



Update of Design of the Existing Lagoon Show in Ocean Park Hong Kong

Noise Review Study Report

9 January 2020

Project No.: 0511456

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Signature Page

9 January 2020

Update of Design of the Existing Lagoon Show in Ocean Park Hong Kong

Noise Review Study Report



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Environmental Permit No. EP-249/2006/D
Ocean Park Master Redevelopment Project
Environmental Team Leader Verification

Reference Document/Plan

Document/ Plan to be Certified/ Verified:	Noise Review Study Report (revised)
Date of Report:	9 January 2020

Reference EP Condition

Environmental Permit Condition:	2.24
The Permit Holder shall, at least one month before the first open-air lagoon show in the Aqua City, deposit with the Director four hard copies and one electronic copy of a noise review study based on the detailed design of fixed plant and noise impacts from the open-air lagoon show in the Aqua City. The study shall at least include:	
(a) locations and orientations of loud speakers;	
(b) sound power levels of loud speakers;	
(c) predicted noise levels; and	
(d) analysis of predictions against the requirements stipulated in the EIA-TM and Condition 2.23.	
Before submission to the Director, the study shall be certified by the ET Leader and verified by the IEC as conforming to the information and recommendations contained in the approved EIA report and the requirements in Condition 2.23. All measures recommended in the deposited study shall be fully and properly implemented.	

ETL Verification

I hereby verify that the above referenced document/ plan complies with the above referenced condition of EP-249/2006/D.	
	
Ms Mandy To	Date: 9 January 2020
Environmental Team Leader	

Our ref: 0511456_ETL Verification Cert_Noise_20200109.docx

Ocean Park Master Redevelopment Project

Environmental Permit No. EP-249/2006/D - Condition 2.24

**Update of Design of the Existing Lagoon Show in Ocean Park Hong Kong
Noise Review Study Report**

Submitted by ERM-Hong Kong, Limited dated 09-01-2020

This is to verify that

**Update of Design of the Existing Lagoon Show in Ocean Park Hong Kong
Noise Review Study Report**

Submitted by ERM-Hong Kong, Limited

dated 09-01-2020

Has been verified by the undersigned.

Signed



Ir Eric Ching
Independent Environmental Checker (IEC)
Retained by Ocean Park Corporation
pursuant to Environmental Permit No. EP-249/2006/D

Date

09 January 2020

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1. INTRODUCTION

1.1 Background

An updated of design of the existing open-air lagoon night show will be hosted at the Aqua City in the Ocean Park (the Park). The layout plan of the lagoon and updated location plan of the audio poles and audio speakers are presented in *Figure 1.1*. Detailed description of the show and updated design details are presented in *Section 2*.

The potential environmental impacts of the Master Redevelopment Plan (MRP) have been assessed and presented in the Environmental Impact Assessment Report for “*Relocation and Long Term Operation Plan of Ocean Park*” (Register No. AEIAR-101/2006) (the approved EIA Report), and an Environmental Permit (EP-249/2006) for the MRP was granted on 28 July 2006. A Noise Review Study Report was deposited to EPD on 19 October 2010 (*Noise Review 2010*) under the requirement of Condition 2.24 of the EP. The EP was varied subsequently with the latest version of EP-249/2006/D issued by EPD on 2 July 2014.

ERM-Hong Kong, Limited (ERM) was appointed by the Ocean Park Corporation, Hong Kong (OPC) to prepare the updated noise review study report based on the most up-to-date design layout and other relevant design details provided by the OPC.

1.2 Purpose of Report

The objective of this Noise Review Study is to update the *Noise Review 2010* which was deposited to EPD on 19 October 2010 based on the proposed design updates of the show. Cumulative noise impact will also be updated based on the fixed plant noise assessment for the whole Park presented in the *Environmental Review Report* approved on 2 July 2014 (ERR 2014) in support of the Variation of EP application. It also provides recommendations as to whether any modification and/or refinement of proposed mitigation measures and monitoring and audits requirements are needed.

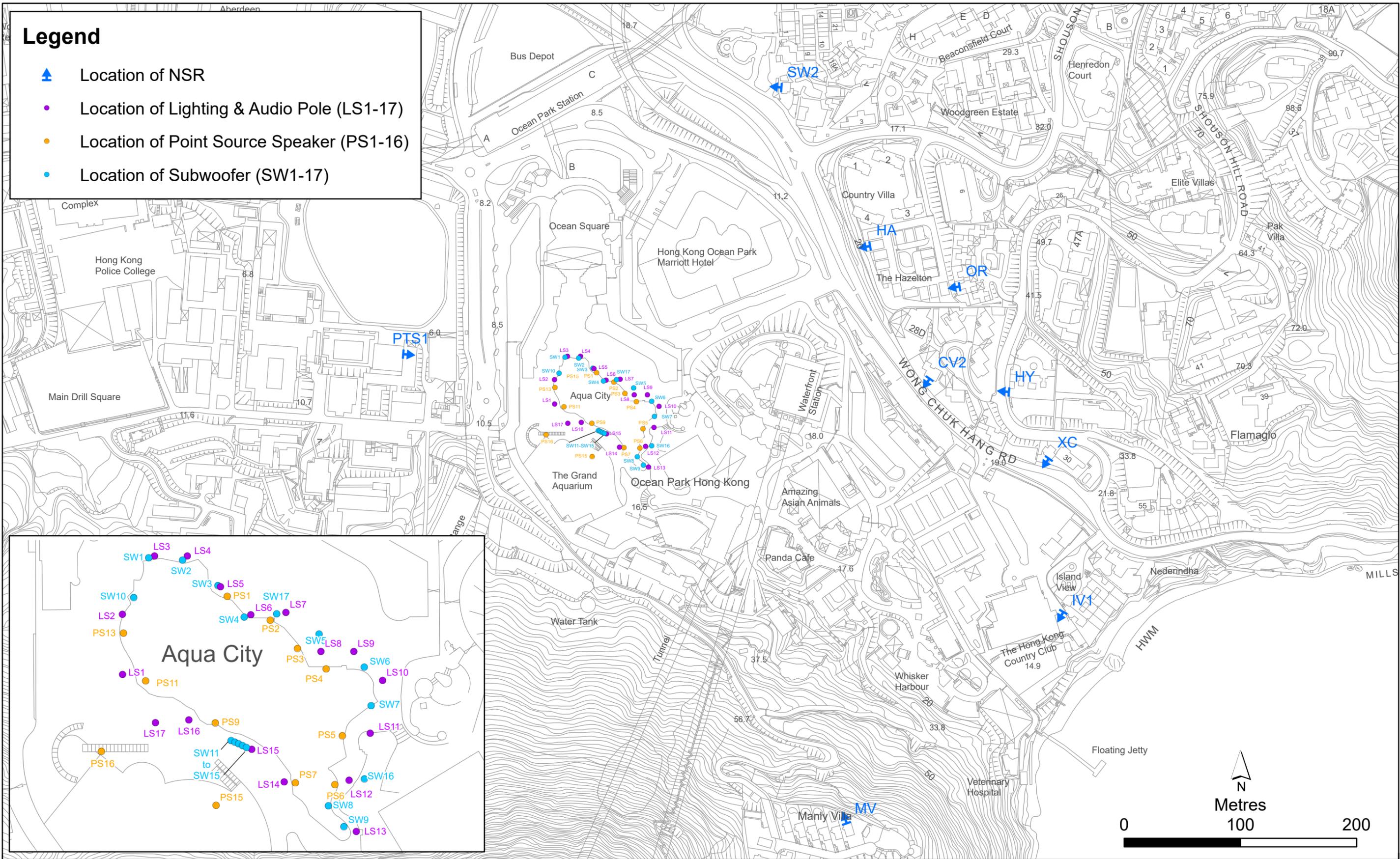


Figure 1.1

Locations of Noise Sensitive Receivers (NSRs) and Noise Sources of the Lagoon Show

2. THE LAGOON NIGHT SHOW

2.1 Overview of the Show

The lagoon night show is an open-air entertainment event to be hosted at the Aqua City featuring a combination of audio and visual effects. Pyrotechnic Special Effect Material (PSEM) will not be used in the updated show. The show effect will focus in the use of audio and visual systems and hence additional audio equipment will be installed for the updated show. Details of the updated lagoon night show are summarised in *Table 2.1*.

Table 2.1 Details of the Updated Lagoon Night Show

Show	Frequency every Night ^(a)	Duration	Description
Main show One, "Soul of the Ocean"	1	About 12 minutes	A timeless story told through a shape-shifting sea creature
Main show Two, "Vision of Hong Kong"	1	About 5 minutes	An unparalleled visual celebration of culture and beauty beneath the night sky of the Southern District of Hong Kong
	Total	About 17 minutes ^(b)	

Note:

- (a) The shows will be started at 19:00 hours and ended before 22:00 hours, ie before the Park closes daily.
- (b) Comparing with the previous show of 10-20 minutes, the duration of the updated show is about the same.

2.2 Design of the Audio System

The major noise source will be the audio system. These speakers will be mounted on poles and on ground around the lagoon. There will be a total of 17 nos. of lighting & audio poles, 10 nos. of point source speakers mounted at ground level, 2 nos. of point source speakers mounted on exterior wall of Grand Aquarium, 12 nos. of subwoofer speakers mounted at ground level and 5 nos. of subwoofer speakers mounted on the side lagoon edge of Grand Aquarium (see *Figure 1.1*). Each lighting & audio pole or audio pole will hold 2 to 5 nos. of audio speakers. The speakers will be used for broadcasting music, sound effects and narrator's description during the show.

The design of the audio system has incorporated the following features that address the recommendations given in the approved EIA Report:

- the audio system will comprise a cluster of low power speakers instead of a few large-power speakers;
- the speakers will be distributed throughout the spectator area rather than being clustered at one end of the venue or directly pointing to Noise Sensitive Receivers (NSRs), and will be placed around the lagoon, in front of the audience;
- directional speakers will be used and oriented to point towards the audience and away from the nearby NSRs; and
- the audio system has been estimated to comply with criteria set out in the *Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)*, whilst also providing sufficient direct sound when considering the intelligibility of the audio system.

2.3 Changes in Design as compared with that of the Noise Review 2010

A comparison of assumptions employed in the *Noise Review 2010* and those in this Noise Review Study is given in *Table 2.2*. Details of SWLs for each speaker and speaker cluster, and the total SWL of all speakers are given in *Appendix A1*. In this Noise Review Study, the noise assessment was conducted with the assumption that all speakers will be in use at the same time to represent the worst-case scenario.

Table 2.2 Comparison of Assumptions in the Noise Review 2010 and this Noise Review Study

Assumptions	Noise Review 2010	This Noise Review Study ^(a)
Number of loudspeaker clusters	<ul style="list-style-type: none"> ■ 17 nos. of lighting & audio poles; ■ 15 nos. of point source speakers at ground level; and ■ 5 nos. of audio support poles 	<ul style="list-style-type: none"> ■ 17 nos. of lighting & audio poles; ■ 10 nos. of point source speakers at ground level; ■ 2 nos. of point source speakers on exterior wall of Grand Aquarium; ■ 12 nos. of subwoofer speakers at ground level; and ■ 5 nos. of subwoofer speakers on the side edge of Grand Aquarium
Sound power level (SWL) of each loudspeaker cluster	<ul style="list-style-type: none"> ■ 89dB(A) for each speaker of the lighting & audio pole and audio support pole; and ■ 88dB(A) for each point source speaker 	<ul style="list-style-type: none"> ■ 88dB(A) for each speaker of the lighting & audio pole and audio support pole; and ■ 91dB(A) for each point source speaker ■ 92dB(A) for each subwoofer speaker
Total SWL of all loudspeaker clusters	108dB(A)	109dB(A) ^(b)
Sound pressure level (SPL) at 9m of each loudspeaker cluster/point source speaker	61 - 68dB(A)	64 - 69dB(A) ^(b) (see <i>Appendix A1</i>)
Notes:		
(a) Confirmation has been obtained from the OPC and their show design contractor that the above SWLs for each lighting & audio pole, audio support pole and point source speaker are practical and adequate for ensuring intelligibility of the broadcast and sound effects.		
(b) The SWL of all speaker clusters is 109dB(A) and SPL of each speaker cluster/point source speaker is in the range of 64 to 69dB(A) at 9m, which are within the respective limits specified under EP condition 2.23, ie total SWL of 109dB(A) and SPL of 75dB(A) at 9m.		

3. FIXED PLANT NOISE IMPACT ASSESSMENT

3.1 Identified Noise Sensitive Receivers

In accordance with the *Noise Review 2010*, the identified NSRs that may potentially be affected by the show are summarised in *Table 3.1*. A review of NSR in vicinity of the Project has been conducted. A new NSR, Hong Kong Ocean Park Marriot Hotel, has been identified. As it is installed with centralised A/C system and not relying on openable windows for ventilation, it will be not included in the assessment.

The locations of the identified NSRs are indicated in *Figure 1.1*.

Table 3.1 Identified Noise Sensitive Receivers (NSRs)

NSR	Description	Land use	Existing/Planned NSR	No. of Storey
PTS1	Old Teaching Block, Police Training School	Government /Institution /Community	Existing	4
SW2	Wong Chuk Hang San Wai	Residential	Existing	1
HA	The Hazelton	Residential	Existing	3
CV2	Country Villa, 28 Shouson Hill Road	Residential	Existing	3
XC	Xanadu Courts	Residential	Existing	3
IV1	Island View	Residential	Existing	2
OR	Orchid Valley	Residential	Existing	3
HY	Hau Yuen	Residential	Existing	3
MV	Manly Villa	Residential	Existing	3

3.2 Fixed Plant Noise Criteria

The *EIAO-TM* and *Technical Memorandum on Noise From Places Other than Domestic Premises, Public Places or Construction Sites (IND-TM)* specify the applicable Acceptable Noise Levels (ANLs) for the fixed plant noise impact from the show. The ANLs are dependent on the Area Sensitivity Rating (ASR) and the time of day. The ANLs are presented in *Table 3.2*.

Table 3.2 ANLs to be used as Fixed Plant Noise Criteria

Time Period	L _{Aeq, 30min} (dB(A))		
	ASR "A"	ASR "B"	ASR "C"
Day-time (ie 07:00-19:00 hrs)	60	65	70
Evening (ie 19:00-23:00 hrs)	60	65	70
Night-time (ie 23:00-07:00 hrs)	50	55	60

Fixed plant noise is controlled under *Section 13* of the *Noise Control Ordinance (NCO)* and the predictions were made in accordance with the *IND-TM*. The noise criteria for planning and design of Designated Projects are set out in the *EIAO-TM* as follows:

- The noise level at the facade of the nearest NSR is at least 5 dB(A) lower than the appropriate ANL (as shown in *Table 3.2*) as specified in the *IND-TM*; or
- The prevailing background noise level (for quiet areas with a noise level 5 dB(A) below the appropriate ANL).

In accordance with the *Noise Review 2010*, the fixed plant noise criteria for the identified NSRs are presented in *Table 3.3*.

Table 3.3 Fixed Plant Noise Criteria

NSR	Corresponding Measurement Location	Description	Fixed Plant Noise Criteria, dB(A)
PTS1	NM1	Old Teaching Block, Police Training School	60
SW2	NM2	Wong Chuk Hang San Wai	60
HA	NM2	The Hazelton	60
CV2	NM2	Country Villa, 28 Shouson Hill Road	60
XC	NM2	Xanadu Courts	60
IV1	NM3	Island View	60
OR	NM3	Orchid Valley	55
HY	NM3	Hau Yuen	55
MV	NM4	Manly Villa	56

3.3 Assessment Methodology

The entertainment noise from the lagoon night show was assessed in this Noise Review Study based on the methodology for fixed plant noise assessment specified in the *IND-TM*. Reference was also made to Appendix 3.5 of the approved EIA Report, the *Noise Review 2010* and *ERR 2014*, with details given in *Appendix A2*. Directivity was not taken into account in the assessment to represent the worst-case scenario. The screening effect provided by the existing building structures between the lagoon and the concerned NSRs are illustrated in *Appendix B*.

The cumulative impact due to the entertainment noise from the lagoon night show and other fixed plant noise from the Park, ie “Scenario 1 – During Lagoon Night Show ” of the *ERR 2014*, has been predicted and compared with the noise criteria as presented in *Table 3.3*.

3.4 Evaluation of Impacts

3.4.1 Entertainment Noise

With the specified SWLs presented in *Table 2.2*, the predicted entertainment noise levels from the show are similar to that predicted in the *Noise Review 2010*. The predicted noise levels with a comparison with the results from the *Noise Review 2010* are summarised in *Table 3.4*. Details of calculation are presented in *Appendix A2*.

Table 3.4 Predicted Entertainment Noise Levels from the Lagoon Night Show

NSRs	Predicted Entertainment Noise Levels from the Lagoon Night Show (Loudspeaker Only), dB(A)	
	Noise Review 2010	This Noise Review Study
PTS1	50	50
SW2	42	44
HA	52	55
CV2	43	46
XC	50	43
IV1	49	42

NSRs	Predicted Entertainment Noise Levels from the Lagoon Night Show (Loudspeaker Only), dB(A)	
	Noise Review 2010	This Noise Review Study
OR	48	44
HY	47	44
MV	49	52

3.4.2 Fixed Plant Noise

There is no change on the fixed plant items from the Park. The predicted noise levels due to other fixed plant noise from the Park were referred to the results presented in *ERR 2014*.

3.4.3 Cumulative Impacts

The cumulative impacts due to the entertainment noise from the lagoon night show and other fixed plant noise from the Park for Scenario N1 (without special event) and S1 (with special event) were predicted and the results are presented in *Tables 3.5* and *3.6*, respectively.

Table 3.5 Cumulative Fixed Plant Noise Levels from the Lagoon Night Show and Other Fixed Plant Noise from the Park – Scenario N1

NSR	Noise Review 2010 & ERR 2014				This Noise Review Study		
	Fixed Plant Noise Level, dB(A) (1)	PSEM Noise Level, dB(A) (2)	Entertainment Noise Level, dB(A) (3)	Cumulative Noise Levels, dB(A) (4) = (1) + (2) + (3)	Entertainment Noise Level, dB(A) (5)	Cumulative Noise Levels, dB(A) (6) = (1) + (5)	Noise Criteria, dB(A)
PTS1	57	48	50	58	50	57	60
SW2	51	44	42	52	44	52	60
HA	52	52	52	57	55	57	60
CV2	54	46	43	55	46	55	60
XC	52	50	50	56	43	53	60
IV1	52	49	49	55	42	52	60
OR	51	52	48	55	44	52	55
HY	53	50	47	55	44	53	55
MV	53	52	49	56	52	55	56

Notes:

- (a) Noise levels in (1) were assessed and presented in *Annex C9* of *ERR 2014*.
- (b) Noise levels in (2) and (3) were assessed and presented in *Noise Review 2010*.
- (c) Noise levels in (5) were assessed based on the most up-to-date design layout and other design details provided by OPC.
- (d) Noise levels in (6) are the cumulative noise levels calculated by the summation of fixed plant noise levels in (1) from the *ERR 2014* and the entertainment noise levels in (5) from this Noise Review Study.

Table 3.6 Cumulative Fixed Plant Noise Levels from the Lagoon Night Show and Other Fixed Plant Noise from the Park – Scenario S1

NSRs	Noise Review 2010 & ERR 2014				This Noise Review Study		
	Fixed Plant Noise Level, dB(A) (1)	PSEM Noise Level, dB(A) (2)	Entertainment Noise Level, dB(A) (3)	Cumulative Noise Levels, dB(A) (4) = (1) + (2) + (3)	Entertainment Noise Level, dB(A) (5)	Cumulative Noise Levels, dB(A) (6) = (1) + (5)	Noise Criteria, dB(A)

PTS1	57	48	50	58	50	57	60
SW2	51	44	42	53	44	52	60
HA	52	52	52	57	55	57	60
CV2	54	46	43	55	46	55	60
XC	52	50	50	56	43	53	60
IV1	52	49	49	55	42	52	60
OR	51	52	48	55	44	52	55
HY	53	50	47	55	44	53	55
MV	53	52	49	56	52	55	56

Notes:

- (a) Noise levels in (1) were assessed and presented in *Annex C9 of ERR 2014*.
- (b) Noise levels in (2) and (3) were assessed and presented in *Noise Review 2010*.
- (c) Noise levels in (5) were assessed based on the most up-to-date design layout and other design details provided by OPC.
- (d) Noise levels in (6) are the cumulative noise levels calculated by the summation of fixed plant noise levels in (1) from the *ERR 2014* and the entertainment noise levels in (5) from this Noise Review Study.

The above results indicate that the cumulative noise levels were in the range of 52 to 57dB(A) for both Scenarios N1 and S1, which were slightly lower than those presented in the *Noise Review 2010* and *ERR 2014*, ie 52 to 58dB(A) for Scenario N1 and 53 to 58dB(A) for Scenario S1. As the predicted noise levels comply with the relevant noise criteria, no mitigation measure is required.

3.5 Recommendations

Although the predicted results indicate compliance with the relevant noise criteria, it is still recommended that the following mitigation measures proposed in the approved EIA Report be adopted and implemented to ensure noise compliance after the commencement of the lagoon night show:

- upon completion of system installation, sound tests to be witnessed by qualified professionals of Independent Environmental Checker (IEC) should be performed to demonstrate that the audio system will satisfy the acoustic design requirements specified in *Table 2.2* and *Appendix A*;
- good management practices should be in place, including noise monitoring, setting up a complaint hotline, and distributing advance notice to nearby NSRs. It is recommended that good management practices be implemented during both rehearsals and shows; and
- As a fallback option, should non-compliance of *EIAO-TM* noise criteria at the NSRs be identified for the lagoon night show, interim measures (such as turning down/off of music volume) should be implemented before long-term measures such as redesigning show with no music/lower music volume are in place.

3.6 Environmental Monitoring and Audit (EM&A) Requirement

In accordance with the approved EIA Report, operational phase noise monitoring was recommended to be undertaken during the lagoon night show at the Aqua City to ensure compliance with the noise criteria. Details of the EM&A programme were provided in the EM&A Manual that form part of the approved documentation on the EIAO Register.

Reference should be made to Sections 2.20 to 2.23, 2.25 of the approved EM&A Manual for the monitoring requirements and Action and Limit Levels for Entertainment Noise. Monitoring requirements are summarised below for easy reference:

Lagoon night show noise monitoring shall be carried out at all the designated monitoring stations (ON1 to ON5) during the performance of lagoon night shows at a logging interval of 30 minutes. The monitoring frequency shall depend on the schedule of the lagoon night shows, and an initial impact monitoring should be conducted at least two times per week, with once on normal weekdays and once on general holidays during the first month of the lagoon night shows.

The need for noise monitoring during the lagoon night show should be reviewed monthly based on the previous monitoring results, any adjustment to the loudspeaker system, and any change to the show schedule or rundown. For the same loudspeaker system and show rundown, if the noise levels of the month comply with the noise criteria as stipulated in *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM), or are consistent with the baseline noise levels, ET may consider not to include this parameter in the subsequent monitoring programme. Agreement from the IEC and EPD must be obtained prior to suspension of noise monitoring. Impact monitoring shall recommence if there is any change to the power, orientation, and volume of the loudspeaker system, or to the show rundown, or an increase of show frequency.

4. CONCLUSION

With the most up-to-date design of the audio system, the cumulative noise levels due to the entertainment noise and fixed plant noise are predicted to comply with the *EIAO-TM* noise criteria. No adverse noise impact is anticipated at the NSRs and no mitigation measure is required.

It is recommended that noise monitoring be undertaken in accordance with the approved EIA Report and the EM&A programme provided in the EM&A Manual that form part of the approved documentation on the EIAO Register.

APPENDIX A ENTERTAINMENT NOISE IMPACT ASSESSMENT

**APPENDIX A1 SOUND POWER LEVELS OF NOISE SOURCES (FIXED
PLANT NOISE ITEMS FROM LAGOON NIGHT SHOW)**

Appendix A-1

Sound Power Levels of Noise Sources (Fixed Plant Noise Items from Lagoon Night Show)

NSRs	Sound Power Level (SWL) of each speaker, dB(A)	No. of Speaker	Total Sound Power Level (SWL) from each pole/point source speaker, dB(A)	Sound Pressure Level (SPL) at 9m away from each pole/point source speaker, dB(A)
LS1	89	5	96.0	69
LS2	88	3	92.8	66
LS3	88	3	92.8	66
LS4	88	3	92.8	66
LS5	88	3	92.8	66
LS6	88	2	91.0	64
LS7	88	4	94.0	67
LS8	88	4	94.0	67
LS9	88	4	94.0	67
LS10	88	3	92.8	66
LS11	88	4	94.0	67
LS12	88	4	94.0	67
LS13	88	3	92.8	66
LS14	89	5	96.0	69
LS15	89	5	96.0	69
LS16	89	5	96.0	69
LS17	88	4	94.0	67
PS1	91	1	91.0	64
PS2	91	1	91.0	64
PS3	91	1	91.0	64
PS4	91	1	91.0	64
PS5	91	1	91.0	64
PS6	91	1	91.0	64
PS7	91	1	91.0	64
PS9	91	1	91.0	64
PS11	91	1	91.0	64
PS13	91	1	91.0	64
PS15	91	2	94.0	67
PS16	91	2	94.0	67
SW1	92	1	92.0	65
SW2	92	1	92.0	65
SW3	92	1	92.0	65
SW4	92	1	92.0	65
SW5	92	1	92.0	65
SW6	92	1	92.0	65
SW7	92	1	92.0	65
SW8	92	1	92.0	65
SW9	92	1	92.0	65
SW10	92	1	92.0	65
SW11	92	1	92.0	65
SW12	92	1	92.0	65
SW13	92	1	92.0	65
SW14	92	1	92.0	65
SW15	92	1	92.0	65
SW16	92	1	92.0	65
SW17	92	1	92.0	65

Notes:

- LS Lighting & audio pole, each will hold 2 to 5 nos. of speakers.
- PS Point source speaker
- SW Subwoofer speaker

APPENDIX A2 FIXED PLANT NOISE PREDICTION (FIXED PLANT NOISE ITEMS FROM LAGOON NIGHT SHOW)

Appendix A-2

Fixed Plant Noise Prediction (Fixed Plant Noise Items from Lagoon Night Show)

NSR		PTS1				
Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	137	-51	-10	3	38
LS2	92.8	132	-50	-10	3	35
LS3	92.8	141	-51	-10	3	35
LS4	92.8	153	-52	-10	3	34
LS5	92.8	165	-52	-10	3	33
LS6	91.0	176	-53	-10	3	31
LS7	94.0	188	-53	-10	3	34
LS8	94.0	202	-54	-10	3	33
LS9	94.0	213	-55	-10	3	32
LS10	92.8	225	-55	-10	3	31
LS11	94.0	225	-55	-10	3	32
LS12	94.0	223	-55	-10	3	32
LS13	92.8	232	-55	-10	3	30
LS14	96.0	203	-54	-10	3	35
LS15	96.0	188	-53	-10	3	36
LS16	96.0	164	-52	-10	3	37
LS17	94.0	154	-52	-10	3	35
PS1	91.0	167	-52	-10	3	32
PS2	91.0	183	-53	-10	3	31
PS3	91.0	194	-54	-10	3	30
PS4	91.0	205	-54	-10	3	30
PS5	91.0	216	-55	-10	3	29
PS6	91.0	219	-55	-10	3	29
PS7	91.0	206	-54	-10	3	30
PS9	91.0	173	-53	-10	3	31
PS11	91.0	145	-51	-10	3	33
PS13	91.0	134	-51	-10	3	33
PS15	94.0	185	-53	-10	3	34
PS16	94.0	141	-51	-10	3	36
SW1	92.0	139	-51	-10	3	34
SW2	92.0	151	-52	-10	3	33
SW3	92.0	164	-52	-10	3	33
SW4	92.0	174	-53	-10	3	32
SW5	92.0	200	-54	-10	3	31
SW6	92.0	218	-55	-10	3	30
SW7	92.0	223	-55	-10	3	30
SW8	92.0	220	-55	-10	3	30
SW9	92.0	228	-55	-10	3	30
SW10	92.0	135	-51	-10	3	34
SW11	92.0	180	-53	-10	3	32
SW12	92.0	182	-53	-10	3	32
SW13	92.0	183	-53	-10	3	32
SW14	92.0	185	-53	-10	3	32
SW15	92.0	186	-53	-10	3	32
SW16	92.0	228	-55	-10	3	30
SW17	92.0	185	-53	-10	3	32
Total SPL						50

Noise Source	Sound Power Level (SWL), dB(A)	Distance (m)	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	335	-59	-10	3	30
LS2	92.8	319	-58	-10	3	28
LS3	92.8	296	-57	-10	3	28
LS4	92.8	289	-57	-10	3	29
LS5	92.8	291	-57	-10	3	28
LS6	91.0	294	-57	-10	3	27
LS7	94.0	287	-57	-10	3	30
LS8	94.0	293	-57	-10	3	30
LS9	94.0	289	-57	-10	3	30
LS10	92.8	294	-57	-10	3	28
LS11	94.0	313	-58	-10	3	29
LS12	94.0	330	-58	-10	3	29
LS13	92.8	346	-59	-10	3	27
LS14	96.0	339	-59	-10	3	30
LS15	96.0	334	-58	-10	3	31
LS16	96.0	336	-59	-10	3	30
LS17	94.0	343	-59	-10	3	28
PS1	91.0	293	-57	-10	3	27
PS2	91.0	292	-57	-10	3	27
PS3	91.0	296	-57	-10	3	27
PS4	91.0	298	-57	-10	3	27
PS5	91.0	317	-58	-10	3	26
PS6	91.0	334	-58	-10	3	26
PS7	91.0	338	-59	-10	3	25
PS9	91.0	332	-58	-10	3	26
PS11	91.0	332	-58	-10	3	26
PS13	91.0	324	-58	-10	3	26
PS15	94.0	357	-59	-10	3	28
PS16	94.0	361	-59	-10	3	28
SW1	92.0	298	-57	-10	3	28
SW2	92.0	291	-57	-10	3	28
SW3	92.0	291	-57	-10	3	28
SW4	92.0	295	-57	-10	3	28
SW5	92.0	288	-57	-10	3	28
SW6	92.0	292	-57	-10	3	28
SW7	92.0	304	-58	-10	3	27
SW8	92.0	341	-59	-10	3	26
SW9	92.0	346	-59	-10	3	26
SW10	92.0	312	-58	-10	3	27
SW11	92.0	335	-58	-10	3	27
SW12	92.0	335	-58	-10	3	27
SW13	92.0	335	-58	-10	3	27
SW14	92.0	335	-58	-10	3	27
SW15	92.0	334	-58	-10	3	27
SW16	92.0	328	-58	-10	3	27
SW17	92.0	289	-57	-10	3	28
Total SPL						44

Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	304	-58	0	3	41
LS2	92.8	295	-57	0	3	38
LS3	92.8	277	-57	-10	3	29
LS4	92.8	267	-57	-10	3	29
LS5	92.8	260	-56	0	3	39
LS6	91.0	255	-56	0	3	38
LS7	94.0	244	-56	0	3	41
LS8	94.0	240	-56	0	3	41
LS9	94.0	231	-55	0	3	42
LS10	92.8	228	-55	0	3	41
LS11	94.0	243	-56	0	3	41
LS12	94.0	259	-56	0	3	41
LS13	92.8	270	-57	-10	3	29
LS14	96.0	277	-57	0	3	42
LS15	96.0	279	-57	0	3	42
LS16	96.0	291	-57	0	3	42
LS17	94.0	302	-58	0	3	39
PS1	91.0	260	-56	0	3	38
PS2	91.0	250	-56	0	3	38
PS3	91.0	247	-56	0	3	38
PS4	91.0	242	-56	0	3	38
PS5	91.0	251	-56	0	3	38
PS6	91.0	264	-56	0	3	38
PS7	91.0	274	-57	0	3	37
PS9	91.0	284	-57	0	3	37
PS11	91.0	298	-57	0	3	37
PS13	91.0	298	-57	0	3	37
PS15	94.0	300	-58	0	3	39
PS16	94.0	323	-58	0	3	39
SW1	92.0	280	-57	0	3	38
SW2	92.0	269	-57	-10	3	28
SW3	92.0	261	-56	-10	3	29
SW4	92.0	258	-56	0	3	39
SW5	92.0	238	-56	0	3	39
SW6	92.0	231	-55	0	3	40
SW7	92.0	237	-55	0	3	40
SW8	92.0	271	-57	0	3	38
SW9	92.0	272	-57	0	3	38
SW10	92.0	289	-57	-10	3	28
SW11	92.0	283	-57	0	3	38
SW12	92.0	282	-57	0	3	38
SW13	92.0	281	-57	0	3	38
SW14	92.0	281	-57	0	3	38
SW15	92.0	280	-57	0	3	38
SW16	92.0	255	-56	0	3	39
SW17	92.0	247	-56	0	3	39
Total SPL						55

Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	364	-59	-10	3	30
LS2	92.8	359	-59	-10	3	27
LS3	92.8	344	-59	-10	3	27
LS4	92.8	333	-58	-10	3	27
LS5	92.8	323	-58	-10	3	28
LS6	91.0	316	-58	-10	3	26
LS7	94.0	304	-58	-10	3	29
LS8	94.0	296	-57	-10	3	30
LS9	94.0	285	-57	-10	3	30
LS10	92.8	279	-57	-10	3	29
LS11	94.0	291	-57	-10	3	30
LS12	94.0	304	-58	-10	3	29
LS13	92.8	310	-58	-10	3	28
LS14	96.0	325	-58	-10	3	31
LS15	96.0	330	-58	-10	3	31
LS16	96.0	347	-59	-10	3	30
LS17	94.0	358	-59	-10	3	28
PS1	91.0	322	-58	-10	3	26
PS2	91.0	310	-58	-10	3	26
PS3	91.0	304	-58	-10	3	26
PS4	91.0	297	-57	-10	3	27
PS5	91.0	300	-58	-10	3	26
PS6	91.0	310	-58	-10	3	26
PS7	91.0	321	-58	-10	3	26
PS9	91.0	330	-58	-10	3	26
PS11	91.0	347	-59	-10	3	25
PS13	91.0	360	-59	-10	3	25
PS15	94.0	349	-59	-10	3	28
PS16	94.0	379	-60	-10	3	27
SW1	92.0	354	-59	-10	3	26
SW2	92.0	346	-59	-10	3	26
SW3	92.0	335	-58	-10	3	27
SW4	92.0	325	-58	-10	3	27
SW5	92.0	318	-58	-10	3	27
SW6	92.0	288	-57	-10	3	28
SW7	92.0	284	-57	-10	3	28
SW8	92.0	291	-57	-10	3	28
SW9	92.0	300	-58	-10	3	27
SW10	92.0	314	-58	-10	3	27
SW11	92.0	336	-59	-10	3	26
SW12	92.0	335	-58	-10	3	27
SW13	92.0	334	-58	-10	3	27
SW14	92.0	333	-58	-10	3	27
SW15	92.0	332	-58	-10	3	27
SW16	92.0	290	-57	-10	3	28
SW17	92.0	290	-57	-10	3	28
Total SPL						44

Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	324	-58	-10	3	31
LS2	92.8	323	-58	-10	3	28
LS3	92.8	313	-58	-10	3	28
LS4	92.8	301	-58	-10	3	28
LS5	92.8	289	-57	-10	3	29
LS6	91.0	279	-57	-10	3	27
LS7	94.0	267	-57	-10	3	31
LS8	94.0	255	-56	-10	3	31
LS9	94.0	244	-56	-10	3	31
LS10	92.8	234	-55	-10	3	30
LS11	94.0	241	-56	-10	3	31
LS12	94.0	252	-56	-10	3	31
LS13	92.8	254	-56	-10	3	30
LS14	96.0	274	-57	-10	3	32
LS15	96.0	282	-57	-10	3	32
LS16	96.0	302	-58	-10	3	31
LS17	94.0	314	-58	-10	3	29
PS1	91.0	287	-57	-10	3	27
PS2	91.0	272	-57	-10	3	27
PS3	91.0	263	-56	-10	3	28
PS4	91.0	254	-56	-10	3	28
PS5	91.0	251	-56	-10	3	28
PS6	91.0	257	-56	-10	3	28
PS7	91.0	270	-57	-10	3	27
PS9	91.0	283	-57	-10	3	27
PS11	91.0	304	-58	-10	3	26
PS13	91.0	323	-58	-10	3	26
PS15	94.0	298	-57	-10	3	30
PS16	94.0	334	-58	-10	3	29
SW1	92.0	319	-58	-10	3	27
SW2	92.0	315	-58	-10	3	27
SW3	92.0	303	-58	-10	3	27
SW4	92.0	290	-57	-10	3	28
SW5	92.0	281	-57	-10	3	28
SW6	92.0	245	-56	-10	3	29
SW7	92.0	240	-56	-10	3	29
SW8	92.0	241	-56	-10	3	29
SW9	92.0	247	-56	-10	3	29
SW10	92.0	258	-56	-10	3	29
SW11	92.0	289	-57	-10	3	28
SW12	92.0	288	-57	-10	3	28
SW13	92.0	287	-57	-10	3	28
SW14	92.0	285	-57	-10	3	28
SW15	92.0	284	-57	-10	3	28
SW16	92.0	241	-56	-10	3	29
SW17	92.0	241	-56	-10	3	29
Total SPL						46

Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	392	-60	-10	3	29
LS2	92.8	392	-60	-10	3	26
LS3	92.8	382	-60	-10	3	26
LS4	92.8	371	-59	-10	3	26
LS5	92.8	359	-59	-10	3	27
LS6	91.0	348	-59	-10	3	25
LS7	94.0	336	-59	-10	3	28
LS8	94.0	324	-58	-10	3	29
LS9	94.0	313	-58	-10	3	29
LS10	92.8	303	-58	-10	3	28
LS11	94.0	308	-58	-10	3	29
LS12	94.0	318	-58	-10	3	29
LS13	92.8	318	-58	-10	3	28
LS14	96.0	340	-59	-10	3	30
LS15	96.0	350	-59	-10	3	30
LS16	96.0	370	-59	-10	3	30
LS17	94.0	382	-60	-10	3	27
PS1	91.0	357	-59	-10	3	25
PS2	91.0	342	-59	-10	3	25
PS3	91.0	332	-58	-10	3	26
PS4	91.0	322	-58	-10	3	26
PS5	91.0	318	-58	-10	3	26
PS6	91.0	323	-58	-10	3	26
PS7	91.0	336	-59	-10	3	25
PS9	91.0	351	-59	-10	3	25
PS11	91.0	372	-59	-10	3	25
PS13	91.0	392	-60	-10	3	24
PS15	94.0	364	-59	-10	3	28
PS16	94.0	401	-60	-10	3	27
SW1	92.0	389	-60	-10	3	25
SW2	92.0	385	-60	-10	3	25
SW3	92.0	373	-59	-10	3	26
SW4	92.0	360	-59	-10	3	26
SW5	92.0	351	-59	-10	3	26
SW6	92.0	314	-58	-10	3	27
SW7	92.0	309	-58	-10	3	27
SW8	92.0	308	-58	-10	3	27
SW9	92.0	313	-58	-10	3	27
SW10	92.0	322	-58	-10	3	27
SW11	92.0	356	-59	-10	3	26
SW12	92.0	355	-59	-10	3	26
SW13	92.0	354	-59	-10	3	26
SW14	92.0	353	-59	-10	3	26
SW15	92.0	351	-59	-10	3	26
SW16	92.0	308	-58	-10	3	27
SW17	92.0	308	-58	-10	3	27
Total SPL						44

Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	428	-61	-10	3	28
LS2	92.8	431	-61	-10	3	25
LS3	92.8	424	-61	-10	3	25
LS4	92.8	413	-60	-10	3	25
LS5	92.8	399	-60	-10	3	26
LS6	91.0	387	-60	-10	3	24
LS7	94.0	376	-59	-10	3	28
LS8	94.0	361	-59	-10	3	28
LS9	94.0	350	-59	-10	3	28
LS10	92.8	339	-59	-10	3	27
LS11	94.0	341	-59	-10	3	28
LS12	94.0	348	-59	-10	3	28
LS13	92.8	345	-59	-10	3	27
LS14	96.0	370	-59	-10	3	30
LS15	96.0	382	-60	-10	3	29
LS16	96.0	404	-60	-10	3	29
LS17	94.0	415	-60	-10	3	27
PS1	91.0	397	-60	-10	3	24
PS2	91.0	381	-60	-10	3	24
PS3	91.0	370	-59	-10	3	25
PS4	91.0	359	-59	-10	3	25
PS5	91.0	351	-59	-10	3	25
PS6	91.0	353	-59	-10	3	25
PS7	91.0	366	-59	-10	3	25
PS9	91.0	384	-60	-10	3	24
PS11	91.0	407	-60	-10	3	24
PS13	91.0	430	-61	-10	3	23
PS15	94.0	393	-60	-10	3	27
PS16	94.0	433	-61	-10	3	26
SW1	92.0	428	-61	-10	3	24
SW2	92.0	426	-61	-10	3	24
SW3	92.0	414	-60	-10	3	25
SW4	92.0	401	-60	-10	3	25
SW5	92.0	390	-60	-10	3	25
SW6	92.0	350	-59	-10	3	26
SW7	92.0	346	-59	-10	3	26
SW8	92.0	341	-59	-10	3	26
SW9	92.0	343	-59	-10	3	26
SW10	92.0	350	-59	-10	3	26
SW11	92.0	389	-60	-10	3	25
SW12	92.0	388	-60	-10	3	25
SW13	92.0	386	-60	-10	3	25
SW14	92.0	385	-60	-10	3	25
SW15	92.0	384	-60	-10	3	25
SW16	92.0	341	-59	-10	3	26
SW17	92.0	341	-59	-10	3	26
Total SPL						43

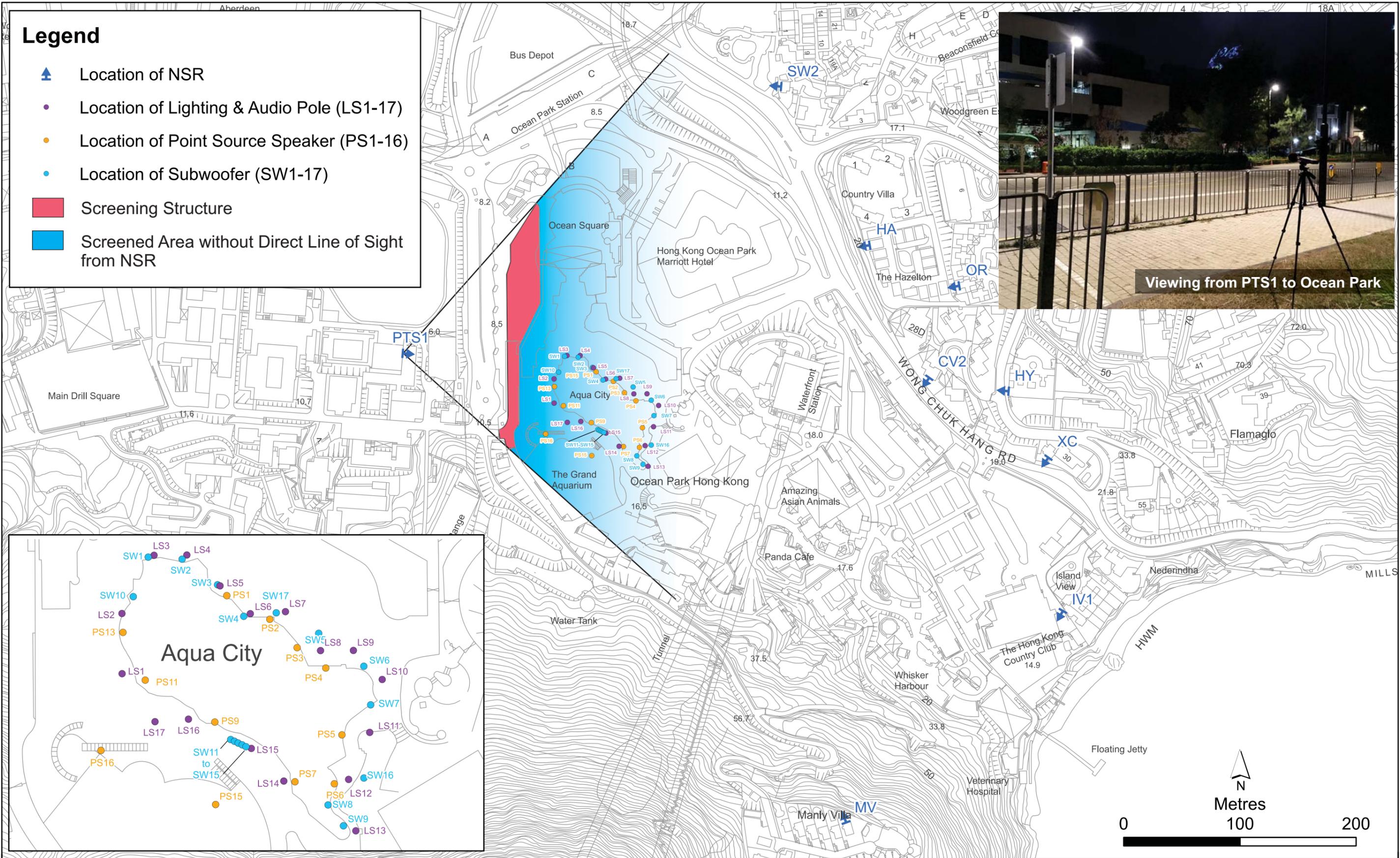
Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	473	-61	-10	3	27
LS2	92.8	481	-62	-10	3	24
LS3	92.8	480	-62	-10	3	24
LS4	92.8	470	-61	-10	3	24
LS5	92.8	455	-61	-10	3	25
LS6	91.0	441	-61	-10	3	23
LS7	94.0	431	-61	-10	3	26
LS8	94.0	414	-60	-10	3	27
LS9	94.0	404	-60	-10	3	27
LS10	92.8	390	-60	-10	3	26
LS11	94.0	386	-60	-10	3	27
LS12	94.0	387	-60	-10	3	27
LS13	92.8	378	-60	-10	3	26
LS14	96.0	407	-60	-10	3	29
LS15	96.0	422	-61	-10	3	28
LS16	96.0	446	-61	-10	3	28
LS17	94.0	456	-61	-10	3	26
PS1	91.0	451	-61	-10	3	23
PS2	91.0	434	-61	-10	3	23
PS3	91.0	422	-60	-10	3	24
PS4	91.0	410	-60	-10	3	24
PS5	91.0	395	-60	-10	3	24
PS6	91.0	391	-60	-10	3	24
PS7	91.0	404	-60	-10	3	24
PS9	91.0	426	-61	-10	3	23
PS11	91.0	450	-61	-10	3	23
PS13	91.0	478	-62	-10	3	22
PS15	94.0	427	-61	-10	3	26
PS16	94.0	470	-61	-10	3	26
SW1	92.0	480	-62	-10	3	23
SW2	92.0	482	-62	-10	3	23
SW3	92.0	471	-61	-10	3	24
SW4	92.0	456	-61	-10	3	24
SW5	92.0	443	-61	-10	3	24
SW6	92.0	402	-60	-10	3	25
SW7	92.0	398	-60	-10	3	25
SW8	92.0	386	-60	-10	3	25
SW9	92.0	382	-60	-10	3	25
SW10	92.0	383	-60	-10	3	25
SW11	92.0	430	-61	-10	3	24
SW12	92.0	428	-61	-10	3	24
SW13	92.0	427	-61	-10	3	24
SW14	92.0	425	-61	-10	3	24
SW15	92.0	424	-61	-10	3	24
SW16	92.0	386	-60	-10	3	25
SW17	92.0	386	-60	-10	3	25
Total SPL						42

Noise Source	Sound Power Level (SWL), dB(A)	Slant Distance	Correction, dB(A)			Corrected Sound Pressure Level, SPL, dB(A)
			Distance	Barrier	Façade	
LS1	96.0	449	-61	0	3	38
LS2	92.8	465	-61	0	3	34
LS3	92.8	476	-62	0	3	34
LS4	92.8	471	-61	0	3	34
LS5	92.8	456	-61	0	3	35
LS6	91.0	443	-61	0	3	33
LS7	94.0	438	-61	0	3	36
LS8	94.0	421	-60	0	3	37
LS9	94.0	416	-60	0	3	37
LS10	92.8	403	-60	0	3	36
LS11	94.0	389	-60	0	3	37
LS12	94.0	378	-60	0	3	37
LS13	92.8	362	-59	0	3	37
LS14	96.0	388	-60	0	3	39
LS15	96.0	403	-60	0	3	39
LS16	96.0	423	-61	0	3	38
LS17	94.0	429	-61	0	3	36
PS1	91.0	453	-61	0	3	33
PS2	91.0	439	-61	0	3	33
PS3	91.0	426	-61	0	3	33
PS4	91.0	416	-60	0	3	34
PS5	91.0	393	-60	0	3	34
PS6	91.0	380	-60	0	3	34
PS7	91.0	387	-60	0	3	34
PS9	91.0	410	-60	0	3	34
PS11	91.0	430	-61	0	3	33
PS13	91.0	461	-61	0	3	33
PS15	94.0	394	-60	0	3	37
PS16	94.0	432	-61	0	3	36
SW1	92.0	469	-61	0	3	34
SW2	92.0	478	-62	0	3	33
SW3	92.0	471	-61	0	3	34
SW4	92.0	458	-61	0	3	34
SW5	92.0	444	-61	0	3	34
SW6	92.0	413	-60	0	3	35
SW7	92.0	411	-60	0	3	35
SW8	92.0	389	-60	0	3	35
SW9	92.0	377	-60	0	3	35
SW10	92.0	366	-59	0	3	36
SW11	92.0	410	-60	0	3	35
SW12	92.0	408	-60	0	3	35
SW13	92.0	407	-60	0	3	35
SW14	92.0	406	-60	0	3	35
SW15	92.0	405	-60	0	3	35
SW16	92.0	388	-60	0	3	35
SW16	92.0	388	-60	0	3	35
Total SPL						52

APPENDIX B DETAILS OF SCREENING BY EXISTING STRUCTURES

Legend

-  Location of NSR
-  Location of Lighting & Audio Pole (LS1-17)
-  Location of Point Source Speaker (PS1-16)
-  Location of Subwoofer (SW1-17)
-  Screening Structure
-  Screened Area without Direct Line of Sight from NSR

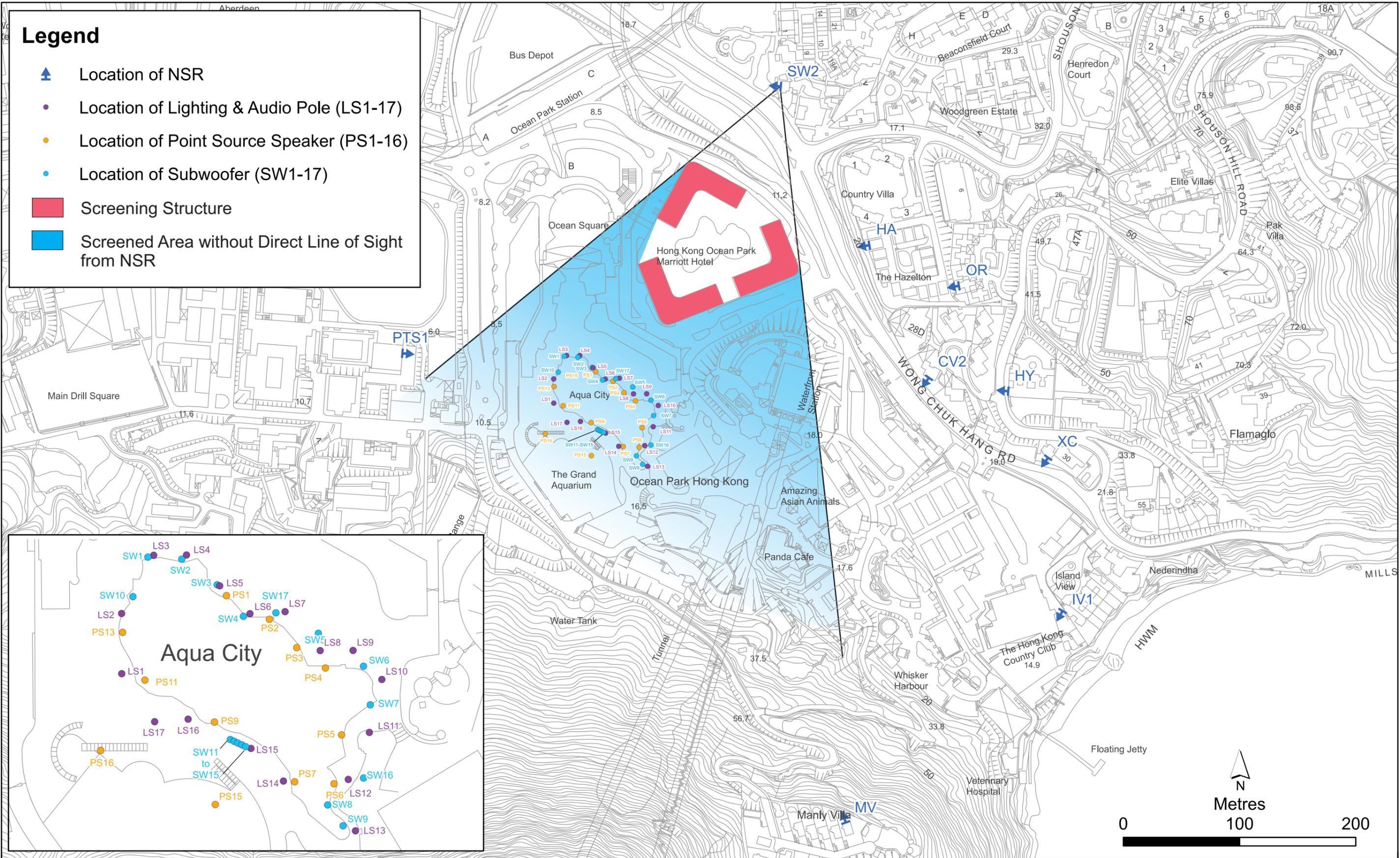


Appendix B1

Details of Screening by Existing Structures (For NSR PTS1)

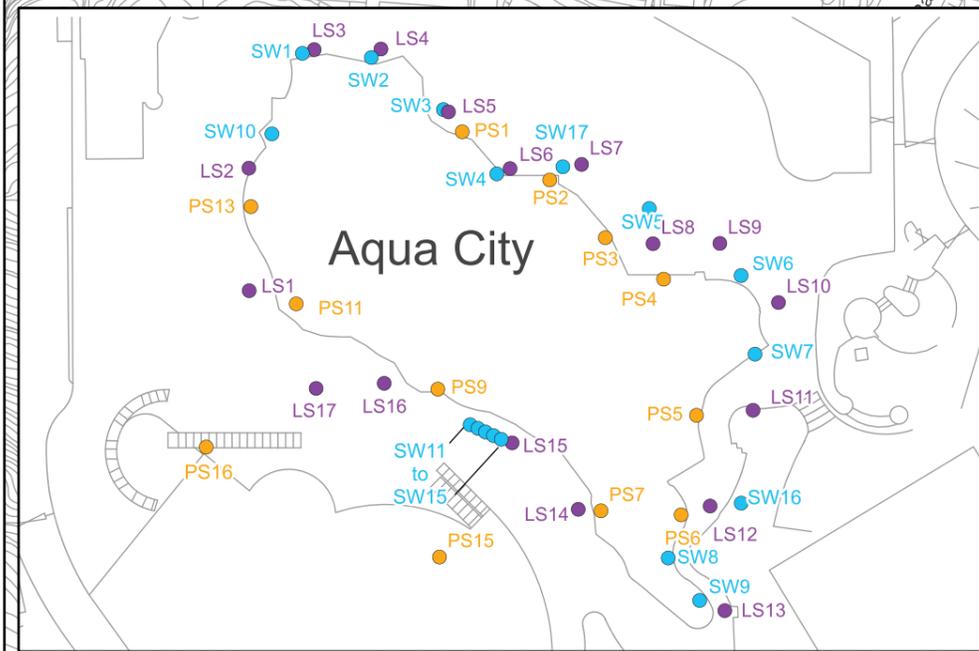
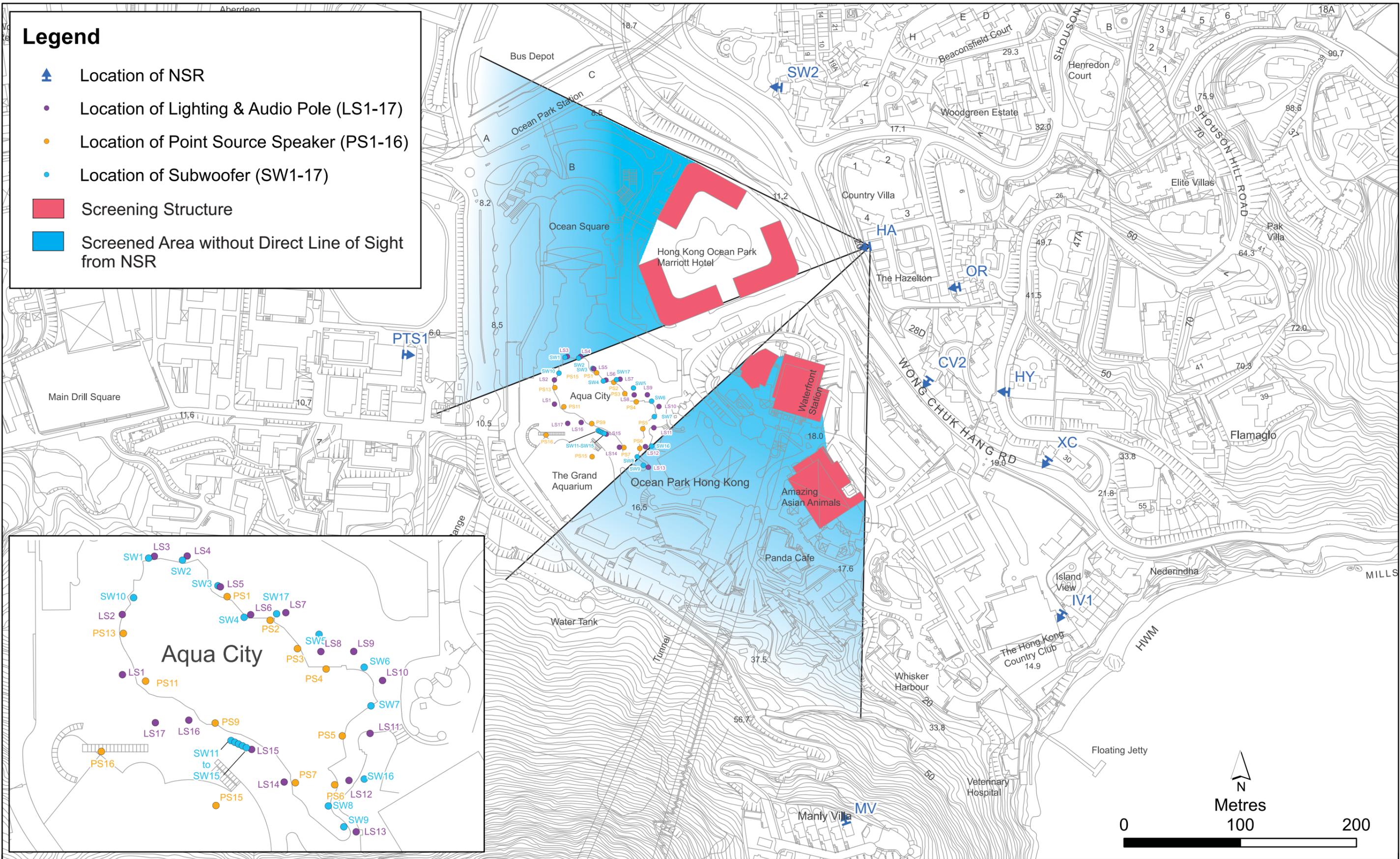
Legend

-  Location of NSR
-  Location of Lighting & Audio Pole (LS1-17)
-  Location of Point Source Speaker (PS1-16)
-  Location of Subwoofer (SW1-17)
-  Screening Structure
-  Screened Area without Direct Line of Sight from NSR



Legend

-  Location of NSR
-  Location of Lighting & Audio Pole (LS1-17)
-  Location of Point Source Speaker (PS1-16)
-  Location of Subwoofer (SW1-17)
-  Screening Structure
-  Screened Area without Direct Line of Sight from NSR



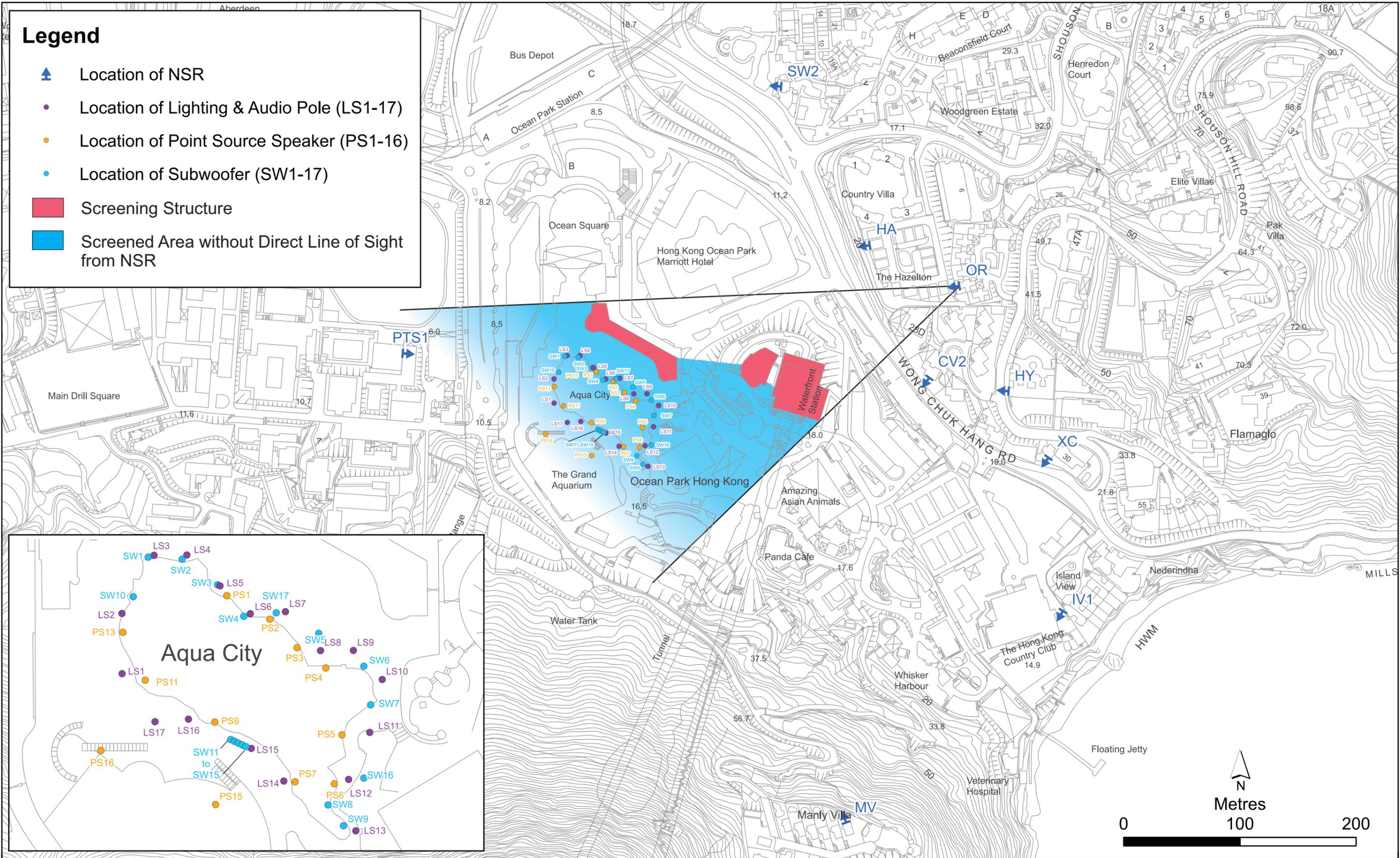
Legend

-  Location of NSR
-  Location of Lighting & Audio Pole (LS1-17)
-  Location of Point Source Speaker (PS1-16)
-  Location of Subwoofer (SW1-17)
-  Screening Structure
-  Screened Area without Direct Line of Sight from NSR



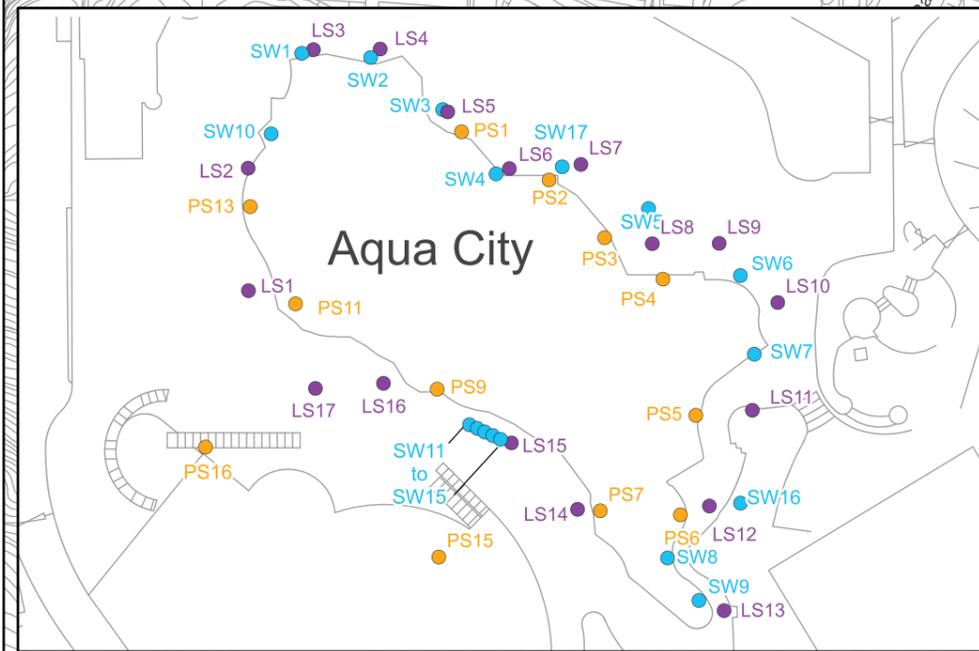
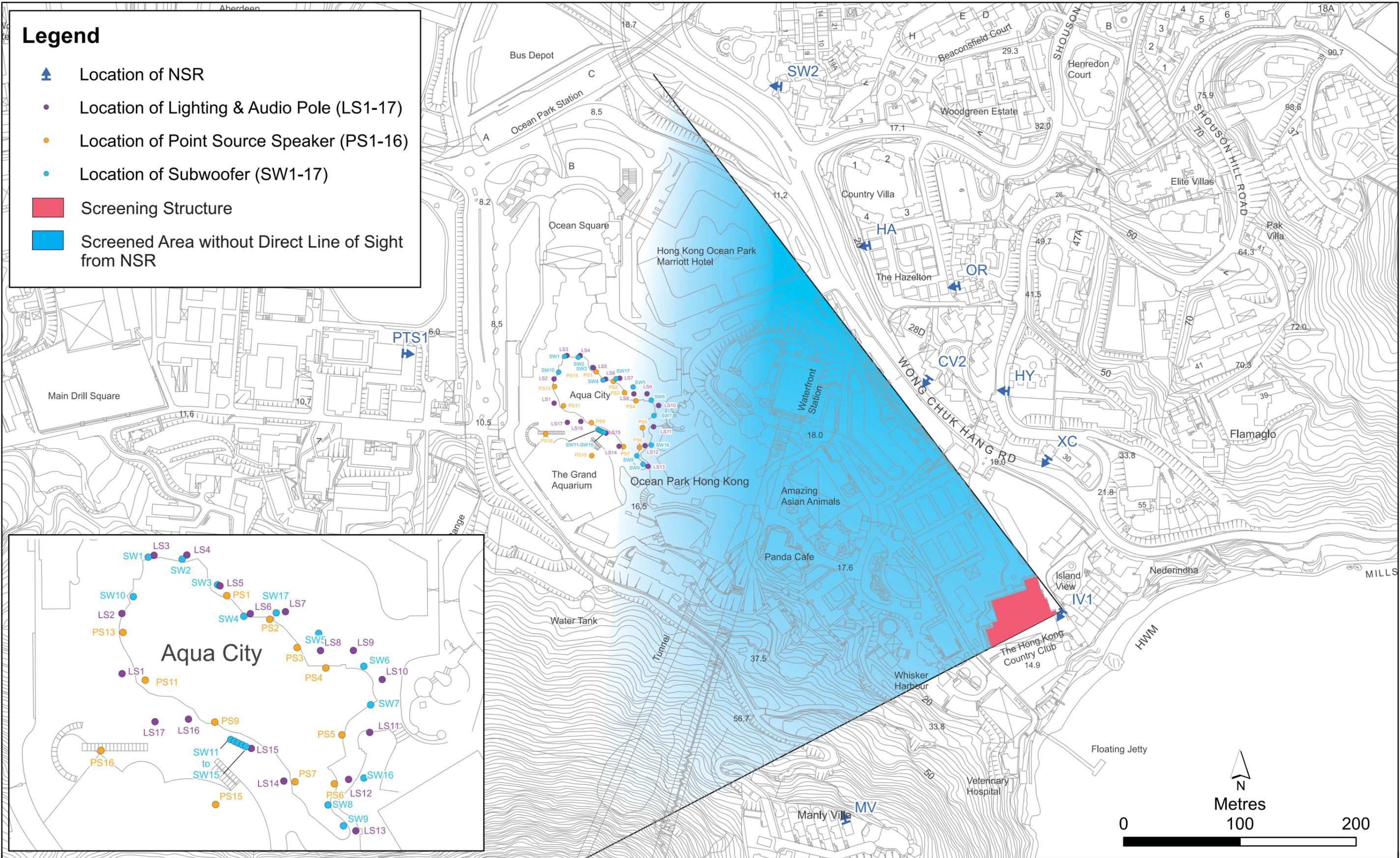
Legend

-  Location of NSR
-  Location of Lighting & Audio Pole (LS1-17)
-  Location of Point Source Speaker (PS1-16)
-  Location of Subwoofer (SW1-17)
-  Screening Structure
-  Screened Area without Direct Line of Sight from NSR



Legend

-  Location of NSR
-  Location of Lighting & Audio Pole (LS1-17)
-  Location of Point Source Speaker (PS1-16)
-  Location of Subwoofer (SW1-17)
-  Screening Structure
-  Screened Area without Direct Line of Sight from NSR



APPENDIX C IMPLEMENTATION SCHEDULE

Reference of Noise Review Study Report	Reference from approved EIA Report	Recommended Environmental Protection Measures/ Mitigation Measures	Who to implement the measures?	When to implement the measures?
S3.5	S3.139 of approved EIA Report	Upon completion of system installation, sound tests to be witnessed by qualified professionals of Independent Environmental Checker (IEC) should be performed to demonstrate that the audio system will satisfy the acoustic design requirements specified in Table 2.2 and Appendix A	OPC	T&C
S3.5	S3.141 of approved EIA Report	Good management practices should be in place, including noise monitoring, setting up a complaint hotline, and distributing advance notice to nearby NSRs. It is recommended that good management practices be implemented during both rehearsals and shows	OPC	Operation
S3.5	S3.142 of approved EIA Report	As a fallback option, should non-compliance of EIAO-TM noise criteria at the NSRs be identified for the lagoon night show, interim measures (such as turning down/off of music volume) should be implemented before long-term measures such as redesigning show with no music/lower music volume are in place	OPC	Operation
S3.6	S2.20-2.23 and 2.25 of the approved EM&A Manual	<p>Reference should be made to Sections 2.20 to 2.23, 2.25 of the approved EM&A Manual for the monitoring requirements and Action and Limit Levels for Entertainment Noise. Monitoring requirements are summarised below for easy reference:</p> <p>Lagoon night show noise monitoring shall be carried out at all the designated monitoring stations (ON1 to ON5) during the performance of lagoon night shows at a logging interval of 30 minutes. The monitoring frequency shall depend on the schedule of the lagoon night shows, and an initial impact monitoring should be conducted at least two times per week, with once on normal weekdays and once on general holidays during the first month of the lagoon night shows.</p> <p>The need for noise monitoring during the lagoon night show should be reviewed monthly based on the previous monitoring results, any adjustment to the loudspeaker system, and any change to the show schedule or rundown. For the same loudspeaker system and show rundown, if the noise levels of the month comply with the noise criteria as stipulated in Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), or are consistent with the baseline noise levels, ET may consider not to include this parameter in the subsequent monitoring programme. Agreement from the IEC and EPD must be obtained prior to suspension of noise monitoring. Impact monitoring shall re-commence if there is any change to the power, orientation, and volume of the loudspeaker system, or to the show rundown, or an increase of show frequency</p>	OPC	Operation

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