore considered necessary.

Given the $L_{eq\ (30min)}$ at the Xiqu Centre is predicted to be 23dB(A) and 20dB(A) for day time and night time respectively , it is envisaged that the ground-borne noise impact from the WR-KSL to the nearby residential parcels, i.e. P2 and P3, would not be exceeding the relevant ground-borne noise criteria..

As mentioned in **Section 4.6.5.1**, the maximum ground-borne noise level at the boundary of the WKT would be 25 dB(A). With such low ground-borne noise level, adverse cumulative impact to the NSRs between the XRL and WR-KSL is not anticipated.

Since the NSR CCP, Music Centre and Musical Theatre are located more than 240m apart from WR-KSL. At this distance low ground-borne noise level is expected and thus cumulative impact from WR-KSL is not expected.

4.6.5.3 Airport Express and Tung Chung Line (AEL/TCL)

Ground-borne vibration measurements were carried out at foundation (G/F) of the Kowloon Station Tunnel Ventilation Building (monitoring location 2) and the ground level of the Elements (monitoring location 3) in proximity of the rail alignment. The measured results at these monitoring locations have been adopted in the assessment of the ground-borne noise impact from AEL/TCL.

The predicted ground-borne noise impact levels at these GBNSRs are presented in **Table 4.25** below and **Appendix 4.8**.

Table 4.25 Predicted Ground-borne Noise Impact from AEL/TCL

GBNSR	Predicted Ground-borne Noise Level at GBNSR, dB(A)			
	Lmax / Criterion	Leq (30min) / Criterion Day & Evening	Leq (30min) / Criterion Night	Leq (24hr)
Freespace#	55 / N.A.	43 / 55	41 / 45	41
M+ (Phase I)^	**56** / 35	44 / 55	42 / 45	42
Lyric Centre^	**56** / 25	44 / 55	42 / 45	42

Note: (#) like-to-like monitoring location building structure with connection to rail tunnel structure underneath
(^) like-to-like monitoring location the near track is equipped with Station Floating Slab. Trackform correction has been applied in the predicted results. **Bold** figures denotes the predicted noise level is exceeded the relevant ground-borne noise criteria.

For Freespace, the predicted ground-borne noise level is based on the measurement results obtained at the like-to-like monitoring location 2 which have with similar alignment and same train speed. The predicted ground-borne noise levels do not exceed the relevant ground-borne noise criteria. Therefore, no adverse impact from AEL/TCL is expected.

According to the results of the ground-borne noise prediction, the predicted L_{max} values at M+ (Phase I) and Lyric Centre based on the measurement results obtained at the like-to-like monitoring location 3 would exceed the proposed ground-borne noise criteria. In the current layout design, part of the footprint of the M+ (Phase I) and Lyric Centre are above the alignment of the AEL/TCL which is same as on like-to-like monitoring location 3. The distances between rail track/ monitoring location and rail track/ NSRs as shown in **Appendix 4.11** are nearly the same. It is hence anticipated that the potential ground-borne noise impact at M+ and Lyric Theatre due to AEL/TCL operation (L_{max} 56 dB(A)) would exceed the proposed ground-borne noise criteria L_{max} 35 dB(A) and L_{max} 25 dB(A) with exceedance of maximum 21 dB(A) and 31 dB(A) respectively. For M+ (Phase II), the footprint is very close (<15m horizontal distance) above the alignment of the AEL/TCL. Therefore, the ground-borne noise level is likely to be over the criteria and the exceedance is similar to M+ (Phase I). In this regard, mitigation measures for M+ (Phase I & II) and Lyric Centre are considered necessary.

Given the $L_{eq\ (30min)}$ at the Lyric Centre is predicted to be 44 dB(A) and 42 dB(A) for day time and night time respectively, it is envisaged that the ground-borne noise impact from the AEL/TCL to the nearby residential parcels, i.e. P29 and P32, would not be exceeding the relevant ground-borne noise criteria.

Similarly, considering that the maximum ground-borne noise level at the boundary of the WKT would be 25dB(A), adverse cumulative impact to the NSRs between the XRL and AEL/TCL is not anticipated.

4.6.6 Marine Traffic Noise

4.6.6.1 Noise from Ferry Movement

Planned NSRs located near the south boundary of the proposed WKCD would be subject to potential marine traffic noise impact from the ferries travelling to and from the China Ferry Terminal. Noise measurements have been carried out at selected representative locations (as shown in **Figure 4.8**) to obtain the source noise level of a ferry pass-by event for the prediction of the potential marine traffic noise at the NSRs. Background noise levels at NSRs have been adopted for identifying potential nuisance raised by marine traffic. If the noise impact from marine traffic is higher than the background noise, nuisance to the noise sensitive receivers is likely to happen.

According to the noise assessment results, as shown in **Appendix 4.9**, the marine traffic noise levels $L_{eq(60min)}$, dB(A) at the planned NSRs located close to the south boundary of WKCD would be around 58-71 dB(A) during day time peak hour of operation of the China Ferry Terminal. Given the measured background noise levels at the relevant NSRs are ranged from 57-65 dB(A) during day time and evening periods, it is envisaged that all planned NSRs within the WKCD fronting the seaside, including P2, P3, P10, P11, P13, P21, P26 and P32 would be subject to potential nuisance from the marine traffic.

With all these NSRs designed with non-openable window facing the travelling route of the ferries, nuisance from marine traffic to the future residents is not likely anticipated. Such at-receiver mitigation measures could also avoid potential nuisance caused by the proposed leisure piers and future increase in marine traffic around the south boundary of the WKCD.

The activities to be conducted in the Outdoor Theatre, such as popular music concerts, would rely on public address (PA) system and are expected to have high sound levels. Based on the measurement results of previous music events conducted in October 2011 within WKCD, the sound levels of such types of music performance have been identified in the range of 76 to 89 dB(A) at the audience location. Details of noise measurement results are presented in **Appendix 4.7b**. As shown in **Appendix 4.9,** the predicted marine traffic noise level at the Outdoor Theatre is about $L_{eq(60min)}$ 59 dB(A), which is lower than the music performance sound levels by at least 17 dB(A). It is therefore expected that there will be no adverse marine traffic noise impact to the audience of the Outdoor Theatre.

4.6.6.2 Noise from the New Yau Ma Tei Typhoon Shelter

According to the current layout of the Concept Plan, the shortest distance from the nearest planned NSR in the WKCD (NSR P32) to the boundary and centre of the New Yau Ma Tei Typhoon Shelter is located about 350m and 1km respectively. With such large separation, it is anticipated that the noise impact from the operation of the typhoon shelter would be minimal.

4.7 Mitigation Measures

4.7.1 Construction Noise

Mitigation measures for each construction site are detailed below, and the following forms of mitigation measures are recommended and should be incorporated into the Contract Specifications:

- good site practice to limit noise emissions at source;
- selection of quieter plant;
- use of movable noise barrier;
- use of noise enclosure/ acoustic shed;
- use of noise insulating fabric, and
- scheduling of construction works outside school examination periods.

While it is recognised that the Contractor may develop a different package of mitigation measures to meet the required noise standards, the following suite of practical and implementable measures demonstrate an approach that would be feasible to reduce noise to acceptable levels.

Good Site Practice

Good site practice and noise management can significantly reduce the impact of construction site activities on nearby NSRs. The following package of measures should be followed during each phase of construction:

- only well-maintained plant to be operated on-site and plant should be serviced regularly during the construction works;
- machines and plant that may be in intermittent use to be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, should, where possible, be orientated to direct noise away from the NSRs;
- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures to be effectively utilised, where practicable, to screen noise from on-site construction activities.

Selecting Quiet Plant

The Contractor may be able to obtain particular models of plant that are quieter than the standards given in the GW-TM. This is one of the most effective measures and is increasingly practicable because of the availability of quiet equipment.

Quiet plant whose actual SWL is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME taken from EPD's QPME Inventory and "*Sound Power Levels of Other Commonly Used PME*" are presented in **Table 4.26**. It should be noted that various types of silenced equipment can be found in Hong Kong.

Table 4.26 Quieter PME Recommended for Adoption during Construction Phase

PME	Power rating/size, weight	Reference	SWL, dB(A)
Crane, mobile	213kW	EPD-01516	101
Excavator, wheeled / tracked	112.5kW	EPD-01230	99
Dump truck	5.5 tonne < gross vehicle weight ≤ 38 tonne	EPD document "Sound Power Levels of Other Commonly Used PME"	105
Lorry	5.5 tonne < gross vehicle weight ≤ 38 tonne	EPD document "Sound Power Levels of Other Commonly Used PME"	105

Whilst quieter PME are listed, the Contractor may be able to obtain particular models of plant that are quieter than the PMEs given in GW-TM.

Use of Movable Noise Barriers

Movable noise barriers can be very effective in screening noise from particular items of plant when constructing the Project. Noise barriers located along the active works area close to the noise generating component of a PME could produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant provided the direct line of sight between the PME and the NSRs is blocked. A schematic configuration of a single movable noise barrier for PME is shown in **Figure 4.9**.

Use of Noise Enclosure/ Acoustic Shed

The use of noise enclosure or acoustic shed is to cover stationary PME such as air compressor and concrete pump. With the adoption of the noise enclosure, the PME could be completely screened, and noise reduction of 15 dB(A) can be achieved according to the EIAO Guidance Note No.9/2010. A schematic configuration of full noise enclosure for PME is shown in **Figure 4.10**.

Use of Noise Insulating Fabric

Noise insulating fabric can also be adopted for certain PME (e.g. drill rig, pilling machine etc). The fabric should be lapped such that there are no openings or gaps on the joints. According to the approved Tsim Sha Tsui Station Northern Subway EIA report (AEIAR-127/2008), a noise reduction of 10 dB(A) can be achieved for the PME lapped with the noise insulating fabric.

The noise screening benefit for each item of plant considered in this assessment is listed in **Table 4.27**.

Table 4.27 Noise Mitigation Measures for Certain PME during Construction Phase

PME	Mitigation Measures Proposed	Noise Reduction, dB(A)
Air compressor	Noise enclosure	15
Generator	Noise enclosure	15
Water pump	Noise enclosure	15
Piling, large diameter bored, grab and chisel	Noise insulating fabric	10
Piling, large diameter bored, reverse circulation drill	Noise insulating fabric	10
Piling, large diameter bored, oscillator	Noise insulating fabric	10
Piling, diaphragm wall, hydraulic extractor	Noise insulating fabric	10
Piling rig	Noise insulating fabric	10
Drill rig, rotary type	Noise insulating fabric	10
Grout mixer	Movable noise barrier	10
GroutpPump	Movable noise barrier	10
Poker, vibratory, hand-held	Movable noise barrier	10
Welding Set	Movable noise barrier	10
Concrete pump, lorry mounted	Movable noise barrier	10
Bar bender and cutter	Movable noise barrier	10
Handheld breaker	Movable noise barrier	10
Circular wood saw	Movable noise barrier	10
Hand-held drill/grinder	Movable noise barrier	10
Concrete mixer	Movable noise barrier	10
Concrete lorry mixer	Movable noise barrier	5
Excavator	Movable noise barrier	5
Mobile crane	Movable noise barrier	5
Dump truck	Movable noise barrier	5

PME	Mitigation Measures Proposed	Noise Reduction, dB(A)
Crane lorry	Movable noise barrier	5
Site fork lift truck	Movable noise barrier	5
Lorry	Movable noise barrier	5
Tipper lorry	Movable noise barrier	5

These enclosures and noise barriers should be free of gaps and made of materials having a surface mass density in excess of 10 kg/m^2. To improve the effectiveness of noise reduction, non-flammable absorptive lining can be adhered on the inner surface of the noise barriers. The barrier can be in the form of vertical or bend top barrier with an effective height to block the line of sight to NSRs.

Scheduling of Construction Works outside School Examination Periods

The daytime construction noise criterion during school examination period is 65 dB(A), which is lower than the normal daytime school criterion of 70 dB(A). During construction phase, the contractor should liaise with the educational institutions (including NSRs LCS and CRGPS) to obtain the examination schedule and avoid the noisy construction activities during school examination periods.

Mitigated Construction Noise Impacts

The effect of the use of quiet plant and using movable barriers, enclosure and insulating fabric has been investigated for the practicable construction activities. The mitigated noise levels from this Project are presented in **Table 4.28**. Mitigated Construction Plant Inventory and details of the mitigated construction noise impact are shown in **Appendices 4.10a to 4.10i**.

Table 4.28: Mitigated Construction Airborne Noise Impact from this Project

NSR ID	Use	Predicted Noise Level dB(A)*										Noise Criteria dB(A)	Exceedance of Noise Criteria	Residual Impact?
		2013	2014	2015	2016	2017	2018	2019	2020	2021 and after	Overall			
HT1	Residential	63	67-73	68-70	69-70	68-70	69-70	68-70	67-69	46-63	46-73	75	No	No
HT3	Residential	64	66-72	67-69	69-70	67-70	68-70	68-70	67-70	45-64	45-72	75	No	No
AST	Residential	61	66-73	67-70	69-70	67-70	68-69	68	67-69	47-62	47-73	75	No	No
RD[#]	Residential	-	-	67-68	65-68	63-65	63-64	63-64	61-63	54-64	54-68	75	No	No
WOB	Residential	60	65-67	65-66	63-66	61-63	61-62	61-63	60-63	54-63	54-67	75	No	No
VT1	Residential	62	67-69	67-68	64-69	63-65	62-63	62-64	61-64	61-69	61-69	75	No	No
VT2	Residential	61	66-69	67-68	64-68	62-64	63	63	61-63	58-66	58-69	75	No	No
LCS	Educational	61	67-68	66-67	65-67	63-65	63-65	64-65	62-64	64-70	61-70	70/65^	Yes	Yes
CRGPS	Educational	60	66-68	65-67	64-67	63-65	63-65	64-65	61-64	63-**76**	60-**76**	70/65^	Yes	Yes
FQ	Residential	64	71-73	71-72	69-72	68-71	68-72	71-72	63-71	69-70	63-73	75	No	No
CUL	Residential	60	61-65	62-64	64-65	63-66	65-66	65-67	65-67	43-65	43-67	75	No	No
P3	Residential	-	-	-	-	-	-	-	-	70	70	75	No	No
P6	Residential	-	-	-	-	-	-	-	-	55-75	55-75	75	No	No
P7	Residential	-	-	-	-	-	75	73-75	65-73	59-73	59-75	75	No	No
P13	Residential	-	-	-	-	-	74	73-74	73	59-73	59-74	75	No	No
P17	Residential	-	-	-	-	-	-	75	75	53-72	53-75	75	No	No
P21	Residential	-	-	-	-	-	75	74-75	74	49-65	49-75	75	No	No
P26	Residential	-	-	-	-	-	-	74	74	48-68	48-74	75	No	No
P29	Residential	-	-	-	-	-		70-71	69-71	45-68	45-71	75	No	No
P32	Residential	-	-	-	-	-	-	73-74	73-74	44-75	44-75	75	No	No

Note: **Bold** figures denotes the predicted noise level is higher than the relevant daytime construction noise criteria

(^) Criteria for examination period

([#]) MTR confirmed that the residential development next to Austin Station will be occupied in middle of 2015

With the incorporation of quiet plant, the use of movable noise barriers, enclosure and insulating fabric, the results indicated that the mitigated noise impact associated with the construction of the Project would comply with the daytime construction noise criterion at most of the representative NSRs. Residual construction noise impact was predicted at one educational NSR during normal school period, namely CRGPS. There is 6 dB(A) exceedance which is attributed to the construction of the Kowloon Park footbridge (west) in the proximity of the CRGPS. All practicable mitigation measures including movable barrier, enclosure and quiet plants have been proposed and exhausted to minimise the noise impact.

Residual construction noise impact was predicted at two educational NSRs during examination periods, namely “LCS” and “CRGPS”. According to the website of Lai Chack Middle School, March, June and December are examination periods. The CRGPS has been assumed same months as the examination periods. During the examination periods, the predicted exceedances for these NSRs are 1-5 dB(A) and 1-11 dB(A) for LCS and CRGPS respectively. All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact. In addition, it is noted that noise insulation works have been installed at this two schools and therefore significant noise impact would not be anticipated.

Cumulative Construction Noise Impacts

The overall cumulative construction noise levels from this Project and the concurrent projects are presented in **Table 4.29**. The predicted noise levels have included the cumulative impacts from other potentially concurrent projects. Details of the cumulative mitigated construction noise impact are shown in **Appendices 4.10a to 4.10i**.

Table 4.29: Overall Cumulative Construction Noise Impact

NSR ID	Use	Predicted Noise Level dB(A)*										Noise Criteria dB(A)	Exceedance of Noise Criteria	Residual Impact?
		2013	2014	2015	2016	2017	2018	2019	2020	2021 and after	Overall			
HT1	Residential	71-73	70-75	68-70	69-70	68-70	69-70	68-70	67-69	46-63	46-75	75	No	No
HT3	Residential	70-71	69-74	67-69	69-70	67-70	68-70	68-70	67-70	45-64	45-74	75	No	No
AST	Residential	72-75	71-**76**	68-72	69-70	67-70	68-69	68	67-69	47-62	47-**76**	75	Yes	Yes
RD[#]	Residential	-	-	67-70	65-68	63-65	63-64	63-64	61-63	54-64	54-70	75	No	No
WOB	Residential	66-69	68-73	65-68	63-66	61-63	61-62	61-63	60-63	54-63	54-73	75	No	No
VT1	Residential	67-69	69-72	67-69	64-69	63-65	62-63	62-64	61-64	61-69	61-72	75	No	No
VT2	Residential	67-69	68-71	67-68	64-68	62-64	63	63	61-63	58-66	58-71	75	No	No
LCS	Educational	66-69	68-**72**	66-68	65-67	63-65	63-65	64-65	62-64	64-70	62-**72**	70/65^	Yes	Yes
CRGPS	Educational	66-68	67-**71**	65-67	64-67	63-65	63-65	64-65	61-64	63-**76**	61-**76**	70/65^	Yes	Yes
FQ	Residential	73-75	72-75	71-72	69-72	68-71	68-72	71-72	63-71	69-70	63-75	75	No	No
CUL	Residential	60	61-74	63-73	64-65	63-66	65-66	65-67	65-67	43-65	43-74	75	No	No
P3	Residential	-	-	-	-	-	-	-	-	70	70	75	No	No
P6	Residential	-	-	-	-	-	-	-	-	55-75	55-75	75	No	No
P7	Residential	-	-	-	-	-	75	73-75	65-73	59-73	59-75	75	No	No
P13	Residential	-	-	-	-	-	74	73-74	73	59-73	59-74	75	No	No
P17	Residential	-	-	-	-	-	-	75	75	53-72	53-75	75	No	No
P21	Residential	-	-	-	-	-	75	74-75	74	49-65	49-75	75	No	No
P26	Residential	-	-	-	-	-	-	74	74	48-68	48-74	75	No	No
P29	Residential	-	-	-	-	-		70-71	69-71	45-68	45-71	75	No	No
P32	Residential	-	-	-	-	-	-	73-74	73-74	44-75	44-75	75	No	No

Note: **Bold** figures denotes the predicted noise level is higher than the relevant daytime construction noise criteria

* The noise level of Express Rail Link, Road Works at West Kowloon and Proposed Road Improvement Works in West Kowloon Reclamation Development have been taken into account in the predicted noise level. The predicted noise level shown is the overall cumulative noise level.

^ Criteria for examination period

[#] MTR confirmed that the residential development next to Austin Station will be occupied in middle of 2015.

Based on the results shown in the table above, the cumulative construction noise impact predicted at the existing NSR AST exceeded the relevant noise criterion for 1 dB(A). The exceedance was identified as contributed dominantly by the concurrent XRL and Road Works at West Kowloon projects and the noise from this Project is only 66 dB(A). All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact. However, NSR AST would still be subject to residual impact which contributed dominantly by concurrent projects.

Residual cumulative construction noise impact was predicted at two educational NSR, namely “LCS” and “CRGPS” during normal school period. The predicted exceendances for these NSRs are 1-2 dB(A) and 1-6 dB(A) respectively during normal school periods which occurred in year 2014 and after year 2030. For Year 2014, the exceedance was identified as dominantly contributed by the concurrent XRL and Road Works at West Kowloon projects and the noise from this Project is only 68 dB(A) at both NSRs. For after year 2030, residual impact is identified at CRGPS, which is attributed to the construction of the Kowloon Park footbridge (west) in the proximity. All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact.

According to the website of Lai Chack Middle School, March, June and December are examination periods. The CRGPS has been assumed same months as the examination periods. During the examination periods, the predicted exceendances for these NSRs are 1-5 dB(A) and 1-11 dB(A) respectively. All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact. In addition, it is noted that noise insulation works have been installed at this two schools and therefore significant noise impact would not be anticipated.

4.7.2 Road Traffic Noise

Exceedance of 1-2 dB(A) of the noise criteria were predicted at certain planned sensitive receivers within WKCD. The exceedances were identified as dominantly contributed by the existing roads and the committed Roads Works at West Kowloon. The predicted noise contributions from the proposed roads of this Project to the overall noise impacts are less than 1.0 dB(A) and the road traffic noise levels of the proposed roads are all below relevant noise criteria. Direct noise mitigation measures on the Project road sections are deemed not necessary as they would not be effective in improving the noise environment at the sensitive receivers. As a result, at-receiver mitigation measures should be considered in terms of self-protecting building design such as shielding by balcony.

The balcony shall be designed with a depth more than 1m with solid parapet of about 1.5m high and ceiling lined with absorptive material to face the noise source. This can reduce the road traffic noise from entering the domestic premises and affecting the residents inside. The expected noise reduction of this design is at least 2 dB(A).

The proposed façade requiring at-receiver noise mitigation measures are shown in **Figure 4.13**. Typical layout of at-receiver noise mitigation measures are shown in **Figures 4.14** to **4.16**.

Existing and planned NSRs are likely to have direct line-of-sight to the portal at the junction of Lin Cheung Road and Austin Road West, the portal of the interim access (i.e. on Austin Road West side) as well as the portal of the permanent access (i.e. on Canton Road side) to the proposed underpass. To avoid traffic noise reverberation inside the tunnel resulting in increased traffic noise to these NSRs, it is recommended to install on the inner walls and ceilings of the underpass with sound-absorbing materials at these three

portals. Such sound-absorbing materials should be extended at least 30m into the underpass at each portal and opening being treated. The locations of these three underpass portals requiring acoustic treatment are shown in **Figure 4.17**.

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

To study the performance of the proposed noise mitigation measures at the planned residential noise sensitive receivers, the numbers of dwellings that would be benefited from and be protected by the provision of noise mitigation measures have been estimated. The definition of "exposed", "benefited" and "protected" noise sensitive uses are defined as follow:

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

Number of dwellings that would be benefited from and be protected by the provision of noise mitigation measures have been identified with the use of the typical floor plan as shown in **Figure 4.16**. Results are tabulated as below.

Table 4.30 Summary of Benefitted and Protected Planned Dwellings (Interim Access at Austin Road West)

NSR ID	Total Number of Dwellings Considered	Unmitigated Scenario	Mitigated Scenario		
		Exposed Dwellings	Exposed Dwellings	Benefitted Dwellings	Protected Dwellings
P3a	12	0	n/a	n/a	n/a
P3b	12	10	0	10	10
P5	18	18	0	18	18
P9	18	4	0	4	4
P16	20	0	n/a	n/a	n/a
P17	22	0	n/a	n/a	n/a
P19	20	0	n/a	n/a	n/a
P22	24	0	n/a	n/a	n/a
P24	22	20	0	20	20
P27	18	18	0	18	18
P28	28	28	0	28	28
P29	32	32	0	32	32
Total	246	130	0	130	130

Table 4.31 Summary of Benefitted and Protected Planned Dwellings (Permanent Access at Canton Road)

NSR ID	Total Number of Dwellings Considered	Unmitigated Scenario	Mitigated Scenario		
		Exposed Dwellings	Exposed Dwellings	Benefitted Dwellings	Protected Dwellings
P3a	12	0	n/a	n/a	n/a

NSR ID	Total Number of Dwellings Considered	Unmitigated Scenario	Mitigated Scenario		
		Exposed Dwellings	Exposed Dwellings	Benefitted Dwellings	Protected Dwellings
P3b	12	10	0	10	10
P5	18	18	0	18	18
P9	18	0	n/a	n/a	n/a
P16	20	0	n/a	n/a	n/a
P17	22	0	n/a	n/a	n/a
P19	20	0	n/a	n/a	n/a
P22	24	0	n/a	n/a	n/a
P24	22	20	0	20	20
P27	18	18	0	18	18
P28	28	28	0	28	28
P29	32	32	0	32	32
Total	246	126	0	126	126

4.7.3 Fixed Plant Noise

With the fixed plant properly designed to meet the maximum allowable SWLs as listed in **Table 4.21**, no residual noise impact from fixed plant is expected. However, it is also recommended that the following noise reduction measures should be considered as far as practicable during design stage:

- Choose quieter plant such as those which have been effectively silenced.
- Include noise levels specification when ordering new plant (including chillier and E/M equipment).
- Locate fixed plant/louvre away from any NSRs as far as practicable.
- Locate fixed plant in walled plant rooms or in specially designed enclosures.
- Locate noisy machines in a basement or a completely separate building.
- Install direct noise mitigation measures including silencers, acoustic louvres and acoustic enclosure where necessary.
- Develop and implement a regularly scheduled plant maintenance programme so that equipment is properly operated and serviced in order to maintain a controlled level of noise.

4.7.4 Open Air Entertainment Activity Noise

The impact noise levels at all selected NSRs complied with the relevant noise criteria for the daytime, and evening time periods. Since no operation of Outdoor Theatre will be anticipated at night-time period, significant open air entertainment noise impact to the existing and planned NSRs is not anticipated. Mitigation measure is therefore considered not required. However, it is recommended that the PA system of Outdoor Theatre should be avoided to face the existing and planned NSRs.

4.7.5 Ground-borne Noise

The ground-borne noise impact assessment results indicate that the potential ground-borne noise impact at Xiqu Centre, M+ (Phase I), Lyric Centre and CCP due to the operation of the planned and existing railways in proximity of WKCD would exceed 7-31 dB(A) of the proposed noise level criteria. Considering the close proximity of the M+ (Phase II) to the existing AEL / TCL, exceedance in relevant ground-borne noise criterion is also envisaged.

Given stringent acoustic performance requirement for these world-class venues, at-receiver end noise and vibration control measures such as building isolation and or box-in-box installation would be required by the acoustic and theatre designers of these venues including CCP, Xiqu Centre, Museum M+ (Phases I & II) and Lyric Centre. The design principles for these noise mitigation measures are to reduce the ground-borne noise vibration by use of resilient structural elements such as specially designed natural rubber, neoprene, or steel spring type isolation bearings. Typically building isolation can have up to 20dB insertion loss, subject to design and workmanship. Box-in-box installation can further reduce up to 15dB structure-borne noise inside the building. The noise reduction of building isolation and box-in-box can have up to 35 dB(A) with proper installation. The conceptual design of building isolation and box-in-box installation are illustrated in **Figures 4.11 and 4.12**.

Examples of the similar mitigation measures can be found in Kwai Tsing Theatre and Shaw Studios in Tseung Kwan O. Both projects are very close to railways, where the slant distance between building foundation and trackform is less than 100m. In Kwai Tsing Theatre, physical and sound vibration of railway had to be limited to levels which would not disturb theatre patrons. The isolation floor system suspends the whole building from the ground on heavy-duty springs. Around 320 spring units support the auditorium seating area, main stage, side stages and rear stage to hold these sensitive areas above the ground surface. Box-in-box installation has been carried out at Shaw Studios in Tseung Kwan O. The noise floor levels of theatre and stages can achieve Noise Rating 12 which is approximately equal to L_{max} 23 dB(A) (with air conditioning in operation and bandwidth measured to 4 Hz).

The ground-borne noise assessment is based on like-to-like measurement results since the basement and foundation designs are yet to be advised at this stage. Therefore, ground-borne noise impact review and monitoring will need to be carried out in the future design stage. In addition, the design consultant should also make reference to the ground-borne assessment findings and the suggested mitigation measures in order to ensure the ground-borne noise impact will be taken into account during the basement and foundation design. In any event, WKCDA will incorporate such requirements into the relevant design contracts for all special venues, including CCP, Xiqu Centre, Museum M+ (Phases I & II), Lyric Centre, Musical Theatre and Music Centre to ascertain that the relevant noise criteria could be achieved.

The exact measures to be adopted are subject to the later detailed structural and foundation designs of the art performance venues. WKCDA will continue to liaise with MTRCL to resolve any interface issues between the WKCD development and the existing/planned railways when more information becomes available.

4.7.6 Helicopter Noise

As mentioned in **Section 4.4.6**, adverse noise impact from the existing helipad at Shun Tak Centre would not be expected at the planned residential and commercial development as well as the proposed Outdoor Theatre within the WKCD. Mitigation measure is therefore considered not required.

4.7.7 Marine Traffic Noise

As the marine traffic noise would likely possess nuisance to the planned NSRs P2, P3, P10, P11, P13, P21, P26 and P32 located close to the south boundary of WKCD, mitigation measures are deemed necessary to reduce the potential noise impact. At-receiver mitigation measures in terms of avoiding any sensitive façades with openable window facing the noise source is recommended. The proposed façades requiring at-receiver noise mitigation measures are shown in **Figure 4.13**. Typical layout of at-receiver noise mitigation measures are shown in **Figures 4.14** to **4.16**.

4.7.8 Summary of At-receiver Noise Mitigation Measures for Residential Development

Based on the earlier assessment findings, the residential floors of a number of affected parcels have been identified with adverse noise impacts and at-receiver mitigation measures should be considered. The at-receiver noise mitigation measures recommended for various NSRs with potential noise exceedance are summarized in **Table 4.32** below.

Table 4.32: Recommended At-receiver Noise Mitigation Measures for Residential Buildings

NSR ID	Potential Noise Exceedance		Recommended At-receiver Noise Mitigation Measures	
	Road Traffic	Marine Traffic	Balcony	Avoid Sensitive Façade with Openable Window
P2		√		√
P3a		√		√
P3b	√		√	
P5	√		√	
P9	√		√	
P10		√		√
P11		√		√
P13		√		√
P21		√		√
P24	√		√	
P26		√		√
P27	√		√	
P28	√		√	
P29	√		√	
P32		√		√

*Note: (1) The residential developments will be subject to the permission from the Town Planning Board on planning application under section 16 of the Town Planning Ordinance. Technical assessment in relation to the detailed design of recommended at-receiver noise mitigation measures for residential buildings will be specified in the planning application.

4.8 Evaluation of Residual Impacts

4.8.1 Construction Phase

The cumulative construction noise impact predicted at the existing NSR AST exceeded the relevant noise criteria for 1 dB(A) for a duration of 1 month. The exceedance was identified as dominantly contributed by

the concurrent XRL and Road Works at West Kowloon projects and the noise from this Project is only 66 dB(A). All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact. However, NSR AST would still be subject to residual impact which contributed dominantly by concurrent projects.

Residual construction noise impact was also predicted at two educational NSR, namely “LCS” and “CRGPS” during normal school periods. The predicted exceendance for NSR LCS is 1-2 dB(A) for a duration of 5 months. The predicted exceedance for NSR CRGPS is 1-6 dB(A) for a duration of 19 months. All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact.

According to the website of Lai Chack Middle School, March, June and December are examination periods. The CRGPS has been assumed same months as the examination periods. The predicted exceendance for NSR LCS during examination periods is 1-5 dB(A) for a duration of 27 months (including 2 months during TST fire station demolition period, 9 months during permanent underpass & relative superstructure construction period and 6 months during footbridge construction period) for the examination period. The predicted exceedance for NSR CRGPS is 1-11 dB(A) for a duration of 25 months (including 2 months during TST fire station demolition period, 9 months during permanent underpass & relative superstructure construction period and 6 months during footbridge construction period) for the examination period. All practicable mitigation measures including movable barrier, enclosure, insulating fabric and quiet plants have been proposed and exhausted to minimise the noise impact. In addition, it is noted that noise insulation works have been installed at these two schools and therefore significant noise impact would not be anticipated.

The daytime construction noise criterion is 65 dB(A) during school examination periods, which is lower than the normal daytime school criterion of 70 dB(A). In this regard, scheduling of construction works outside school examination period to less intrusive periods would help reduce the overall noise impacts at the NSRs. The Contractor shall liaise with the school representative(s) to obtain the examination schedule and avoid noisy construction activities during school examination period.

The residual impacts during construction phase are assessed in accordance with Section 4.4.3 of the TM-EIAO as shown in **Table 4.33** below:

Table 4.33 Assessment of Residual Impacts during Construction Phase

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	The predicted exceendance of construction noise for NSR AST is 1 dB(A). The exceedance was identified as contributed by the concurrent XRL and Road Works at West Kowloon projects and the noise from this Project is only 66 dB(A). All practicable mitigation measures have been proposed and exhausted to minimise the noise impact. However, NSR AST would still be subject to residual impact which contributed dominantly by concurrent projects. The predicted exceendance of construction noise for NSR LCS is 1-2 dB(A) during normal school period and 1-5 dB(A) during examination period. The predicted exceedance for NSR CRGPS is 1-6 dB(A) during normal school period and 1-11 dB(A) during examination period. All practicable measures have been proposed and exhausted to minimise

Criteria	Assessment
	the noise impact. In addition, it is noted that noise insulation works have been installed at this two schools and therefore significant noise impact would not be anticipated.
Geographic extent of the adverse environmental impact	The geographic extent of the adverse impacts from noise is anticipated to be limited to one residential use at Austin Road West and two educational uses at Canton Road.
Duration and frequency of the adverse environmental impacts	The predicted exceedance duration of construction noise for NSR AST is 1 month. The predicted exceedance duration of construction noise for NSR LCS is 5 months during normal school period and 27 months during examination period. The predicted exceedance duration for NSR CRGPS is 19 month during normal school period and 25 months for examination period. All practicable measures have been proposed and exhausted to minimise the noise impact. All the construction noise exceedance is temporary and reversible.
Likely size of the community or the environmental that may be affected by the adverse impacts	One residential at Austin Road West and two educational uses at Canton Road would be temporarily affected by residual construction noise.
Degree to which the adverse environmental impacts are reversible or irreversible	Construction phase impact should be reversible.
Ecological context	Not Applicable in noise section
Degree of disruption to sites of cultural heritage	Not Applicable in noise section
International and regional importance	The impacts are localized and not of international and regional importance
Likelihood and degree of uncertainty of adverse environmental impact	The impacts predicted are based upon worst case assumptions and as such, would not occur to the extent predicted on all occasions.

Base on the above information, the potential construction phase residual impacts have been assessed to be acceptable in view of the nature, magnitude, duration, and frequency of the noise impacts as well as the conservative assessment results.

4.8.2 Operation Phase

Exceedance of 1-2 dB(A) of the road traffic noise criteria has been predicted at planned residential developments of NSRs P3b, P5, P9, P24, P27, P28 and P29 within WKCD. The exceedances were identified as dominantly contributed by the existing roads and the committed RWWK project. The predicted noise contributions from the proposed roads of this Project to the overall noise impacts are less than 1.0 dB(A) and the road traffic noise levels of the proposed roads are all below the relevant noise criterion of 70 dB(A). Direct noise mitigation measures on the Project road sections are deemed not necessary as they would be ineffective in improving the noise environment at the sensitive receivers. As a result, at-receiver mitigation measure has been recommended according to Annex 13 of the EIAO-TM. With implementations of proposed at-receiver noise mitigation measures in form of balcony at the affected NSRs, adverse road traffic noise impact is not anticipated.

Adverse fixed plant noise impact is not anticipated. In order to ensure compliance of the operational noise level with the stipulated noise standards in TM, noise commissioning tests for all major fixed noise sources should be included in the Contract Document.

No adverse noise impact from Open Air Entertainment Activities at the proposed Outdoor Theatre and existing helipad at Shun Tak Centre would be expected.

Potential ground-borne noise impact to Xiqu Centre, (M+ (Phases I & II), Lyric Centre and CCP in the vicinity of the existing and planned railways operating underground is anticipated. Mitigation measures in forms of building isolation and box-in-box installation would most likely be incorporated into the structural and foundation design at CCP, Xiqu Centre, Museum M+ (Phases I & II) and Lyric Centre as one of the mitigation measures. Further review of the impact would be carried out at the detailed design stage of the relevant art performance venues in WKCD to confirm the exact measures to be adopted. The conceptual design, working principle and examples of mitigation measures have been suggested and should be adopted as references for the future basement and foundation design consultant. WKCDA will incorporate the comparable stringent criteria and requirements which make reference to the ground-borne noise assessment findings and the suggested mitigation measures in design contract of all special venues. With proper mitigation measures in place, no adverse ground-borne noise impact is anticipated.

Potential nuisance due to marine traffic noise is anticipated for the planned NSRs P2, P3, P10, P11, P13, P21, P26 and P32, which are located close to the south boundary of WKCD. By designing these buildings so as to avoid any sensitive façades with openable window facing the noise source as indicated in **Figures 4.15 and 4.16**, potential nuisance from marine traffic is not anticipated. In addition, no adverse noise impact from the New Yau Ma Tei Typhoon Shelter is anticipated.

4.9 Environmental Monitoring and Audit

4.9.1 Construction Phase

Residual airborne noise impact is predicted during the construction phase. To ensure that the nearby NSRs will not be subject to unacceptable construction noise impact, an Environmental Monitoring and Audit (EM&A) programme is recommended. Details on the noise monitoring requirements, methodology and action plans would be described in a separate EM&A Manual.

4.9.2 Operation Phase

With implementation of the proposed mitigation measures, no adverse road traffic, marine traffic noise and ground-borne noise impact are anticipated from the operation of the Project, hence no environmental monitoring and audit is proposed.

Prior to the operation phase of the Project, as part of the design process, commissioning tests should be conducted to ensure the operational noise from the fixed plant within WKCD would comply with the relevant EIAO-TM noise criteria.

4.10 Conclusion

4.10.1 Construction Phase

The construction phase noise impact assessment has been made based on the best available information, taking into account other expected concurrent projects. Having exhausted practicable mitigation measures in the form of quiet plant, movable noise barrier, enclosure and insulting fabric, the construction noise levels at most of the representative NSRs are predicted to comply with the noise standards stipulated in the EIAO-TM. The cumulative construction noise impact predicted at one existing residential development at

Austin Road West would exceed the relevant noise criteria by 1 dB(A) for a duration of 1 month. The exceedance was identified as dominantly contributed by the concurrent XRL and Road Works at West Kowloon projects and the noise from this Project is only 66 dB(A). Residual construction noise impacts are also predicted at two representative NSRs of educational use at Canton Road. However, the two NSRs have already been implemented with noise insulation works and therefore significant noise impacts are not anticipated during the construction. Notwithstanding this, it is recommended that the particularly noisy construction activities should be scheduled to avoid examination periods of these NSRs as far as practicable.

4.10.2 Operation Phase

The potential road traffic noise impacts have been assessed based on the peak traffic flows in 2032. The exceedances were identified as dominantly contributed by the surrounding existing roads and the committed RWWK project road sections. The predicted noise contributions from the proposed roads of this Project are less than 1.0 dB(A) at those affected NSRs and the road traffic noise levels of the proposed roads are all below the relevant noise criteria. Direct noise mitigation measures on the Project road sections are deemed not necessary as they would be ineffective in improving the noise environment at the sensitive receivers. As a result, at-receiver mitigation measures in form of balcony have been proposed for those NSRs with predicted noise levels exceeding the road traffic noise criteria. With implementations of the proposed at-receiver noise mitigation measures in form of balcony at NSRs P3b, P5, P9, P24, P27, P28 & P29, adverse traffic noise impact is not anticipated.

Noise impact from the planned fixed plant could be effectively mitigated by implementing noise control measures at sources during the detailed design stage. With the adoption of the proposed maximum allowable SWLs of the proposed fixed plant, the impact noise levels at all selected NSRs would comply with the relevant noise criteria for the daytime, evening time and night time periods. Therefore, significant fixed plant noise impact to the existing NSRs is not anticipated.

The predicted open air entertainment noise levels arising from the proposed Outdoor Theatre at all selected NSRs will comply with the relevant noise criteria for the daytime, and evening time periods. Since no operation of Outdoor Theatre will be anticipated at night-time period, significant open air entertainment noise impact to the nearby NSRs is not anticipated. Mitigation measure is therefore considered not required.

Exceedance in ground-borne noise criteria at Xiqu Centre, M+ (Phases I & II), Lyric Centre and CCP in the vicinity of the existing and planned railways operating underground is expected due to the stringent criteria for these special venues. The mitigation measures such as building isolation and box-in-box installation would most likely be integrated into the structural and foundation design of the relevant art performance venues in WKCD. Further review of the impact would be carried out at the detailed design stage of the art performance venues. WKCDA will incorporate, into the relevant design contracts of all special venues including Xiqu Centre, CCP, Lyric Centre, Music Centre, Musical Theatre and the Museum M+ (Phase I & II), the comparable stringent criteria and requirements which make reference to the ground-borne noise assessment findings and the suggested mitigation measures. With this mitigation in place, no adverse ground-borne noise impact is anticipated.

The helicopter noise from the existing helipad at Shun Tak Centre, which is located at 1.1km from site boundary of WKCD, is measured to be around L_{max} 73dB(A) at the location of the proposed Outdoor Theatre to the west of the Project site where is the place within the WKCD site nearest to the existing helipad. Therefore, it is considered that the helicopter noise would comply the helicopter noise criteria and

hence adverse helicopter noise impact is not anticipated at the residential and commercial development on the WKCD. Given the activities to be conducted in the Outdoor Theatre, such as popular music concerts, will rely on public address (PA) system and are expected to have high sound levels and that helicopter noise would be just noticeable and transient, adverse helicopter noise impact to the Outdoor Theatre is not anticipated.

Potential nuisance due to marine traffic noise is anticipated for the planned NSRs P2, P3, P10, P11, P13, P21, P26 and P32, which are located close to the south boundary of WKCD. By designing these buildings so as to avoid any sensitive façades with openable window facing the noise source, potential nuisance from marine traffic noise is not anticipated. In addition, given the large separation between the nearest planned NSR on the WKCD (NSR P32) and the New Yau Ma Tei Typhoon Shelter, it is anticipated that the noise impact from the operation of the typhoon shelter would be minimal.