

# 5. Noise Impact Assessment

# 5.1 Introduction

This section presents the assessment of the potential noise impacts associated with the construction and operation phases of the Project. Noise generated from various construction activities is the primary concern during the construction phase. Fixed plant noise from ventilation shafts is the major noise impact during operation phase. Representative Noise Sensitive Receivers (NSRs) 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.

# 5.2 Environmental Legislation, Standards and Guidelines

# **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 form 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)

## General Construction Activities during Non-Restricted Hours

Noise impacts arising from general construction activities other than percussive piling during the daytime period (0700 - 1900) 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 Use	0700 to 1900 hours on any day not being a Sunday or general holiday, L <sub>eq (30 min)</sub> , dB(A)					
All domestic premises including temporary housing accommodation	75					
Hotels and hostel						
Educational institutions including kindergarten,	70					
nurseries and all others where unaided voice communications is required	65 during examination					
Source: EIAO-TM. Annex 5. Table 1B – Noise Standards for Davtime 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 1 m 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

#### General Construction Activities during Restricted Hours

Noise impacts arising from general construction activities (excluding percussive piling) conducted during the restricted hours (1900-0700 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 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 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.

## **Operation Phase**

## 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 5.2**.



#### Table 5.2: Relevant Road Traffic Noise Standards for Planning Purposes

Uses	Road Traffic Noise Peak Hour Traffic L <sub>10 (1hour)</sub> , 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

#### Fixed Noise

For 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 5.3** below. Industrial area, major road or the area within the boundary of Project area shall be considered to be an IF.

#### Table 5.3: 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	А	В	В			
(ii) Low density residential area consisting of low- rise or isolated high-rise developments	А	В	С			
(iii) Urban area	В	С	С			
(iv) Area other than those above	В	В	С			

The ANLs laid down in the Table 2 of the IND-TM is shown in Table 5.4 below.

#### Table 5.4: Acceptable Noise Level for Fixed Noise Source

	Area Sensitivity Rating (ASR)				
Time Period	Α	В	С		
Day (0700 to 1900 hours)	- 60	6E	70		
Evening (1900 to 2300 hours)	- 60	CO	70		
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 criterion to be adopted is 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 identified NSRs (detailed in **Section 5.3**) are located in an urban area and next to the Po Chong Wan Industrial Area. According to **Table 5.3**, the ASRs of the identified NSRs VSA and HKJCC shall be "C" and "B" respectively. The noise criteria of the fixed plant noise at the identified NSRs are summarised in **Table 5.5** below. As mentioned in **Section 2.5**, the opening hours of the Project will be from 9 a.m. to 11 p.m. daily. Therefore, noise impacts after 11 p.m. is not anticipated and night-time assessment has been excluded.

NSR ID.	Time Period	ASR*	ANL-5, dB(A)	Background Noise Level, dB(A) <sup>#</sup>	Fixed Plant Noise Criteria
VSA	Daytime (0700 to 1900)	С	65	55	55
HKJCC	Daytime (0700 to 1900)	P	60	53	53
	Evening Time (1900 – 2300)	В	60	50	50

Table 5.5: Noise Criteria for Fixed Plant Noise

Notes: (\*) NSR "VSA" is within 100m of a zone designated as "Industrial" and NSR "HKJCC" is between 100 m and 250 m from "Industrial" zone.

(#) Background noise measurement results are shown in Appendix 5.1.

In any event, the ASR assumed in this EIA report is only indicative and if it is used for assessment only. It should be noted that the fixed noise sources are controlled under section 13 of the NCO. Therefore, the Noise Control Authority shall determine noise impact from concerned fixed noise sources on the basis of prevailing legislation and practices being in force, and taking account of contemporary conditions / situations of adjoining land uses. The assessment of fixed noise in this EIA report shall not bind the Noise Control Authority in the context of law enforcement against any of the fixed noise sources being assessed.

#### Noise from Open Air Entertainment Activity

Potential noise impact from open air entertainment activity is considered as fixed noise in this EIA report. Therefore, the noise standard for fixed noise sources as stipulated in Annex 5 of the EIAO-TM and described above will be adopted in assessing open air entertainment activity noise as well.



# 5.3 Assessment Area and Sensitive Receivers

## Study Area

The study area is defined as within 300 m of the site boundary of the Project for noise impact assessment. This study area is identified and shown in **Figure 5.1**.

In addition, in accordance with Clause 3.4.5.2 of the EIA Study Brief (ESB–261/2013), the study area is expanded to include NSRs at distances over 300m from the Project (i.e. Victoria Shanghai Academy and Hong Kong Juvenile Care Centre).

## Description of the Environment

Site visits were conducted in October 2013 to understand the existing environment in the vicinity of the Project area. The Project area is surrounded by areas slopes with residential, educational and industrial uses. The existing noise environment is dominated by marine traffic in Sham Wan and road traffic from Shum Wan Road and Nam Long Shan Road.

## Identification of Noise Sensitive Receivers

There are no NSRs in accordance with Annex 13 of the EIAO-TM within the 300 m assessment area. Existing, planned/committed noise sensitive developments and relevant uses 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 were also reviewed. The planned hotel developments will not rely on open window for ventilation (i.e., equipped with central air conditioning), and are therefore not considered as NSRs.

For the purpose of noise assessment and in accordance with Clause 3.4.5.2 of the EIA Study Brief, NSRs over 300m from the Project have been included in noise impact assessment

Descriptions and locations of all selected representative NSRs are shown in **Table 5.6** and **Figures 5.1** and **5.2**.

				Existing		<b>₁</b> st	۸	No	ise Impac	t Assessr	nent
No	NSR ID	Description	Use*	or Planned #	No. of Storeys^	Assessment Level (mPD)	R R	Constr- uction	Road Traffic	Fixed Plant	Open Air Entertai- nment
1	VSA	Victoria Shanghai Academy	E	E	7	10.5	С	$\checkmark$	V	V	$\checkmark$
2	HKJCC	Hong Kong Juvenile Care Centre	E	E	4	72.5	В	$\checkmark$	V	V	V
3	BC	Broadview Court	R	E	38	28.8	В		V		
4	SWC	South Wave Court	R	E	34	30.3	В		V		
5	WCH1	Planned Development on Wong Chuk Hang Station	R	Р	28	16.3	С		V		

#### Table 5.6: Representative Noise Sensitive Receivers

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		Depot (Tower 1)								
6	WCH2	Planned Development on Wong Chuk Hang Station Depot (Tower 13)	R	Ρ	29	16.7	С		$\checkmark$	
7	WCH3	Planned Development on Wong Chuk Hang Station Depot (Tower 9)	R	Ρ	35	17.9	C		$\checkmark$	
8	GG	Grandview Garden	R	E	25	36.7	С		V	

Note: \* Use: E = Educational, R = Residential # Existing/planned: E = Existing, P = Planned

^ Sensitive use only

# Background Noise Condition

Noise surveys were carried out in October 2013 and March 2014 to investigate the background noise condition of the surrounding environment and the Project area. Measurements were conducted on a weekday and Sunday, at relevant time periods, to provide a better representation of the background noise levels. The background noise measurement locations are shown in **Figure 5.3**.

Two 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 5.1**.

# 5.4 Identification of Pollutant Sources

# **Construction Phase**

The major construction activities of the Project will involve site formation, foundation and construction of main building. As mentioned in **Section 2.12**, the construction programme of the Project will not interface with other projects. Therefore, no cumulative construction noise impact has been assessed.

Off-site traffic of construction trucks may potentially cause noise impact on surrounding sensitive receivers. It is expected that a maximum of fifteen construction trucks per hour will be arriving or exiting the construction site via Wong Chuk Hang Road, Nam Long Shan Road, Shum Wan Road, Heung Yip Road and Police School Road. Construction programme of the Project is from year 2014 Q3 to year 2017 Q1, and the year with peak construction traffic to the Project area is identified to be year 2015.

The contribution to the existing heavily trafficked Wong Chuk Hang Road, Nam Long Shan Road, Shum Wan Road, Heung Yip Road and Police School Road is expected to be limited. According to the 2012



Annual Traffic Census, the annual average daily traffic of Wong Chuk Hang Road and Nam Long Shan Road are 66,800 veh/day and 2,360 veh/day respectively.

The projected maximum traffic flows in 2015 of the concerned major road links within the assessment area and their corresponding capacities are shown in **Table 5.7**. The estimated minimum overall traffic flows with construction traffic along the concerned road links are shown in **Table 5.8**.

Table 5.7: Projected Background Traffic Flows at Concerned Road Links (2015) - Maximum

	Traffic flow (veh/hr) - Year 2015							
Concerned Roads Links	Without Project <sup>(1)</sup>	With Project <sup>(2)</sup>	Difference	Capacity <sup>(3)</sup>				
Maximum <sup>(4)</sup>								
A. Wong Chuk Hang Road	4,795	4,810	+15	5,550				
B. Nam Long Shan Road	1,415	1,285	-130	2,400				
C. Shum Wan Road	1,045	1,025	-20	1,600				
D. Heung Yip Road	1,640	1,515	-125	3,400				
E. Police School Road	1,105	980	-125	1,600				

(1) Assume second entrance is still in operation without the construction of the Project

(2) Assume second entrance is closed while with the construction vehicles access to the Project

(3) Capacity used in the EIA traffic forecast

(4) Traffic flow during the project construction hours.

#### Table 5.8: Projected Traffic Flows at Concerned Road Links (Year 2015) – Minimum

	Traffic flow (veh/hr) -	Year 2015		
Concerned Roads Links	Without Project <sup>(1)</sup>	With Project <sup>(2)</sup>	Difference	Capacity <sup>(3)</sup>
Minimum <sup>(4)</sup>				
A. Wong Chuk Hang Road	4,485	4,500	+15	5,550
B. Nam Long Shan Road	875	755	-120	2,400
C. Shum Wan Road	940	710	-230	1,600
D. Heung Yip Road	1,325	1,205	-120	3,400
E. Police School Road	685	565	-120	1,600

(1) Assume second entrance is still in operation without the construction of the Project

(2) Assume second entrance is closed while with the construction vehicles access to the Project

(3) Capacity used in the EIA traffic forecast

(4) Traffic flow during the project construction hours.

It is noted that the estimated flow of "Maximum Hour with Construction Traffic" and "Minimum Hour with Construction Traffic" scenario for the concerned road links (except Wong Chuk Hang Road) are below "Maximum Hour without Construction Traffic" and "Minimum Hour without Construction Traffic". All concerned road links are estimated to be operating within their capacity during the construction phase.

During the construction phase, the current second entrance gate to the Ocean Park along Shum Wan Road is assumed to be closed and the associated traffic from tourist coaches is diverted. The construction vehicles are assumed to use Shum Wan Road, however, the volume of construction vehicles is less than



the coach volume and therefore a decrease in traffic along Nam Long Shan Road, Shum Wan Road, Heung Yip Road and Police School Road is expected.

For Wong Chuk Hang Road, estimated traffic flow of Maximum Hour and Minimum Hour with construction traffic is 15 veh/hr higher than that of without construction traffic, i.e., about 0.3% increased only. Minor increase to Wong Chuk Hang Road due to construction traffic and the associated coach diversion is expected. The trucks movement would be within acceptable speed limit. Therefore, potential noise impact from the movements of construction trucks would unlikely be significant.

# **Operation Phase**

#### Road Traffic Noise

The Project does not involve the construction of any new roads. However, the Project is expected to increase traffic flow in the surrounding road network due to increased visitors. Noise sensitive facades may be impacted by the road traffic noise surrounding the Project. Road access to the Project is expected to be through Shum Wan Road only, passing by the Aberdeen Marina Club, Marine Police Port District Headquarters, various residential premises and the Victoria Shanghai Academy. Two hotels, namely Fisherman Wharf's Hotel and Spa Hotel, adjacent to the Project are currently under planning process. Although construction timetable for the two proposed hotel is not available during the preparation of the report, it is expected that the Project will be in operation by year 2031. Therefore, the peak hour traffic flow forecast adopted in the assessments has included the planned hotels.

#### Fixed Noise

Operation of fixed plant within the Project such as air intake/exhaust openings, pumps and etc. would likely to generate noise impacts. Another source would be the operation of public address (PA) system throughout the Ocean Park. Other existing fixed plant noise sources which could impact on the noise sensitive uses include fixed plants currently operating in the Ocean Park. These include air-conditioning units, chiller, pump, ventilation fan, PA systems and rides. Given the locations of existing fixed noise sources are within Ocean Park, the sound power levels (SWLs) could not be identified through noise measurements due to the high background noise level from visitors. Nevertheless, the background noise measurements taken at the identified NSRs were conducted during the operation of the existing Ocean Park and therefore have taken into account of the existing fixed noise sources.

The Project does not comprise of a designated venue for open air entertainment. However, open air entertainment activities are expected to occur at various locations within the Project at different times of the day. Noise impact from these open air shows is expected due to the use of sound amplification systems for voice and potentially instrumental music. In addition, temporary open air shows and indoor attractions at the Summit of the existing Ocean Park during special event would likely to generate noise impacts.



# 5.5 Assessment Methodology

## **Construction Phase**

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 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

- Formulate a typical construction schedule / programme;
- Identify a typical project-specific equipment inventory for each work stage together with the number;
- Obtain 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 any 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):

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

Where Sound Pressure Levels, SPL in dB(A) Sound Power Levels, SWL in dB(A) Distance Attenuation, DC in dB(A) = 20·log(D) + 8 (where D is the distance between NSRs and noise source in meters) Façade Correction, FC in dB(A) = 3dB(A)

# **Operation Phase**

## Road Traffic Noise

Road traffic noise levels at the representative assessment points have been calculated based on the peak hour traffic flow within a 15 years period upon commencement of operation of the Project, i.e., the assessment year. Traffic noise has been predicted using the model "RoadNoise". The model has fully

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incorporated the procedures and methodology documented in "Calculation of Road Traffic Noise (CRTN)" (1988) published by the U.K. Department of Transport.

In accordance with the requirements specified in Appendix C, Clause (i)(a) of the EIA Study Brief, four scenarios are to be assessed:

- Scenario without the Project at the design year;
- Unmitigated scenario at assessment year;
- Mitigated scenario at assessment year; and
- Prevailing scenario for indirect technical remedies eligibility assessment, if applicable.

As mentioned in **Section 5.4**, the Project is expected to increase the traffic flow in surrounding road network, which are outside the 300m assessment area, also where the identified NSRs are located. As such, the road traffic assessment has included roads that are outside the 300 m assessment area in order to predict the potential traffic noise impact to the NSRs.

According to the traffic impact assessment, the year with maximum traffic flow within a 15-year period upon commencement of operation of the Project is determined to be year 2032. Therefore, the traffic data for year 2032 has been adopted for the assessment.

The road extent included in road traffic noise assessment and peak hour traffic forecast is shown in **Appendices 5.2** and **5.3** respectively.

#### 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 fixed plant, the maximum allowable sound power level (Max SWL) 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:

 $\begin{array}{l} {\rm SPL} = {\rm Max}\; {\rm SWL} - {\rm DC} + {\rm FC} - {\rm BC} \\ {\rm where} \\ {\rm SPL}: \; {\rm Sound}\; {\rm Pressure}\; {\rm Level}\; {\rm in}\; {\rm dB}({\rm A}) \\ {\rm MAX}\; {\rm SWL}: \; {\rm Maximum}\; {\rm Allowable}\; {\rm Sound}\; {\rm Power}\; {\rm Level}\; {\rm in}\; {\rm dB}({\rm A}) \\ {\rm DC}:\; {\rm Distance}\; {\rm Attenuation}\; {\rm in}\; {\rm dB}({\rm A}) = 20\; {\rm log}\; {\rm D} + 8\; ({\rm where}\; {\rm D}\; {\rm is}\; {\rm the}\; {\rm distance}\; {\rm in}\; {\rm m}) \\ {\rm FC}:\; {\rm Façade}\; {\rm Correction}\; {\rm in}\; {\rm dB}({\rm A}) = +3\; {\rm dB}({\rm A}) \\ {\rm BC}:\; {\rm Barrier}\; {\rm Correction}\; {\rm in}\; {\rm dB}({\rm A}) \end{array}$ 

For the case where the NSR has no direct line of sight to the source / opening as it is blocked by buildings or natural terrains, a 10dB(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.

As discussed in **Section 5.4**, the SWLs of the existing fixed plant noise sources could not be determined due to the high background noise level in the Ocean Park. Therefore, the background noise levels measured at the identified sensitive receivers, which had already included the noise from existing fixed plant, have been considered in the assessment of the maximum allowable sound levels.

#### Open Air Entertainment Noise

The open air shows during operation phase are expected to be held at various locations at non-designated time periods. Majority of the open area accessible by visitors may hold such open air shows at various times, with the aim to spread guests across the Ocean Park. As such, as a conservative approach, area which shows may potentially be held that is closest to the nearest NSR has been set as assessment point. This assessment point would represent the worst case scenario where nearby NSRs are expected to be the most affected should shows are held at this location, given the close proximity, when compared to other open areas. The chosen assessment point is shown in **Figure 5.4**.

The maximum allowable SWLs at the chosen assessment point have been determined for future detailed operation planning. The SWLs were determined by adopting standard acoustics principles, equivalent to those used in fixed plant noise assessment, as discussed above.

Where NSR has no direct line of sight to the assessment point as it is blocked by buildings or natural terrains, a 10 dB(A) attenuation would be applied. If exceedance to the noise criteria is found, the SWL of the source would be gradually lowered until the corrected SPL at all NSRs complies with the relevant criteria.

Fixed plants are expected to operate throughout the entire opening hours, where open air entertainment activities will be occurring irregularly. Therefore, impact from both fixed noise sources at the same time is anticipated. As such, cumulative assessment of fixed plant noise and open air entertainment has been assessed. The maximum allowable SWLs have been determined under the cumulative scenario as a conservative approach. Potential noise impact from temporary open air shows and indoor attractions at the Summit of the existing Ocean Park during special event, as shown in **Figure 5.5**, have also been included in the cumulative assessment.



# 5.6 Prediction and Evaluation of Environmental Impact

## **Construction Phase**

The type and quantity of PME likely to be used for the construction of the Project and their SWLs are shown in **Appendix 5.4**.

The unmitigated construction noise levels from this Project have been predicted and are summarised in **Table 5.9** below. Detailed breakdown of unmitigated construction noise level is shown in **Appendix 5.4**.

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NSR ID	Use	Predicted Noise Level, dB(A)	Noise Criteria, dB(A)	Exceedance of Noise Criteria	Exceedance of Noise Criteria during Examination Period	Mitigation Measure required?
VSA	Educational	59-67	70 or 65 during examination	No	Yes	During Examination Only
HKJCC	Educational	59-68	70 or 65 during examination	No	Yes	During Examination Only

#### Table 5.9: Unmitigated Construction Airborne Noise Impact

Note: **Bold** figures denote exceedance in relevant noise criteria.

According to the assessment results, no exceedance of the daytime construction noise criteria were predicted during the non-examination period of the two identified NSRs of educational use. However, exceedances of 65 dB(A) from month 2 to 14 and 21 to 26 of the construction programme were predicted with level of exceedance of 2 to 3 dB(A). Should these particular months be overlapping with the examination periods of the NSRs, adverse construction noise impacts are anticipated.

## **Operation Phase**

## Road Traffic Noise

The predicted road traffic noise levels in year 2032 in absence of the Project and with the Project have been predicted and are summarised in **Table 5.10** below. Detailed breakdown of the road traffic noise level is shown in **Appendix 5.5**.

Table E 10.	Dood	Troffie	Naiaa in	Veer 2022
	Roau	Tranic	Noise in	rear 2032

NSR ID	Noise Criteria	Without Project		With Pr	Difference	
		Predicted Noise Level L <sub>10(1hr)</sub> dB(A)	Exceedance of Noise Criteria?	Predicted Noise Level L <sub>10(1hr)</sub> dB(A)	Exceedance of Noise Criteria?	
VSA	65	76-79	Yes	76-80	Yes	0.1
HKJCC	65	70	No	70	No	0.0-0.1
BC	70	68- <b>73</b>	Yes	68- <b>73</b>	Yes	0.0-0.1
SWC	70	72-76	Yes	72-77	Yes	0.0-0.1
WCH1	70	51- <b>75</b>	Yes	51- <b>75</b>	Yes	0.0-0.1
WCH2	70	50- <b>71</b>	Yes	50- <b>71</b>	Yes	0.0-0.2
WCH3	70	51- <b>74</b>	Yes	52 <b>-74</b>	Yes	0.1-0.2

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NSR ID	Noise	Without Project		With Project		Difference
	Criteria	Predicted Noise Level L <sub>10(1hr)</sub> dB(A)	Exceedance of Noise Criteria?	Predicted Noise Level L <sub>10(1hr)</sub> dB(A)	Exceedance of Noise Criteria?	
GG	70	71-79	Yes	71-79	Yes	0.0

Source: Bold figures denote exceedance of relevant noise criteria.

As shown in **Table 5.10** above, the road traffic noise levels predicted at the selected NSRs are predicted to exceed the relevant noise criteria under both scenarios. However, the differences between the without and with Project scenarios is predicted to be less than 1dB(A). Therefore, the Project is not expected to cause significant adverse road traffic noise impact, and mitigation measures will not be required.

#### Fixed Noise

Noise from fixed plant of the Project would mainly be associated with the air intake/exhaust openings and pumps. In addition, PA system is also expected to be used. According to preliminary design, 112 source locations were identified and are shown in **Figure 5.5**. Cross section from NSR VSA and HKJCC to the assessment point is shown in **Figure 5.5a**. Noise from open air entertainment activities is expected intermittently.

Based on the methodology mentioned in **Section 5.5**, the maximum allowable SWLs of the proposed fixed plants during day time and evening are predicted and summarised in **Table 5.11** below. Calculations of fixed noise assessment are shown in **Appendix 5.6**.

Source ID	Noise Source Description	Maximum Allowable SWL, dB(A)* at both day and evening time
Fixed Plant		
N1	Pool Filtration Plant Room	82
N2	Pool Filtration Plant Room	82
N3	Pool Filtration Plant Room	82
N4	Pump Room	82
N5	Plumbing Service Plant Room	82
N6	Pool Filtration Plant Room	82
N7	Pool Filtration Plant Room	83
N8	Pool Filtration Plant Room	83
N9	Pool Filtration Plant Room	83
N10	Boiler Plant	83
N11	Boiler Plant	83
N12	Chiller Plant	83
N13	Calorifier Room	83
N14	Water Meter Room	83
N15	Water Meter Room	83
N16	Shower Room	82
N17	Shower Room	82
N18	Shower Room	82
N19	Shower Room	82
N20	Shower Room	82
N21	Kitchen	83

 Table 5.11:
 Maximum Allowable SWLs of Fixed Noise Sources

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Source ID	Noise Source Description	Maximum Allowable SWL, dB(A)* at both day and evening time
N22	Air Handling Unit / Fan	83
N23	Air Handling Unit / Fan	83
N24	Washroom	83
N25	Kitchen	83
N26	Fan Room	83
N27	Kitchen	83
N28	Transfer Room	83
N29	Generator Room	83
N30	Washroom	83
N31	Food and Beverage	83
N32	Air Ventilation	83
N33	Air Ventilation	83
N34	Air Ventilation	83
N35	Air Ventilation	83
N36	Air Ventilation	83
N37	Air Ventilation	83
N38	Air Ventilation	83
N39	Air Ventilation	83
N40	Shower Room	82
N41	Transformer Room	82
N42	Transformer Room	82
N43	Transformer Room	82
N44	Transformer Room	82
N45	Transformer Room	82
N46	Transformer Room	82
N47	Transformer Room	82
N48	Transformer Room	82
N49	Shower Room	82
N50	Air Ventilation	82
N51	Air Ventilation	82
N52	Washroom	83
N53	Washroom	82
N54	Cooling Tower	82
N55	Cooling Tower	82
N56	Cooling Tower	82
N57	Cooling Tower	82
N58	Cooling Tower	82
N59	Cooling Tower	82
N60	Cooling Tower	82
N61	Cooling Tower	82
N62	Cooling Tower	83
N63	Cooling Tower	83
N64	Cooling Tower	83
N65	Cooling Tower	83
N66	Air Handling Unit	82
N67	Kitchen	82
N68	Kitchen	82
N69	Washroom	82
N70	Washroom	82

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Source ID	Noise Source Description	Maximum Allowable SWL, dB(A)* at both day and evening time
N71	Pool Filtration Plant Room	82
N72	Pool Filtration Plant Room	82
N73	Pool Filtration Plant Room	82
N74	Pool Filtration Plant Room	82
N75	Shower Room	82
N76	Shower Room	82
N77	Air Ventilation	82
N78	Air Ventilation	82
N79	Air Ventilation	82
N80	Air Ventilation	82
N81	Air Ventilation	82
N82	Mechanical, electrical, plumbing	82
N83	Mechanical, electrical, plumbing	82
N84	Air Ventilation	82
N85	Air Ventilation	82
N86	Air Ventilation	82
N87	Air Ventilation	82
N88	Air Ventilation	82
N89	Air Ventilation	82
N90	Air Ventilation	82
N91	Air Ventilation	82
N92	Air Ventilation	82
N93	Air Ventilation	82
N94	Air Ventilation	82
N95	Air Ventilation	82
N96	Air Ventilation	82
N97	Air Ventilation	82
P1	PA system	94
P2	PA system	94
P3	PA system	94
P4	PA system	94
P5	PA system	94
P6	PA system	94
P7	PA system	94
P8	PA system	94
P9	PA system	94
P10	PA system	94
P11	PA system	94
P12	PA system	94
P13	PA system	94
P14	PA system	94
P15	PA system	94
Open Air Enterta	inment Activity	102

Note: \* Maximum allowable SWL of each source.



The proposed SWLs in **Table 5.11** are only maximum allowable levels. The actual noise level emitted from the fixed plants within the Project will be determined in later detailed stage and are expected to be lower due to the proximity to the visitors' activity areas.

The proposed maximum allowable SWL for open air entertainment activity is only at the selected assessment point, but not at all open show areas. As mentioned in above sections, open air entertainment activities may occur at various locations, subject to detailed planning of future operation style. Should the NSRs are affected by more than one opening air entertainment activity location, the maximum permissible SWL at each location shall be applied a correction factor to account for the cumulative effect. The values of the correction factor related to the number of locations are shown in **Table 5.12** below.

Number of Open Air Entertainment Locations	Correction to Maximum Allowable SWL, dB(A)
1	0
2	-3
3	-5
4	-6
5	-7
6	-8
7	-8
8	-9
9	-10
10	-10

Table 5.12: Correction Factor for Maximum Allowable SWL of the Open Air Entertainment Activities

# 5.7 Mitigation of Adverse Environmental Impact

## **Construction Phase**

According to the results of the unmitigated construction noise impact assessment, potential adverse noise impacts are anticipated only during the examination periods of the two identified NSRs. Mitigation measures during construction stage 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 quiet plant;
- Use of movable noise barrier;



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.

- 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 give in the GW-TM. This is one of the most effective measures and is increasingly practicable because of the availability of quiet equipment.

The actual SWL of quiet plant is less than the value specified in GW-TM for the same piece of equipment. Example of SWL for specific silenced PME taken from EPD's Quality Powered Mechanical Equipment (QPME) Inventor is presented in **Table 5.13**. It should be noted that various types of silenced equipment can be found in Hong Kong.

					•	
I able 5.13:	Quiet PME	Recommended to	r Adoption	during	Construction	Phase

PME	Power rating / size, weight	Reference	SWL, dB(A)
Excavator, wheeled / tracked	70IW	EPD-01217	100

While quiet PME is 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 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 that 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 5.6**.

The noise screening benefit for each item of plant considered in this assessment is listed in Table 5.14.

 Table 5.14:
 Noise Mitigation Measures for Certain PME during Construction Phase

РМЕ	Mitigation Measure Proposed	Noise Reduction, dB(A)
Concrete lorry mixer	Movable Barrier	5
Breaker, hand-held, mass >= 20kg and <= 35kg	Movable Barrier	5
Crane, mobile / barge mounted (diesel)	Movable Barrier	5
Concrete pump, stationary/lorry mounted	Movable Barrier	10
Poker, vibratory, hand-held	Movable Barrier	10
Saw, circular, wood	Movable Barrier	10

The noise barriers should be free of gaps and made of materials having a surface mass density in excess of 7 kg/m<sup>2</sup>. 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.

The effect of the use of quiet plant and movable barriers has been investigated for the practicable construction activities and the results are summarised in **Table 5.15** below. Detailed calculation and mitigated construction plant inventory is shown in **Appendix 5.7**.

NSR ID	Use	Predicted Noise Level, dB()A	Noise Criteria, dB(A)	Exceedance of Noise Criteria	Residual Impact
VSA	Educational	59-65	70 or 65 during examination	No	No
HKJCC	Educational	59-65	70 or 65 during examination	No	No

Table 5.15: Mitigated Construction Airborne Noise Impact



With the incorporation of quiet plant and the use of movable noise barriers, the results indicated that the mitigated noise impact associated with the construction of the Project would comply with the daytime construction noise criterion at all NSRs, including during examination period. Residual construction noise impact exceeding the relevant noise criteria is not anticipated.

The mitigation measures recommended above can be altered, where the Contractor may be allowed to use acoustic blankets on PMEs or re-schedule noise works. It is the responsibility of the Contractor to comply with the construction noise criteria which should be stated in the contractual agreement. It is further recommended that the Contractor should follow the "*Recommended Pollution Control Clauses for Construction Contracts*" to minimise the construction noise impact.

## **Operation Phase**

#### Road Traffic Noise

As mentioned in **Section 5.6**, the increased traffic flow under the operation of the Project is expected to cause less than 1 dB(A) increase in road traffic noise level. Therefore, no adverse road traffic noise impact is anticipated and no mitigation measure is required.

#### Fixed Plant Noise

With the adoption of the proposed maximum allowable SWLs in **Table 5.11**, all representative NSRs is expected to comply with the relevant noise criteria for the daytime and evening time periods. No adverse fixed plant noise impact is anticipated.

However, it is also recommended that the following noise reduction measures should be considered as far as practicable during design stage:

- choose quiet plant such as those which have been effectively silenced;
- include noise levels specification when ordering new plant (including chiller 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 machine in a basement or a completely separate building;
- install direct noise mitigation measures including silencers, acoustic louvres 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.

#### Open Air Entertainment Noise

With the adoption of the proposed maximum allowable SWLs in **Table 5.11** and **Table 5.12**, all representative NSRs is expected to comply with the relevant noise criteria for the daytime and evening



periods. No adverse open air entertainment noise impact is anticipated. However, the following measures should be considered as far as practicable during stage:

- use small clusters of small power loudspeakers rather than a few large power loudspeakers; and
- loudspeakers should be pointed away from nearby NSRs.

# 5.8 Evaluation of Residual Impact

#### **Construction Phase**

With the adoption of quiet PME and movable noise barriers, no exceedance of relevant construction noise criteria is expected. No residual construction noise impact exceeding the relevant noise criteria is anticipated.

#### **Operation Phase**

With the fixed plant properly designed and open air entertainment activities planned to meet the maximum allowable SWLs listed in **Table 5.11** and **Table 5.12**. The increased traffic flow under the operation of the Project is expected to cause less than 1 dB(A) increase in road traffic noise level. No residual impacts exceeding the relevant noise criteria are anticipated.

# 5.9 Conclusion

## **Construction Phase**

The noise impact associated with unmitigated construction activities for the Project would cause exceedance of daytime construction noise criteria at the representative NSRs only during the examination periods. Therefore, good site practices and mitigation measures including the use of quiet plant and erection of movable noise barriers have been proposed to alleviate the noise impact. With the good site practices and mitigation measures exceeding the relevant noise criteria are predicted at all NSRs.

## **Operation Phase**

The traffic flow induced by the operation of the Project in comparing with the base traffic flow is insignificant and therefore significant adverse off-site road traffic noise impact is not anticipated from the Project.

With the specification of maximum allowable SWLs for the proposed fixed plants and open air entertainment activities, full compliance of relevant noise criteria will be achieved and no residual impact exceeding the relevant noise criteria is anticipated.