

5. NOISE IMPACT ASSESSMENT

5.1. INTRODUCTION

- 5.1.1. This section presents a noise impact assessment, which identifies potential sources of noise impact, assesses the potential impacts and recommends mitigation measures where required to reduce the noise impacts to acceptable levels, for the construction and operation of the Project. This noise impact assessment has been conducted in accordance with the requirements of Annex 5 and Annex 13 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) as well as the technical requirements set out under Section 3.4.5 and Appendix C of the Environmental Impact Assessment (EIA) Study Brief (No. ESB-347/2021).

5.2. ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

General

- 5.2.1. The *Noise Control Ordinance, Cap 400 (NCO)* and the Environmental Impact Assessment Ordinance (EIAO) (Cap 499) provide the statutory framework for noise control. Assessment procedures and standards relevant to the Project are set out in the Technical Memoranda (TM) given below:

- 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);
- TM for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites (IND-TM); and
- EIAO Guidance Note No.9/2010

- 5.2.2. Percussive piling is prohibited between 1900 and 0700 hours or at any time on a general holiday (including Sunday). A valid construction noise permit (CNP) is required for the carrying out of percussive piling during the permitted hours. According to the current construction programme, percussive piling works would not be required.

Construction Phase

General Construction Activities during Non-Restricted Hours

- 5.2.3. Noise impacts arising from general construction activities other than percussive piling between 0700 and 1900 hours on any day not being a Sunday or general holiday are assessed against the standards set out in the EIAO-TM. The noise standards are summarised in **Table 5-1** below.

Table 5-1 Noise Standards for Construction Noise during Non-Restricted Hours

Uses	Noise Standards, Leq(30mins) dB(A)
<ul style="list-style-type: none"> • All domestic premises, • Temporary housing accommodation, • Hostels, • Convalescent homes, and • Homes for the aged 	75
<ul style="list-style-type: none"> • Places of public worship, • Courts of law, and • Hospitals and medical clinics 	70
<ul style="list-style-type: none"> • Educational institutions (including kindergartens and nurseries) 	70 65 (during examination period)

Notes:

[1] Non-restricted hours are 0700 to 1900 hours on any day not being a Sunday or general holiday.

[2] The above standards apply to noise sensitive uses which rely on opened windows for ventilation.

[3] The above standards shall be viewed as the maximum permissible noise levels assessed at 1m from the external façade.

- 5.2.4. Based on the currently envisaged construction programme shown in [Appendix 2.1](#), no work will be required in restricted hours (i.e. on all days during 1900 and 0700 hours and at any time on Sundays and general holidays). In case of any construction activities during restricted hours, it is the Contractor's responsibility to ensure compliance with the Construction Noise Permit (CNP) and the relevant TMs under the NCO. 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. Regardless of the results of construction noise impact assessment in this EIA study, the Noise Control Authority will process CNP application, if necessary, based on the NCO, the relevant technical memoranda issued under the NCO, and the contemporary conditions/ situations.

Operation Phase

Fixed Plant Noise

- 5.2.5. The NCO and IND-TM control noise from fixed noise sources from places or premises other than domestic premises, public places or construction sites. For the assessment of impacts from fixed noise sources, the Area Sensitive Rating (ASR) of the noise sensitive receivers (NSRs) must be determined in accordance with the IND-TM. The appropriate Acceptable Noise Level (ANL) can be determined based on the ASR. There are 4 types of area described in the IND-TM which are summarised in **Table 5-2** below. Within these areas, the presence of "Influencing Factors" (IFs) such as the presence of industrial area or major roads) with an annual average daily traffic flow in excess of 30,000, can further affect the ASR and hence the ANL.

Table 5-2 Area Sensitivity Ratings of NSRs

Type of Area Containing NSR	Degree to which NSR is affected by Influencing Factors (IFs)		
	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

Notes:

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

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

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

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

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

5.2.6. According to the IND-TM, the ANLs based upon the different ASRs during different periods are shown in **Table 5-3** below.

Table 5-3 ANLs for Fixed Plant Noise

Time Period	ANL, dB(A)		
	ASR 'A'	ASR 'B'	ASR 'C'
Day and evening (0700-2300 hrs)	60	65	70
Night (2300-0700 hrs)	50	55	60

5.2.7. More stringent criteria for assessing fixed plant noise are specified in the EIAO-TM for planning purposes. The assessment criteria are:

- 5dB(A) below the appropriate ANL set out in the IND-TM (as shown in **Table 5-3** above); or
- The prevailing background noise level, whichever is the lower.

5.3. IDENTIFICATION OF NOISE SENSITIVE RECEIVERS

5.3.1. Representative NSRs were identified in accordance with Annexes 5 and 13 of the EIAO-TM and should include all domestic premises, temporary housing accommodation, hostels,

convalescent homes, homes for the aged, educational institutions including kindergarten, nurseries, place of public worship, courts of law, hospitals, medical clinics and other premises or places that are considered by the Director to have similar sensitivity to noise as the above that have direct line-of-sight and substantial angle of view of the Project area.

- 5.3.2. The study area for the noise impact assessment covered an area of 300m from the boundary of the Project and works of the Project as specified in the Study Brief. The first layer of the NSRs has been selected for assessment as they are at the most affected locations which would provide acoustic shielding to those receivers at further distance behind.
- 5.3.3. The existing NSRs were identified with reference to the latest best available information at the time of preparation of this report, such as those showing on the survey maps, topographic maps, aerial photos, approved Outline Zoning Plan (OZP) No. S/K1/28 – Tsim Sha Tsui and other relevant land use plans. Site surveys were conducted on 20 and 21 June 2022 to verify the sensitive receivers and confirm the desktop studies. No planned NSR is identified within the 300m assessment area.
- 5.3.4. The noise assessment points (NAPs) will be assigned to the noise sensitive façade of the identified NSRs with openable window for ventilation. [Figure 5.1a](#) shows the project boundary and representative NSRs while [Figure 5.1b](#) shows the photo of representative NSRs. [Figure 5.2](#) shows the NAPs. Details of the representative existing and planned NSRs with the corresponding NAPs are summarised in [Table 5-4](#).

Table 5-4 Representative Existing NSRs with the Corresponding NAPs

NSR ID	NAP ID	Name	No. of Storeys	Use ^[1]	Approx. Shortest Horizontal Distance from NSR to Project Site (m)	Potential Impact ^[2]
NSR01 ^[3]	NAP101	HKO Quarters No.2 (Within HKOHQ)	2	R	Adjacent to Project Site	C&O
	NAP102	HKO Quarters No.3 (Within HKOHQ)	2	R		C&O
NSR02 ^[4]	NAP201	HKO Quarters No.1 (Within HKOHQ)	2	R	Within Project Site	C&O
NSR03	NAP301	King's Mansion	15	R	10	C&O
NSR04	NAP401	New Knutsford House	14	R	12	C&O
NSR05	NAP501	Lok Fun Mansion	13	R	10	C&O
NSR06	NAP601	Carlton Building	13	R	10	C&O
NSR07	NAP701	St. Andrew's Church	3	W	46	C&O

Notes:

[1] R- Residential, W- Place of Worship

[2] C- Construction air-borne noise, O- Operational fixed plant noise

[3] NSR01 is within the HKO Headquarters but outside the Project Site. It is immediately adjacent to indicative works area of UU works.

[4] NSR02 is within Project Site. No works is to be carried out at NSR02. It is immediately adjacent to indicative works area of UU works.

ASR of Noise Sensitive Receivers

- 5.3.5. According to the latest OZP (No. S/K1/28) in the area, the surrounding areas are currently zoned as “Commercial” (“C”) and “Government, Institution or Community” (“G/IC”). The Project and associated NSRs are located within the urban area of Tsim Sha Tsui.

- 5.3.6. According to the Annual Traffic Census of 2021 published by the Transport Department (TD), the annual average daily traffic (AADT) at Nathan Road (from Hillwood Road to Kimberley Road) was about 28,080 vehicles per day. By definition, this road section of Nathan Road is not an IF within the study area in accordance with the IND-TM.
- 5.3.7. The Project and associated NSRs are located within the urban area of Tsim Sha Tsui and since the nearby noise sensitive receivers would not be affected by the adjacent Nathan Road, an ASR of B, would be allocated to all representative NSRs.
- 5.3.8. In order to determine the fixed plant noise assessment criteria, prevailing background noise surveys were conducted in June 2022. The lowest measured background noise levels in the same time period were adopted for determining the fixed plant noise assessment criteria. The survey results were compared with the ANL-5 dB(A) criteria to determine the noise criteria to be adopted in this assessment. The survey locations are shown in [Figure 5.2](#). The results of the prevailing background noise surveys and the fixed plant noise assessment criteria are shown in [Table 5-5](#) and [Appendix 5.1](#). The lesser of the lowest background noise levels has been compared with the ANL-5dB(A) to obtain the Noise Criteria.

Table 5-5 Lowest Measured Prevailing Background Noise Levels for NSRs and Fixed Plant Noise Assessment Criteria

NSR ID	Location ID	Lowest Measured Background Noise Level $L_{eq(30mins)} \text{ dB(A)}^{[1]}$			ANL – 5 dB(A)			Fixed Plant Noise Assessment Criteria $L_{eq(30mins)} \text{ dB(A)}$		
		Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
NSR01	M1	58	57	53	60	60	50	58	57	50
NSR02	M1	58	57	53	60	60	50	58	57	50
NSR03	M2	61	61	60	60	60	50	60	60	50
NSR04	M2	61	61	60	60	60	50	60	60	50
NSR05	M3	62	63	62	60	60	50	60	60	50
NSR06	M3	62	63	62	60	60	50	60	60	50
NSR07	M1	58	57	53	60	60	50	58	57	50

Note:

[1] The lowest measured background noise levels in the same time period were adopted for determining the fixed plant noise assessment criteria.

5.4. DESCRIPTION OF THE EXISTING ENVIRONMENT

- 5.4.1. The Project Site is located in Tsim Sha Tsui. The surrounding land uses comprise “C” and “GI/C”. Major developments in the vicinity include the Tsim Sha Tsui District Kaifong Welfare Association, Mira Place, St. Andrew’s Church Compound, Antiquities and Monuments Office (AMO) Head Office and Knutsford Terrace, etc. Site surveys conducted on 20 & 21 June 2022 revealed that the background noise environment was dominated by traffic noise.

5.5. IDENTIFICATION OF POTENTIAL NOISE SOURCES

Construction Phase

- 5.5.1. The potential sources of noise impact during the construction phase of the Project are the use of PME for various construction activities. As broadly indicated in the preliminary construction programme in [Appendix 2.1](#), the construction of the Project would tentatively start from July 2025 to January 2029 and last for about 43 months. The major construction activities include:
- Site preparation and road works;
 - Excavation and Foundation; and
 - Construction of Annex Block and Refurbishment of the Red House.
- 5.5.2. Referring to *Section 3.4.24*, socket H-pile is considered to be more preferable for the Project. Percussive piling activities is not anticipated.
- 5.5.3. In order to provide a realistic noise assessment for the construction activities, details of construction plant inventory with the percentage on-time of PME to be operated on site were considered when calculating the total sound power level (SWL) of the construction activities as given in [Appendix 5.3](#). The construction plant inventory is reviewed and agreed by Project Engineer and ArchSD.
- 5.5.4. Excavation works for connection of UU to the existing buildings are expected. As confirmed by the Project Team, the work duration of the excavation for UU will be short (around 2 - 3 months). Such works will be conducted section by section and will take around 1-2 hours per day. Limited amount of PME will be used.
- 5.5.5. Two concurrent projects that may potentially interface with the Project during construction phase are summarized in **Table 2.4**. For project CE 41/2018 (DS) “Drainage Improvement Works”, potential construction noise impacts would be associated with the use of PME for construction of stormwater pumping station at around 265m to the southeast of Project Site. Works nearest to the Project Site are mainly pipe laying at Observatory Road and Kimberley Road which is approximately 89m in distance from the Project Site. As the drainage improvement works are of limited scale and good site practices as well as recommended mitigation measures for noise control under EPD’s RPCC for construction contract will be implemented, cumulative noise nuisance to nearby sensitive receivers shall be minimised. For project 3075RE “Expansion of Hong Kong Science Museum and Hong Kong Museum of History”, it is now undergoing pre-construction activities and will be completed in 2023 – 2024. Its tentative construction works programme will take place between year 2026 - 2027 during which the Project will be undergoing excavation, foundation, construction of Annex Block and refurbishment of Red House, hence overlapping of major construction works from the two projects is anticipated. Given that the project 3075RE is about 228m from the Project Site and there are clusters of building between the two projects, cumulative noise nuisance to nearby sensitive receivers is not expected.

Operation Phase

5.5.6. Operational noise from and associated with the Project includes the following:

- Fixed plant noise
 - Mechanical ventilation and air conditioning system (MVAC) equipment and other fixed noise sources equipment

Fixed Plant Noise - Corrections

5.5.7. Corrections for tonality, intermittency or impulsiveness for each MVAC equipment and other fixed noise sources are determined according to the IND-TM.

5.5.8. In this assessment, the corrections for tonality, impulsiveness and intermittency were not applied to the MVAC equipment and other fixed noise sources.

5.5.9. The quantities, referenced SWLs, operation durations and operation frequencies of the equipment in the Project are shown in [Appendix 5.2](#).

Fixed Plant Noise – MVAC equipment and other fixed noise sources

5.5.10. MVAC equipment and other fixed noise sources associated with the operation of the Project were identified as potential noise sources. They will be enclosed within plant rooms except the outdoor units of the air conditioning system on roof. Louvres and ventilation fans are designed at facades.

5.5.11. The locations of key fixed noise sources are shown on the preliminary design layout plans in [Figure 5.4](#). The estimated quantity of identified noise sources to be operated during day / evening and night-time periods are shown in [Appendix 5.2](#).

5.6. ASSESSMENT METHODOLOGY

Construction Phase

5.6.1. Methodology for assessing noise impacts from the construction activities associated with the Project is developed based on standard acoustic principles and the GW-TM and is summarised as follows:

- Identification of notional noise source locations of the work site with respect to NSRs;
- Determination of distance attenuation and screening effects between NSRs and notional noise sources;
- Estimation of construction noise levels at NSRs in the absence of any mitigation measures;
- Proposal of mitigation measures and evaluation of their effectiveness; and
- Determination of residual impacts.

- 5.6.2. The adopted approach to assess the noise impact is in line with the Guidance Note titled “Preparation of Construction Noise Impact Assessment under the EIAO” (GN 9/2010).
- 5.6.3. The proposed NAPs for the construction noise impact assessment are summarised in **Table 5-4**. The NAPs were identified at the worst façade location nearest to the Project. The construction inventory for the major construction activities (including type and quantity of the PME used as well as percentage on time utilization) is shown in [Appendix 5.3](#) and the locations of notional noise sources are provided in [Figure 5.3](#).
- 5.6.4. The construction noise impact was then assessed against the noise standards given in the EIAO-TM as shown in **Table 5-1**.

Operation Phase

Fixed Plant Noise

- 5.6.5. As discussed in *Section 5.5*, major fixed plant noise sources of the Project include operation of MVAC equipment and other fixed noise sources.
- 5.6.6. The noise sources of the MVAC equipment and other fixed noise sources were identified based on the preliminary design layout plans.
- 5.6.7. The assessment approach for the fixed plant noise impacts from the Project was conducted with consideration of standard acoustic principles and are summarised as follows:
- Sound pressure levels (SPLs) at NAPs were calculated based on distance attenuation, tonality correction, impulsiveness correction, intermittency correction, percentage on-time correction, barrier correction, quantity correction and façade correction.
- 5.6.8. The quantity, operational modes and the operation duration of MVAC equipment and other fixed noise sources at the Project were verified by the future users. The operation modes include daytime operation and nighttime operation and thus are designed to meet the nighttime noise criteria.
- 5.6.9. Since the design of the equipment to be installed in the plant rooms was not available during the course of this study, the maximum allowable SWLs for MVAC equipment & other fixed noise sources would be determined.

5.7. PREDICTION AND EVALUATION OF NOISE IMPACTS

Construction Phase

- 5.7.1. This evaluation of construction noise impact assesses the construction activities for the Project.
- 5.7.2. Referring to *Section 5.5.4*, excavation works for connection of UU to the existing buildings are expected. In view of limited PME employed and short work duration, noise from excavation work for UU is expected to be acceptable with the mitigation measures

implemented. Movable noise barrier shall be used. Contractor will carefully schedule the works to avoid parallel operation at the Annex Block construction works area.

- 5.7.3. The works will be carefully scheduled to avoid simultaneous operation of noisy PME. In view of the short separation distance between the Project Site and the Staff Quarters No.1 – 3 (NAP101, NAP102, NAP201), the Contractor should keep close liaison with the residents of Staff Quarters for the arrangement of work sequence; movable noise barrier should also be utilized to provide screening effect if needed.
- 5.7.4. Table 5-6 summarises the predicted construction noise levels due to the Project. The maximum construction noise levels during normal daytime working hours were predicted. The results indicate that construction activities of the Project, if unmitigated, would cause exceedance of the construction noise standards at all NAPs except NAP301 (King's mansion). Mitigation measures are therefore considered to minimize the construction noise impact.

Table 5-6 Predicted Construction Noise Levels at Representative NAPs during Normal Daytime Working Hours due to the Project for Unmitigated Scenario

NAP ID	Description	ANL, dB(A)	Predicted Construction Noise Level, dB(A)		
			Site Preparation and Road Works	Excavation and Foundation	Construction of Annex Block and Refurbishment of Red House
NAP 101	HKO Quarters No.2 (Within HKOHQ)	75	82 - 84	80 - 86	77 - 85
NAP 102	HKO Quarters No.3 (Within HKOHQ)	75	80 - 82	78 - 84	75 - 83
NAP 201	HKO Quarters No.1 (Within HKOHQ)	75	80 - 82	78 - 84	75 - 83
NAP 301	King's Mansion	75	70- 72	68 - 74	65 - 73
NAP 401	New Knutsford House	75	76 - 78	74 - 80	71 - 79
NAP 501	Lok Fun Mansion	75	82 - 84	80 - 86	77 - 85
NAP 601	Carlton Building	75	79 - 81	77- 83	74 - 82
NAP 701	St. Andrew's Church	70	71 - 73	69- 75	66 - 74

Notes:

[1] Construction noise criteria for all domestic premises and places of public worship are 75 dB(A) and 70 dB(A) respectively.

[2] Noise levels exceeding the construction noise criteria are **bolded**.

Operation Phase

Fixed Plant Noise

- 5.7.5. During the operation phase, noise impacts due to the fixed plant noise sources including MVAC equipment and other fixed noise sources were assessed. As confirmed by HKO, night time operation at Annex Block is expected. As a conservative approach, all fixed plants are assumed to be operating during night time, the predicted fixed plant noise levels at the NAPs are shown in **Table 5-8**. Detailed calculations of fixed plant noise impact assessment for

night time operation and the maximum allowable SWL of each equipment as shown in **Table 5-7**, which should not be exceeded in order to comply with the fixed plant noise assessment criteria, are presented in table below and detailed in [Appendix 5.2](#).

Table 5-7 Maximum Allowable SWL for the Equipment

Fixed Plant	Maximum Allowable SWL, dB(A)
Cooling Tower (R/F)	80
Variable Refrigerant Volume (“VRV”) (R/F)	68
Chiller / Primary Air-handling Unit (“PAU”) / Pump (G/F to 3/F)	72
Exhaust Fan (G/F to R/F)	68

- 5.7.6. It is anticipated that there should be no sudden change in noise levels at various floor levels at all the NAPs. The predicted maximum fixed plant noise levels at the NAPs at representative floors (high, mid and low zones) complied with both day/ evening time and night-time fixed plant noise assessment criteria.
- 5.7.7. If there is any change in design information during detailed design stage or fitting-out stage, the design of fixed plant should be reviewed by the Engineer/ Contractor to ensure that both the *NCO* and fixed plant noise criteria at the NSRs will be met in the future.

Table 5-8 Summary of Predicted Fixed Plant Noise Levels at NAPs

NAP ID	Level	Assessment Height (mPD)	Predicted Maximum Noise Level, $L_{eq}(30mins)$ dB(A)	Noise Criteria, $L_{eq}(30mins)$ dB(A)		
			Night-time	Day-time	Evening	Night-time
NAP 101	G/F	32	44	58	57	50
	1/F	38	44			
NAP 102	G/F	32	44	58	57	50
	1/F	38	44			
NAP 201	G/F	32	42	58	57	50
	1/F	38	42			
NAP 301	1/F	22	34	60	60	50
	7/F	38	35			
	14/F	60	37			
NAP 401	1/F	22.5	38	60	60	50
	6/F	38	41			
	13/F	61	42			
NAP 501	1/F	23	46	60	60	50
	6/F	37	47			
	13/F	59	49			
NAP 601	1/F	23	49	60	60	50
	6/F	36.5	50			
	13/F	58	47			

NAP ID	Level	Assessment Height (mPD)	Predicted Maximum Noise Level, L_{eq} (30mins) dB(A)	Noise Criteria, L_{eq} (30mins) dB(A)		
			Night-time	Day-time	Evening	Night-time
NAP 701	G/F	20	36	58	57	50
	3/F	32	37			
	6/F	44	37			

5.8. PROPOSED MITIGATION MEASURES

Construction Phase

5.8.1. Mitigation measures are required for the NSRs at which unmitigated construction noise levels are predicted to exceed the corresponding construction noise standards.

5.8.2. A number of available construction noise mitigation measures are proposed in this assessment, including:

- Selection and optimisation of construction programmes, such as avoidance of simultaneous operation of noisy PME, and/or reduction in the percentage on-time of PME;
- Use of Quieter Alternative Construction Equipment/ Methods;
- Use of quality powered mechanical equipment (QPME);
- Use of movable at-source noise mitigation measures such as movable noise barriers, noise enclosures, noise jacket and mufflers;
- Implementation of good site practices to limit noise from construction site; and
- Preparation of Construction Noise Management Plan before construction commencement.

Selection and Optimisation of Construction Programmes

5.8.3. The timing and sequencing of the various construction activities shall be carefully arranged according to the actual site work situation, in order to limit the amount of concurrent activities and where applicable, to avoid simultaneous operation of noisy PME in order to minimise the total noise generated during the construction periods. Limiting the quantity of PME to be operated concurrently and also the percentage on-time of PME were recommended in the Project and incorporated in this assessment. The proposed quantity of PME and their percentage on-time were confirmed feasible by the Project Proponent.

Use of Quieter Alternative Construction Equipment/ Methods

5.8.4. Construction methods have been carefully reviewed and studied to minimize potential impact to the nearby NSRs. The construction options are studied on the basis of the site constraints and previous site investigation information.

- 5.8.5. For site preparation works, hydro-demolition will be adopted as far as practicable for the removal of existing carpark slab.
- 5.8.6. For the foundation method, percussive piling which would induce a relatively high disturbance in terms of noise level and vibration will not be adopted. Instead, socketed steel H-piling will be adopted, which will generate less noise and vibration. Precautions to minimize disturbance to vibration sensitive equipment will be carefully considered before commencement of works. Hydraulic press-in piling method will not be used for the Project, as it is to be used for sheet piling while no such works will be carried out.
- 5.8.7. For the main building construction, as mentioned in chapter 3, innovative construction methods are encouraged in the Project. Localised precast concrete construction will be adopted (e.g. precast staircase) to minimize in-situ work. Reinforced concrete MiC by fully making use of Building Information Modelling (BIM) tool will be adopted where applicable for staff offices, rest rooms, lavatories and pantries at 2/F and 3/F. It will be sub-divided into pre-finished modules with building services provisions by means of off-site prefabrication.
- 5.8.8. The use of self-compacting concrete (SCC) as an alternative to conventional concrete works with vibratory poker, non-explosive chemical expansion agent, bursting system is studied. For this particular case, reinforced concrete MiC will be used. In view of the works nature of the Project, SCC will not to be adopted, and there is no work involving non-explosive chemical expansion agent, bursting system. It is of limited use for this project, and thus not to be adopted.
- 5.8.9. The possibility of adopting various construction methods to minimise the potential impact had been reviewed based upon the latest available information during the course of this EIA study by the Project Engineer and ArchSD. It is confirmed that the proposed quieter construction equipment and methods are practicable and will be used in the construction of project. In order to further reduce the potential impact, the Contractor is required to carry out detailed construction noise impact assessment with mitigation proposal before commencement of construction/ demolition. The detailed construction noise impact assessment with mitigation proposal shall take into consideration of the available technology and updated site conditions, and show the compliance of noise criteria. Such requirements will be stated in the tender specification.

Use of QPME

- 5.8.10. QPME is defined as a PME having actual SWL lower than the value specified for PME in the GW-TM. SWLs for typical PMEs provided in the GW-TM and that for equivalent QPME are presented in **Table 5-9**.
- 5.8.11. The use of QPME can result in reduction in noise levels. It is possible to further reduce the noise impact by adopting quiet working methods and specifying maximum SWL for specific plant equipment.
- 5.8.12. The QPME adopted in this assessment is for reference only and to be confirmed by the Contractor, in view of the actual construction conditions and programmes. Whilst QPME are listed, the Contractor may be able to obtain particular models of plant that are quieter

than the QPMEs listed. The associated mitigation measures to the particular PME should be reviewed by the Contractor.

Table 5-9 SWLs for Selected QPME

Identification Code in GW-TM	Description	SWL in GW-TM, dB(A)	Example in QPME List from EPD	SWL of QPME, dB(A)
CNP 081	Excavator/ loader, wheeled/ tracked	112	QPME EPD-12392	92
CNP 101	Generator, Standard	108	QPME EPD-12580	88
CNP 025	Breaker, hand-held, mass \geq 20kg and \leq 35kg	111	QPME EPD-12553	99
CNP 003	Air compressor, air flow $>$ 30m ³ /min	104	QPME EPD-12191	94
CNP 048	Crane, mobile/barge mounted (diesel)	112	QPME EPD-05808	92

Use of Movable Noise Barriers

- 5.8.13. Movable noise barrier is very effective in screening noise from construction plant. Noise barrier located close to a PME can produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant provided that the direct line-of-sight of the PME is blocked. Subject to site condition, the noise barriers should be placed near to the construction plant as far as practical.
- 5.8.14. Barrier material of surface mass in excess of 10 kg/m² is recommended to achieve the maximum screening effect. The Contractor shall be responsible for the design of the movable noise barrier with due consideration given to the size of the PME and the requirement of intercepting the line-of-sight of the PME, as well as ensuring that the barrier should have no openings and gaps.

Implementation of Good Site Practices

- 5.8.15. Good site practices and noise management can provide considerable reductions in noise impact of the site activities. The following practices should be followed while carrying out construction works for the Project:
- Use only well-maintained and regularly-serviced plant during the works;
 - Turn off or throttle down the plant in intermittent use to a minimum;
 - Orient the plant known to emit noise strongly in one direction to face away from the NSRs;
 - Use silencers, mufflers and enclosures for plant where possible and maintain properly throughout the works;
 - Site fixed plant as far away from NSRs as possible; and

- Use stockpiles of excavated materials and other structures such as site buildings effectively to screen noise from the works.

Summary of Proposed Key Mitigation Measures for Construction Noise Impact

- 5.8.16. The proposed key mitigation measures to minimize construction noise impact are summarized in **Table 5-10** below.

Table 5-10 Key Mitigation Measures for Construction Noise Impact

Key Mitigation Measures for Construction Noise	Details
Site Preparation and Road Works	<ol style="list-style-type: none"> 1. Use of QPME 2. Quiet construction method: hydro-demolition for removal of slab 3. Use of movable noise barrier 4. Good site practices
Foundation	<ol style="list-style-type: none"> 1. Use of QPME 2. Quiet Construction method: socketed steel H-piling 3. Use of movable noise barrier 4. Good site practices
Main building construction (including refurbishment of the Red House)	<ol style="list-style-type: none"> 1. Use of QPME 2. Quiet Construction method: Precast concrete construction/ MiC 3. Use of movable noise barrier 4. Good site practices

Operation Phase

Fixed Plant Noise – MVAC equipment and other fixed noise sources

- 5.8.17. With reference to “Good Practices on Ventilation System Noise Control” (GP-VS), acoustic treatments, such as acoustic louvres, silencers and enclosures, could be applied to achieve noise attenuation. Prior to the operation phase of the Project, as part of the design process, commissioning test should be conducted to ensure the fixed plant noise shall comply with relevant noise criteria and such requirement should be included in the tender document and/or specification.
- 5.8.18. A regular plant maintenance programme should be developed and implemented so that equipment is properly operated and serviced in order to maintain a controlled level of noise. The programme should be implemented by trained personnel.

5.9. ASSESSMENT OF NOISE IMPACT WITH THE APPLICATION OF MITIGATION MEASURES***Construction Phase***

- 5.9.1. Construction noise calculation was carried out with the incorporation of different noise mitigation measures as discussed in *Section 5.8*, as far as practicable according to the actual construction condition and limitation.
- 5.9.2. **Table 5-11** summarises the predicted construction noise levels due to the Project at NAPs under mitigated scenario. The detailed calculations are shown in [Appendix 5.4](#).

Table 5-11 Predicted Construction Noise Levels at Representative NAPs under Mitigated Scenario due to the Project

NAP ID	Description	ANL, dB(A)	Predicted Construction Noise Level, dB(A)		
			Site Preparation and Road Works	Excavation and Foundation	Construction of Annex Block and Refurbishment of Red House
NAP 101	HKO Quarters No.2 (Within HKOHQ)	75	68 - 73	71 - 75	70 - 75
NAP 102	HKO Quarters No.3 (Within HKOHQ)	75	66 - 71	69 - 73	68 - 73
NAP 201	HKO Quarters No.1 (Within HKOHQ)	75	66 - 71	69 - 73	68 - 73
NAP 301	King's Mansion	75	56 - 61	59 - 63	58 - 63
NAP 401	New Knutsford House	75	62 - 67	65 - 69	64 - 69
NAP 501	Lok Fun Mansion	75	68 - 73	71 - 75	70 - 75
NAP 601	Carlton Building	75	65 - 70	68 - 72	67 - 72
NAP 701	St. Andrew's Church	70	57 - 62	60 - 64	59 - 64

Notes:

[1] Construction noise criteria for all domestic premises and churches are 75 dB(A) and 70 dB(A) respectively.

[2] Noise levels exceeding the construction noise criteria are **bolded**.

- 5.9.3. The predicted construction noise levels with mitigation measures at all the representative NSRs shall comply with the construction noise standards.
- 5.9.4. Noise mitigation measures as proposed in *Section 5.8* are recommended to be implemented as far as practicable in order to minimise the potential construction noise impact associated with the Project.

Operation Phase**Fixed Plant Noise**

- 5.9.5. With the MVAC and other fixed noise sources properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, no adverse fixed noise impact is anticipated.

5.10. RESIDUAL IMPACTS

Construction Phase

- 5.10.1. With the implementation of the recommended noise mitigation measures, the predicted construction noise levels at the NSRs would comply with the noise criteria set out in EIAO-TM and thus, no residual impact is anticipated.

Operation Phase

- 5.10.2. With the MVAC and other fixed noise sources properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, no adverse fixed noise impact is anticipated.

5.11. ENVIRONMENTAL MONITORING AND AUDIT

Construction Phase

- 5.11.1. Noise monitoring at the nearby NSRs during the construction phase of the Project is recommended. Environmental monitoring and audit (EM&A) programme is proposed to be established to ensure the implementation of mitigation measures as well as a noise complaint handling mechanism. Details of the programme are provided in a stand-a-lone EM&A Manual. A CNMP shall be prepared and checked by Certified Noise Modelling Professional recognized by the Hong Kong Institute of Qualified Environmental Professionals (HKIQEP) or equivalent, so that both the verification of the plant inventory, and the assessment of the effectiveness and practicality of all identified mitigation measures for mitigating the construction noise impact of the Project, would be performed during the design, tendering and construction stage of the Project. A clear method statement of all the recommended mitigation measures for controlling the construction noise impacts should be formulated in the CNMP(s) to be prepared by future Contractors, such that all the recommended mitigation measures will be implemented and executed properly.

Operation Phase

- 5.11.2. With the implementation of the recommended noise mitigation measures and use of a set of specified maximum SWLs for the MVAC equipment and other fixed noise sources, no adverse impact is expected during the operation phase. Noise monitoring during the operation phase of the Project is considered not necessary.

5.12. CONCLUSION

Construction Phase

- 5.12.1. With the implementation of the recommended mitigation measures such as the use of QPME, limiting the number of construction plants operating concurrently, using movable noise barriers and adopting good site practices, adverse construction noise impact is not anticipated at all representative NSRs. It is recommended that more detailed construction planning, which includes the arrangement on work sequence and plant locations, etc. before actual

construction work is undertaken by the Contractor, and practicable noise mitigation measures should be implemented according to the actual site condition and constraints, in order to reduce the construction noise impact.

- 5.12.2. Environmental monitoring and auditing procedures are recommended in EM&A Manual to ensure the implementation of construction noise mitigation measures as well as to establish a noise complaint handling mechanism.

Operation Phase

- 5.12.3. With the implementation of the mitigation measures for the MVAC and other fixed noise sources properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, adverse fixed noise impact on the NSRs is not anticipated during operation phase.

[This page is intended to be blank]