

5. Noise Impact Assessment

5.1 Introduction

This section presents an assessment of the potential noise impacts associated with the construction and operation phases of the Project. Recommendations for mitigation measures have been made, where necessary, to reduce the identified noise impacts to an acceptable level.

5.2 Environmental Legislation, Standards and Guidelines

5.2.1 Construction Phase

Control over the generation of construction noise in Hong Kong is governed by the Noise Control Ordinance (NCO) and the EIAO and their subsidiary requirements. Various Technical Memoranda (TMs) have been issued under the NCO and the EIAO to stipulate criteria and control approaches. 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)

5.2.1.1 General Construction Activities during Non-Restricted Hours

Noise impact 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 5.1** below.

Table 5.1: Noise Standards for Daytime Construction Activities

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

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

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

5.2.1.2 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 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 GW-TM under the NCO.

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.

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.

5.2.2 Operation Phase

5.2.2.1 Fixed Plant Noise

For the fixed plant noise assessment, the Acceptable Noise Levels (ANLs) for the Noise Sensitive Receivers (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 5.2**. Industrial area, major road or the area within the boundary of Hong Kong International Airport shall be considered to be an IF.

Table 5.2: 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

Fixed plant noise is controlled under the NCO and shall comply with the ANLs laid down in the Table 2 of the IND-TM. For a given ASR, the ANL, in dB(A), is given by **Table 5.3**.

Table 5.3: Acceptable Noise Level for Fixed Plant Noise

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

Time Period	Area Sensitivity Rating		
	A	B	C
Night (2300 to 0700 hours)	50	55	60

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

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

According to **Table 5.2**, the ASR of the Project site shall be “A”. The noise criteria of the fixed plant noise at different locations of the Project are summarised in **Table 5.4** below.

Table 5.4 Noise Criteria of Fixed Plant Noise

NSR ID.	Time Period	ANL – 5, dB(A)	Location ID of Background Noise	Background Noise Level, dB(A)*	Fixed Plant Noise Criteria, dB(A)
N1 & N2	Daytime	55	A	53	53
	Evening Time	55	A	55	55
	Night-time	45	A	54	45
N3	Daytime	55	A	53**	53
	Evening Time	55	C	48	48
	Night-time	45	C	48	45
N4 & N5	Daytime	55	B	50	50
	Evening Time	55	B	51	51
	Night-time	45	B	51	45

Notes: (*) Refer to Table 5.6 for the background noise measurement results.

(**) Point A daytime noise measurement result has been used. Please refer to Table 5.6 for details.

5.3 Study Area and Sensitive Receivers

5.3.1 Study Area

In accordance with Clause 3.4.5.2 of the EIA Study Brief, the Study Area is defined as within 300m of the site boundary of the Project for noise impact assessment. The Study Area has been identified and is shown in **Figure 5.1**.

5.3.2 Noise Sensitive Receivers (NSRs)

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 earmarked 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 and any land use and development applications approved by the Town Planning Board.

There are numerous scattered village houses situated along the proposed site area which are identified as NSRs. For the purpose of noise assessment, the first layer of houses of each village located close to the site boundary have been selected as assessment points/ identified representative NSRs within the Study Area for prediction of the noise impact levels.

A summary of all selected existing and planned representative NSRs for assessment is tabulated in **Table 5.5**. Locations and photos of representative NSRs are shown in **Figure 5.1** and **Figure 5.2** respectively.

Table 5.5: Representative Noise Sensitive Receivers Identified for the Assessment

NSR ID	Description	Existing / Planned	Use	No. of Storeys (Sensitive use only)	Construction Phase	Operation Phase
N1	Village House No. 308, Sha Ling	Existing	Residential	1	✓	✓
N2	Village House No. 319, Sha Ling	Existing	Residential	2	✓	✓
N3	Village House No. 265, Sha Ling	Existing	Residential	1	✓	✓
N4	Village House in Sha Ling	Existing	Residential	1	✓	✓
N5	Planned residential development in Kong Nga Po Comprehensive Development Area	Planned	Residential	3	✗	✓

5.4 Description of the Existing Environment

The Project will be located at Sha Ling in the North District, within the Frontier Closed Area. Part of the Project site is currently occupied by Sha Ling Livestock Waste Composting Plant. It will be decommissioned and replaced by the proposed Organic Waste Treatment Facility Phase 2 (OWTF2).

The major land uses in the close vicinity of the Project site comprises scattered village houses. The Project site is located adjacent to the Man Kam To Road and Kong Nga Po Road that have low traffic flows. The existing noise environment for the study area is dominated by low level of traffic noise from Man Kam To Road and Kong Nga Po Road.

5.5 Background Noise Condition

Noise surveys were carried out on 4 July 2012 to investigate the background noise condition of the surrounding environment and the Project site. The baseline noise measurement locations are shown in **Figure 5.1**.

Three noise measurements were conducted in the vicinity of the Project site. The noise measurements were undertaken using Type 1 sound level meters, namely Rion NL-31. The sound level meters were set at 1.2m above ground in free-field condition. Insect noise was recorded during evening and night-time periods at location A and B. For each measurement set, 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 the noise measurement. The measurements were accepted as valid only if the calibration levels before and after the noise measurement agreed to within 1.0 dB(A). The sound level meters and acoustic calibrators are calibrated at accredited laboratories annually to ensure reliable performance. The measurement results are shown in **Table 5.6**.

Table 5.6: Measured Background Noise Levels

Location ID	Location Description	Time Period	Start Time	*Measured Noise Level in L_{eq} (15min), dB(A)	Corrected Facade Noise Level, dB(A)
A	Next to village house No. 308, Sha Ling	Daytime (0700 – 1900)	15:07	49.9	52.9
		Evening Time (1900 – 2300)	19:50	51.5	54.5
		Night-time (2300 – 0700)	23:05	51.1	54.1
B	Next to village house identified as NSR N4 in Sha Ling	Daytime (0700 – 1900)	11:28	46.5	49.5
		Evening Time (1900 – 2300)	20:54	47.9	50.9
		Night-time (2300 – 0700)	00:08	47.6	50.6
C	Middle of access road to the site of proposed organic waste treatment facilities	Daytime (0700 – 1900)	12:12	55.3	58.3**
		Evening Time (1900 – 2300)	21:50	45.0	48.0
		Night-time (2300 – 0700)	01:12	45.0	48.0

Note (*): All background noise measurements were free-field measurement.

(**): Daytime background noise measurement at Location C has been affected by road traffic noise. Location A daytime background noise level has been used at NSR N3 since two locations has similar daytime noise environment.

5.6 Assessment Methodology

5.6.1 Construction Phase

5.6.1.1 Construction Airborne Noise

The assessment approach to the noise impact assessment is in line with the Guidance Note “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 summarised below:

- Assume a typical construction schedule/programme;
- Assume a typical project-specific equipment inventory for each work stage together with the number of equipment;
- Obtained from GW-TM, the SWL for each PME assumed in the equipment inventory;
- Select representative NSRs for the construction noise impact assessment;
- Calculate the unmitigated Predicted Noise Level (PNL) and correct it for facade reflection to obtain the Corrected Noise Level (CNL) at the representative NSRs;
- If necessary, re-select typical project-specific silenced equipment and calculate the mitigated noise impact;
- 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):

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

where

SPL: Sound Pressure Level in dB(A)

SWL: Sound Power Level in dB(A)

DC: Distance Attenuation in dB(A) = $20 \log D + 8$ [where D is the distance between NSR and noise source in m]

FC: Facade Correction in dB(A) = +3 dB(A)

5.6.2 Operation Phase

5.6.2.1 Fixed Plant Noise

The noise criteria for the assessment has been firstly defined for the assessment. In accordance with Annex 5 of the EIAO-TM, the noise criteria for fixed plant noise assessment shall be either

- 5 dB(A) below the appropriate Acceptable Noise Levels (ANL) shown in Table 2 of the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites, or
- the prevailing background noise levels (for quiet areas with level 5 dB(A) below the ANL).

Given that the Project will be developed in a quiet rural environment, background noise measurements were carried out for comparison with the ANL in establishing the noise criteria.

In the absence of detailed information and noise specification for fixed plant, the maximum permissible noise emission levels at the proposed fixed plant are determined instead for a proposed worst case design for fixed plant.

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

The calculation methodology is estimated with the following standard formula (2):

$$\text{SPL} = \text{Max SWL} - \text{DC} + \text{FC} \quad (2)$$

where

SPL: Sound Pressure Level in dB(A)

Max SWL: Maximum Permissible 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)

If the noise sources do not fall within the view angle of the representative NSR under assessment or are completely blocked by the residential blocks/ buildings, it is assumed that these noise sources are insignificant to that NSR and would be excluded from calculation. When the sources fall within the view angle of the NSR but with no direct line of sight to the opening, 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 is repeated for other representative NSRs for exceedance in the noise criteria until all corrected SPLs at the representative NSRs meet the noise criteria. The maximum permissible SWLs of the ventilation openings will then be predicted.

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

5.7 Identification of Potential Noise Impact

5.7.1 Construction Phase

5.7.1.1 Construction Noise Impact

The potential source of noise impact during the construction phase of the Project is from the use of PME for various construction activities, including demolition and removal of the existing above ground structures of the Sha Ling Livestock Waste Composting Facility, construction of superstructure for the waste reception and pre-treatment, composting facility, administration building and environmental education centre, the installation of treatment facilities including, processing and pre-treatment equipment, digesters, gas storage tank, and facilities for wastewater treatment, emissions/odour treatment, auxiliary facilities for biogas processing, utilisation and transmission etc. PME likely to be used at the OWTF 2 site include breakers, cranes, lorries and other vehicles, air compressors, and generators etc.

Under normal conditions, construction activities for the Project would be carried out during non-restricted hours (0700 – 1900 hours) on normal working days. In the case of any activities that have to be carried out during restricted hours, it is the Contractor's responsibility to ensure compliance with the NCO as well as the relevant TMs. The Contractor will be required to submit application for the CNP and abide by the conditions set out by the Noise Control Authority. For carrying out of any general construction activities involving the use of any 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 GW-TM under the NCO.

5.7.1.2 Cumulative Noise Impact

Construction of the OWTF 2 is expected to commence in the first quarter of 2015. Based on current available information, the proposed/committed projects that may have cumulative impacts during the construction phase of the Project include:

- Cement Mixer Plant;
- Proposed Man Kam To Development Corridor;
- Columbarium, Crematorium and related facilities at Sandy Ridge Cemetery as recommended under the "Land Use Planning for the Closed Area Feasibility Study";
- Proposed comprehensive development on Kong Nga Po Road;
- Proposed residential development in Hung Lung Hang; and
- If biogas export to the gas grid is considered, construction of a 200mm diameter biogas pipeline.

Where construction programmes are known, cumulative assessment has been conducted. However, projects identified are generally in early development (recommended or feasibility) and there is currently no

information available regarding the construction programme and plant to be used in these projects. These projects are therefore not assessed in this EIA and would need to be included in studies conducted by the project proponent.

OWTF 2 will include construction of a rising main to transfer sewage flows to the existing Sha Ling pumping station, minor modification of the access road to accommodate swept path of RCVs accessing the site, and may include construction of a gas pipeline connection running from the site along the Kong Nga Po road to the existing NENT Landfill / Tai Po Synthetic Natural Gas (SNG) pipeline. The construction noise impact associated with such construction activities have been assessed with worst case scenario assumed for construction noise impact assessment.

5.7.2 Operation Phase

5.7.2.1 Operation Noise Impact

During the operation phase of the Project, potential noise impact is from the operation of proposed fixed plant including shredders, screw pumps, mixers and power generation systems, etc. Since all waste reception, pre-treatment, digestion and post-treatment activities will be undertaken in enclosed buildings, the potential fixed plant noise impact should be minimal.

5.7.2.2 Cumulative Noise Impact

Operation of the OWTF 2 is expected to commence in 2017. Based on current available information, the proposed/committed projects that are anticipated to have cumulative effects during the operation phase of the Project include:

- Cement Mixer Plant;
- Proposed Man Kam To Development Corridor;
- Columbarium, Crematorium and related facilities at Sandy Ridge Cemetery as recommended under the "Land Use Planning for the Closed Area Feasibility Study";
- Proposed comprehensive development on Kong Nga Po Road; and
- Proposed residential development in Hung Lung Hang.

Projects identified are in early development (recommended or feasibility) and there is currently no information regarding the development program or emissions these projects may produce. Therefore, they are not assessed in this EIA and would need to be included in studies conducted by the project proponent.

5.8 Prediction and Evaluation of Noise Impact

5.8.1 Construction Noise Impact

The type and quantity of Powered Mechanical Equipment (PME) likely to be used for this Project and their Sound Power Levels (SWLs) are shown in **Appendix 5.1**. Confirmation of the validity of the inventory was provided by the Project Proponent (EPD) by email correspondence on 24 January 2013.

To minimise the construction noise impact, construction methods to avoid use of percussive piling and blasting such as bored piling have been adopted.

The predicted noise levels are presented in **Table 5.7**. Details of the construction noise impact at the representative NSRs are shown in **Appendix 5.2**.

Table 5.7: Unmitigated Construction Airborne Noise Impact

NSR ID	Use	Predicted Noise Level dB(A)	Noise Criteria dB(A)	Exceedance of Noise Criteria?	Mitigation Measure required?
N1	Residential	75 - 86	75	Yes	Yes
N2	Residential	74 - 85	75	Yes	Yes
N3	Residential	81 - 88	75	Yes	Yes
N4	Residential	76 - 86	75	Yes	Yes

Remarks: **Bold** figure denotes exceedance of relevant noise criteria.

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.

5.8.2 Operational Stage Noise

According to the preliminary design information, noise from fixed plant of the Project would mainly be associated with the above ground ventilation openings and fixed plant. The identified major fixed plant noise sources are summarised in **Table 5.8** and the corresponding locations are shown in **Figure 5.3**.

Table 5.8: Summary of Fixed Plant Noise Sources

Fixed Noise Source	Existing/Planned	Number of Source Facade	Opening ID
Inlet Air Louver of Maturation, Screening, Storage Building	Planned	4	FS1, FS2, FS8 and FS9
Inlet Air Louver of Tunnels Building	Planned	3	FS3, FS4 and FS5
Inlet Air Louver of Compositing System and Waste Water Treatment Building	Planned	2	FS6 and FS7
Inlet Air Louver of Separator (Upper Level)	Planned	3	FS10, FS11 and FS12
Inlet Air Louver of Reception Zone within OWTF	Planned	3	FS13, FS14 and FS15
Inlet Air Louver of Pre-treatment Building	Planned	4	FS16, FS17, FS18 and FS19
Inlet Air Louver of CHP / Boiler	Planned	4	FS20, FS21, FS22 and FS23

Based on the methodology mentioned in **Section 5.6.2.1**, the maximum permissible SWLs of the proposed fixed plants during daytime and night-time are predicted as summarised in **Table 5.9** below.

Table 5.9: Maximum Permissible SWLs of the Fixed Plant

Fixed Noise Source	Source ID	Maximum Permissible SWL, dB(A) ^{[1][2]}		
		Daytime	Evening Time	Night time
Inlet Air Louver of Maturation, Screening, Storage Building	FS1	90	84	80
Inlet Air Louver of Maturation, Screening, Storage Building	FS2	90	84	80
Inlet Air Louver of Tunnels Building	FS3	90	84	80
Inlet Air Louver of Tunnels Building	FS4	90	84	80

Fixed Noise Source	Source ID	Maximum Permissible SWL, dB(A) ^{[1][2]}		
		Daytime	Evening Time	Night time
Inlet Air Louver of Tunnels Building	FS5	90	84	80
Inlet Air Louver of Compositing System and Waste Water Treatment Building	FS6	90	84	80
Inlet Air Louver of Compositing System and Waste Water Treatment Building	FS7	90	84	80
Inlet Air Louver of Maturation, Screening, Storage Building	FS8	90	84	80
Inlet Air Louver of Maturation, Screening, Storage Building	FS9	90	84	80
Inlet Air Louver of Separator (Upper Level)	FS10	88	84	81
Inlet Air Louver of Separator (Upper Level)	FS11	88	84	81
Inlet Air Louver of Separator (Upper Level)	FS12	88	84	81
Inlet Air Louver of Reception Zone within OWTF	FS13	86	82	79
Inlet Air Louver of Reception Zone within OWTF	FS14	86	82	79
Inlet Air Louver of Reception Zone within OWTF	FS15	86	82	79
Inlet Air Louver of Pre-treatment Building	FS16	86	80	79
Inlet Air Louver of Pre-treatment Building	FS17	86	80	79
Inlet Air Louver of Pre-treatment Building	FS18	86	80	79
Inlet Air Louver of Pre-treatment Building	FS19	86	80	79
Inlet Air Louver of CHP / Boiler	FS20	84	82	80
Inlet Air Louver of CHP / Boiler	FS21	84	82	80
Inlet Air Louver of CHP / Boiler	FS22	84	82	80
Inlet Air Louver of CHP / Boiler	FS23	84	82	80

Remarks: [1] Correction factor for tonality, impulsiveness and intermittency have not included in the maximum permissible SWL.

[2] If the SWL cannot be adjusted during normal operation, the lowest maximum permissible SWL should be adopted as the design criteria.

With the adoption of the proposed maximum permissible SWLs of the proposed fixed plant, the fixed plant noise impacts to the surrounding NSRs are presented in **Appendix 5.3**. The impact noise levels at all selected NSRs complied 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.

5.9 Mitigation of Adverse Noise Impact

5.9.1 Construction Noise

Mitigation measures for construction activities are detailed below. 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; and
- use of noise insulating fabric.

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.

Selection of Quieter 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 is defined as QPME 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 a British Standard, namely *Noise Control on Construction and Open Sites, BS 5228: Part 1: 2009* and EPD's QPME Inventory are presented in **Table 5.10**. It should be noted that various types of silenced equipment can be found in Hong Kong.

Table 5.10: Quieter PME Recommended for Adoption during Construction Phase

PME	Power rating/size, weight	Reference	SWL, dB(A)
Asphalt paver	92kW	BS5228 Table D8-24	101
Bulldozer	200kW	BS5228 Table D9-2	104
Hydraulic breaker, Excavator mounted	52kW	BS5228 Table D8-12	106
Compactor, vibratory	2.2kW	EPD-00054	102
Concrete lorry mixer	6m ³	BS5228 Table D6-23	100
Concrete pump	100kW	BS5228 Table D6-36	106
Dump truck	50t	BS5228 Table D9-39	103
Excavator, wheeled/tracked	112.5kW	EPD-01230	99
Mobile crane	62kW	BS5228 Table D7-114	101
Road roller	62kW	EPD-00223	99
Vibratory Poker, handheld	0.75kW each poker	BS5228 Table D6-40	98

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 5.4**.

Use of Noise Enclosure/ Acoustic Shed

The use of noise enclosure or acoustic shed is to cover stationary PME such as air compressor and generator. 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 5.5**.

Use of Noise Insulating Fabric

Noise insulating fabric can also be adopted for certain PME (e.g. piling 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 5.11**.

Table 5.11 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
Piling, diaphragm wall, bentonite filtering plant	Noise insulating fabric	10
Piling, diaphragm wall, hydraulic extractor	Noise insulating fabric	10
Bar bender and cutter	Movable noise barrier	10
Hand-held breaker	Movable noise barrier	10
Hydraulic breaker	Movable noise barrier	10
Concrete pump, lorry mounted	Movable noise barrier	10
Saw, circular, wood	Movable noise barrier	10
Bulldozer	Movable noise barrier	5
Compactor, vibratory	Movable noise barrier	5
Hand-held drill/grinder	Movable noise barrier	5
Excavator, wheeled/tracked	Movable noise barrier	5
Poker, vibratory, hand-held	Movable noise barrier	5
Lorry, with crane/grab, 5.5 tonne < gross vehicle weight ≤ 38 tonne	Movable noise barrier	5

These noise barriers should be free of gaps and made of materials having a surface mass density in excess of 7 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.

Use of quieter plants, movable barriers, enclosures and noise insulating fabric are common noise mitigation measures in construction sites. Therefore, negative side effects or constraints associated with the proposed measures are not anticipated.

The effect of the use of quieter plant, movable barriers, enclosures and noise insulating fabric has been investigated for practicable construction activity. The predicted results are presented in **Table 5.12**. Mitigated Construction Plant Inventory and details of the mitigated construction noise impact are shown in **Appendix 5.4** and **Appendix 5.5** respectively.

Table 5.12: Mitigated Construction Airborne Noise Impact

NSR ID	Use	Predicted Noise Level dB(A)	Noise Criteria dB(A)	Exceedance of Noise Criteria?	Residual Noise Impact?
N1	Residential	64 - 74	75	No	No
N2	Residential	63 - 73	75	No	No
N3	Residential	68 - 75	75	No	No
N4	Residential	65 - 74	75	No	No

With the incorporation of quieter plant, movable barriers, enclosures and noise insulating fabric, the results indicate that the mitigated noise impact associated with the construction of the Project would comply with the daytime construction noise criterion at all representative NSRs. Therefore, significant construction noise impact is not anticipated.

5.9.2 Operational Noise

With the fixed plant designed to meet the maximum SWL listed in **Table 5.9**, there would not be any residual impacts predicted. However, it is still recommended that the following noise reduction measures shall be considered as far as practicable during construction:

- 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/louver 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 completely separate building;
- Install direct noise mitigation measures including silencers, acoustic louvers and acoustic enclosure where necessary; and
- 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.

5.10 Evaluation of Residual Impact

With the implementation of proposed mitigation measures, no exceedance of noise impact during either construction or operation phase was predicted at the representative NSRs. Hence, no residual impact is anticipated. No planned noise sensitive uses have noise impact with the proposed practicable direct technical remedies in place. Therefore it is predicted that there is no constraint on planned noise sensitive development/land uses from this Project.

5.11 Environmental Monitoring and Audit

5.11.1 Construction Phase

Given that unmitigated construction noise impact is predicted during the construction phase and to ensure that the nearby NSRs will not be subjected 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 are described in the separate EM&A Manual.

5.11.2 Operation Phase

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

It is predicted that there will be no adverse noise impact generated from the operation of the Project, hence no environmental monitoring and audit is proposed.

5.12 Conclusion

5.12.1 Construction Phase

Assessments have been based on the latest available information. With the implementation of the mitigation measures in form of quiet plant, movable noise barrier/ enclosure and noise insulating fabric, the construction noise levels at all representative NSRs are predicted to comply with the noise standards stipulated in the EIAO-TM. Significant and residual construction noise impacts are therefore not anticipated from this Project.

5.12.2 Operation Phase

The assessment assumes a worst case condition. Noise impact from planned fixed plant can be confirmed to be effectively mitigated by implementing noise control measure at source during the detailed design stage. With the adoption of the proposed maximum permissible SWLs of the proposed fixed plant, the impact noise levels at all selected NSRs complies with the relevant noise criteria for the daytime, evening time and night time periods. Therefore, significant fixed plant noise impact to the existing and planned NSRs is not anticipated.