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1. INTRODUCTION

Background

1.1 This is the Operational Noise Monitoring Report prepared by ENSR Asia (HK) Ltd. (ENSR), the designated Environmental Team (ET), for the Project "Infrastructural Works for Cyberport Development at Telegraph Bay". This report presents the results of operational traffic noise level at noise sensitive receivers (NSRs) identified in the latest Traffic Noise Monitoring Plan (October 2008). The objective of this report is to assess whether the level of traffic noise measured at the designated NSRs are comparable to those predicted noise levels in the report of "Cyberport Residential Development at Telegraph Bay, Pok Fu Lam -- Traffic Noise Impact Review (March 2008)" [2] under the full provision of the latest mitigation measures recommended.

1.2 In accordance with the Environmental Permit of "Infrastructural Works for Cyberport Development at Telegraph Bay (Environmental Permit No.: EP-040/1999/E" [1], in order to assess the effectiveness of the proposed noise mitigation measures, traffic noise monitoring is required to be carried out at the NSRs within one year after the issuance of Occupation Permit (OP) from Buildings Department for the last Phase of the Development. Occupation Permit (OP No.: HK20/2008(OP)) for the last Phase of the Development had been issued on 1 August 2008. The operational noise monitoring requirements are also stipulated in the Environmental Permit No.EP-040/1999/E Condition No. 5.2.

1.3 In accordance with the Traffic Noise Monitoring Plan (October 2008), the noise measurements were conducted at 2 designated monitoring locations (with one low floor and one medium floor monitoring points at each monitoring station) as shown in Figure 2.1 & 2.2. The objectives of the measurements were to obtain sound pressure levels (SPL), in $L_{10\ (1\text{-hour})}$, as measured at the sensitive receivers during the morning traffic peak hour, afternoon traffic hour and evening traffic peak hour and compare with the Traffic Noise Impact Review's (March 2008) [2] predictions in year 2022.

1.4 In addition to the SPL measurement, relevant information, including traffic counts, speed checks, weather conditions, activities which might generate extraneous noises were also recorded.

1.5 This report presents the operational noise measurement methodology and results and observations of monitoring events carried out within one year after the issuance of Occupation Permit (OP) from Buildings Department for the last Phase of the Development, i.e. before 1 August 2009.

2. MEASUREMENT METHODOLOGY

Measurement Time

2.1 Traffic noise measurements were conducted on 10 September 2008 and 2 October 2008 (normal weekdays) during AM traffic peak hour period (around 08:30 - 09:30), during afternoon period (around 12:00 - 13:00) and during PM traffic peak hour period (around 17:30 - 18:30). The peak hour traffic noise measurement periods (i.e. AM traffic peak hour period, afternoon period and PM traffic peak hour period) was advised by the traffic consultant of the captioned project.

Noise Monitoring Locations (Noise Sensitive Receivers)

2.2 Noise measurements were conducted at two designated monitoring locations (with one low floor and one medium floor monitoring points at each monitoring location), M1 and M2, according to the latest Traffic Noise Monitoring Plan (October 2008) which were shown in Figure 2.1 & 2.2. Table 2.1 describes these monitoring stations.

Table 2.1 Noise Monitoring Locations (Sensitive Receivers) during Operational Phase

Noise Sensitive Receivers stated in the Report*	Monitoring Station	Location	Predicted Noise Level, L_{10} dB(A) in Year 2022 (Without Route 4 & With Mitigation Measures)	Noise Standard L_{10} (peak hour) (dB(A))
T7B	M1	8/F & 16/F Flat B of Tower T7 of Phase RIII & IVA high-rise residential building	65.1 (8/F)	70
			69.4 (16/F)	
T6A	M2	9/F & 15/F Flat A of Tower T6 of Phase RV high-rise residential building	69.9 (9/F)	
			70.4 (15/F)	

Note: * The report of "Cyberport Residential Development at Telegraph Bay, Pok Fu Lam – Traffic Noise Impact Review"[2] dated March 2008.

Noise Monitoring Equipment

2.3 The Sound Level Meters used for the monitoring comply with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1). The instrumentation used for the noise monitoring is given Table 2.2.

Table 2.2 Traffic Noise Monitoring Equipment

Manufacturer	Description
Integrating Sound Level Meter	Bruel & Kjaer 2238
Calibrator	Bruel & Kjaer 4231

Maintenance and Calibration

2.4 The sound level meters were calibrated using a Bruel and Kjaer Sound Level Calibrator Type 4231 for 94dB at 1kHz, prior to and after each set of measurements. The results of the calibration were recorded

on the field data sheet. Measurement results will be discarded if the calibration before and after does not agree to within 1dB(A) and measurement will be taken until this condition is fulfilled.

2.5 Calibration certificates for the sound level meters and calibrator are provided in Appendix A.

Noise Measurement Methodology

2.6 The noise measurements were conducted to obtain three sets of A-weighted $L_{10\ (1\ hour)}$ sound pressure level during AM traffic peak hour period, afternoon period & PM traffic peak hour period over 1-hour period at each designated sensitive receiver.

2.7 The noise measurement point was at a point 1m from the exterior of the sensitive receiver building facades and was at a position at least 1.2m above ground of the sensitive receiver level.

2.8 Noise measurements were made in accordance with Section III of the "Calculation of Road Traffic Noise (CRTN), 1998" [3].

2.9 All monitoring were carried out at 1m from the façade of the building. No monitoring was carried out in a free-field condition.

2.10 Statistical results such as L_{max}, L_{min}, L_{eq} and L_{90} were also obtained for reference purpose.

2.11 The wind speed was frequently checked with a portable wind meter.

2.12 Observations were recorded when intrusive noise was unavoidable.

2.13 Noise monitoring was cancelled in the presence of fog, rain, wind with a steady speed exceeding 5 m/s, or wind with gusts exceeding 10 m/s.

Traffic Survey

2.14 Traffic survey was conducted concurrently with the noise measurement for the sections of Cyberport Road near the representative sensitive receivers.

2.15 Background information, including weather conditions and noise sources other than traffic noise from Cyberport Road, was recorded at each sensitive receiver. The traffic survey included monitoring of traffic flow, percentage of heavy and light vehicles and average traffic speed.

2.16 Details of the noise measurement and traffic survey locations as well as relevant activities are presented in Table 2.3.

Table 2.3 Details of the Noise Measurement and Traffic Survey locations

Monitoring Station	Monitoring Station Location	Type of Measurement	Nature	Activities
M1	8/F & 16/F Flat B of Tower T7 of Phase RIII & IVA high-rise residential building	Façade	Noise Sensitive Receiver	• Noise measurement • Recording of noise sources other than traffic along Cyberport Road
--	16/F Flat B of Tower T7 of Phase RIII & IVA high-rise residential building	N/A	Traffic Survey Location	• Traffic flow survey • Traffic Speed measurement • Recording number of heavy vehicles
M2	9/F & 15/F Flat A of Tower T6 of Phase RV high-rise residential building	Façade	Noise Sensitive Receiver	• Noise measurement • Recording of noise sources other than traffic along Cyberport Road
--	15/F Flat A of Tower T6 of Phase RV high-rise residential building	N/A	Traffic Survey Location	• Traffic flow survey • Traffic Speed measurement • Recording number of heavy vehicles

3. MEASUREMENT RESULTS AND OBSERVATIONS

General

3.1 During the course of noise monitoring, road traffic along Cyberport Road was the major noise source. Noise data was continuously recorded by sound level meter at an interval of 1 second. Other sources included construction noise, dog barking, sirens from emergency vehicles and etc. These activities were recorded during the monitoring events and these extraneous noises were not taken into calculation of the traffic noise level.

Traffic Noise Level Monitoring Results

3.2 Traffic noise measurements were conducted on normal weekdays during AM traffic peak hour period (around 08:30 – 09:30), afternoon period (around 12:00 – 13:00) and PM traffic peak hour period (around 17:30 – 18:30) on 10 September and 02 October 2008. Random check of wind speed at the monitoring stations showed that it was below 5 m/s.

3.3 There were some activities, which generated extraneous noises, and these activities were recorded during the monitoring events. Based on the site monitoring records, the measured Leq which was dominant due to activities other than traffic noise would be neglected in the calculation of $L_{10(1hour)}$. Traffic noise monitoring data, extraneous noises' types and its time periods are detailed in Appendix C.

3.4 The summaries of traffic noise levels recorded are provided in Table 3.1.

Table 3.1 Traffic Noise Measurement Results

Monitoring Date	Weather Condition	Monitoring Station	Monitoring Period	Noise Level, $L_{10\ (1\ hour)}$, dB(A)
02 October 2008	Sunny	8/F Flat B of Tower T7 of Phase RIII & IVA high-rise residential building **(M1)**	AM Peak	63.6
			Afternoon	63.1
			PM Peak	61.9
		16/F Flat B of Tower T7 of Phase RIII & IVA high-rise residential building **(M1)**	AM Peak	65.8
			Afternoon	65.1
			PM Peak	64.8
10 September 2008	Sunny	9/F Flat A of Tower T6 of Phase RV high-rise residential building **(M2)**	AM Peak	69.7
			Afternoon	69.0
			PM Peak	68.8
		15/F Flat A of Tower T6 of Phase RV high-rise residential building **(M2)**	AM Peak	68.9
			Afternoon	68.7
			PM Peak	68.8

3.5 Comparison of the edited noise measurement results was made against the Traffic Noise Impact Review (March 2008) [2] predicted noise level and the noise standard of 70 dB(A). Tables 3.2 showed that measurement in L_{10} at the monitoring stations, predicted noise level in the Traffic Noise Impact Review (March 2008) [2] and the noise standard.

Table 3.2 Noise Level Comparison with the Noise Standard

Monitoring Station	Monitoring Period	Measured Noise Level, $L_{10\ (1\ hour)}$ dB(A)	Predicted Noise Level in Traffic Noise Impact Review [2], $L_{10\ (1\ hour)}$ dB(A)	Noise Standard $L_{10\ (1\ hour)}$ dB(A)
8/F at M1	AM Peak	63.6	65.1	70
	Afternoon	63.1	65.1*	
	PM Peak	61.9	65.1*	
16/F at M1	AM Peak	65.8	69.4	
	Afternoon	65.1	69.4*	
	PM Peak	64.8	69.4*	
9/F at M2	AM Peak	69.7	69.9	
	Afternoon	69.0	69.9*	
	PM Peak	68.8	69.9*	
15/F at M2	AM Peak	68.9	70.4	
	Afternoon	68.7	70.4*	
	PM Peak	68.8	70.4*	

Notes: * Year 2022 Two-way AM Peak Hour Flow (without Route 4 and with mitigated measures implemented) was adopted for comparison of other time periods, since it is the worst scenario as stated in the Traffic Noise Impact Review (March 2008)[2]

Road Condition and Traffic Survey

3.6 The road surface of Cyberport Road is asphalt paved. No obstruction or damage was noted from the road surfaces during the monitoring.

3.7 The traffic conditions along Cyberport Road were normal and there was no traffic congestion during the monitoring periods.

3.8 The percentage of heavy vehicle (HV) was generally smaller than that of light vehicle (LV). Details of the measured and the traffic noise impact review [2] predicted traffic flow and the percentage of heavy vehicle are provided in Table 3.3 and detailed in Appendix B.

Table 3.3 Traffic Flow of Cyberport Road (Section 2B) for M1

	Measured Value				Traffic Noise Impact Review [2] prediction (Year 2022 AM Two-way Peak Hour Flow (without Route 4)	
Monitoring Period	LV	HV	Total Flow	Percentage of HV	Traffic Flow*	Percentage of HV*
AM Peak	358	258	616	42%	790	25.7%
Afternoon	406	238	644	37%		
PM Peak	314	196	510	38%		

Notes: * Year 2022 two-way AM peak hour flow (without Route 4) was adopted for comparison of other time periods, since it is the worst scenario as stated in the Traffic Noise Impact Review (March 2008) [2].
HV represents Heavy Vehicle
LV represents Light Vehicle

Table 3.4 Traffic Flow of Cyberport Road (Section 2A) for M2

	Measured Value				Traffic Noise Impact Review [2] prediction (Year 2022 AM Two-way Peak Hour Flow (without Route 4)	
Monitoring Period	LV	HV	Total Flow	Percentage of HV	Traffic Flow*	Percentage of HV*
AM Peak	620	248	868	29%	1020	25.7%
Afternoon	406	294	700	42%		
PM Peak	478	196	674	29%		

Notes: * Year 2022 two-way AM peak hour flow (without Route 4) was adopted for comparison of other time periods, since it is the worst scenario as stated in the Traffic Noise Impact Review (March 2008) [2]
HV represents Heavy Vehicle
LV represents Light Vehicle

3.9 The traffic speeds along Cyberport Road (Section 2A and 2B) were estimated concurrently with the noise measurement. According to the latest Traffic Noise Monitoring Plan (October 2008), traffic speed shall be estimated by measuring the time used by vehicles travelling between two lighting poles of the road and divide the measured time by the distance to obtain the speed. 20 different typed vehicles were randomly picked every 30 minutes (half hour) on both eastward and westward bound of Cyberport Road during the monitoring periods, in order to estimate the average vehicle speed of vehicles travelled on Cyberport Road. Vehicle speed data were detailed in Appendix C. Table 3.4 provides a summary of averaged vehicle speed of the monitoring results and the Traffic Noise Impact Review's (March 2008) [2] prediction.

Table 3.5 Traffic Speed Measurement

	Monitoring Period	Measured Speed (km/hr)	Traffic Noise Impact Review [2] Predicted Speed (km/hr)
Section 2B (at M1)	AM Peak	71	50
	Afternoon	64	
	PM Peak	63	
Section 2A (at M2)	AM Peak	53	
	Afternoon	52	
	PM Peak	50	

4. DISCUSSION

Predicted Noise Levels under the Traffic Flow Condition in 2022

4.1 According to the Traffic Noise Impact Review (March 2008) [2] for the Project, "Cyberport Residential Development at Telegraph Bay, Pok Fu Lam – Traffic Noise Impact Review"[2], under the worst case scenario, the traffic noise levels were predicted to occur in year 2022.

4.2 Based on the Environmental Permit of "Infrastructural Works for Cyberport Development at Telegraph Bay (Environmental Permit No.: EP-040/1999/E"[1], noise monitoring should be carried out at the NSRs with at least 3 sets of measurements within one year after the issuance of Occupation Permit (OP) from Buildings Department for the last Phase of the Development. Occupation Permit (OP No.: HK20/2008(OP)) for the last Phase of the Development had been issued on 1 August 2008. In conjunction with the noise monitoring, traffic information including traffic flow, speed and percentage of heavy vehicles was also obtained.

4.3 The predicted noise level under the traffic flow condition in 2022 was in accordance with Section III of the "Calculation of Road Traffic Noise (CRTN), 1988" [3] for adjustment to the measured traffic noise level by adding a correction factor and for comparison with prediction from the CRTN. This will include the traffic flow, percentage of heavy vehicles, and an average vehicle speed. The following equation extracted from the CRTN was adopted to correct the measured noise level in consideration of the differences between the measured traffic flow and the predicted traffic flow in the Traffic Noise Impact Review (March 2008) [2].

$$* \text{ Correction Factor} = 10\text{Log}\left(\frac{Q'}{Q}\right) + 33\text{Log}\left(\frac{V' + 40 + 500/V'}{V + 40 + 500/V}\right) + 10\text{Log}\left(\frac{1 + 5p'/V'}{1 + 5p/V}\right)$$

Where Q' is predicted traffic flow by using the CRTN noise model,
V' is predicted traffic speed by using the CRTN noise model,
p' is predicted percentage heavy vehicle by using the CRTN noise model,
Q is measured traffic flow during the traffic noise monitoring event,
V is measured traffic speed during the traffic noise monitoring event,
p is measured percentage heavy vehicle during the traffic noise monitoring event.

4.4 The predicted noise levels at the sensitive receivers, M1 and M2 are estimated based on the equation from CRTN.

4.5 Detailed traffic conditions in year 2022 are summarized in the Table 4.1.

Table 4.1 Traffic Noise Impact Review (March 2008) [2] Predicted 2022 Two-way AM Peak Hour (without Route 4) Traffic Data

Noise Monitoring Location	Traffic Flow (Nr/hr)	% of HV	Traffic Speed (km/hr)
M1	790	25.7	50
M2	1020	25.7	50

4.6 The correction factors for each monitoring period were evaluated and summarized in Table 4.2.

Table 4.2 Correction Factor for Different Monitoring Period

Monitoring Location	Monitoring Period	Correction Factor dB(A)
M1	AM Peak	-1.8
	Afternoon	-1.1
	PM Peak	-0.1

M2	AM Peak	0.2
	Afternoon	-0.1
	PM Peak	1.4

4.7 Under the designed traffic condition in Year 2022, the projected noise levels as received at the sensitive receivers, M1 and M2 are estimated and shown in Table 4.3 and detailed calculations are presented in Appendix B.

Table 4.3 Projected and Traffic Noise Impact Review (March 2008) [2] Predicted Noise Level

Monitoring Station	Monitoring Period	Noise Level, $L_{10\ (1\ hour)}$ dB(A)		
		Correction Factor*	Projected Noise Level	Traffic Noise Impact Review [2] Predicted Noise Level#
8/F at M1	AM Peak	-1.8	**61.8**	65.1
	Afternoon	-1.1	**62.0**	
	PM Peak	-0.1	**61.8**	
16/F at M1	AM Peak	-1.8	**64.0**	69.4
	Afternoon	-1.1	**64.0**	
	PM Peak	-0.1	**64.7**	
9/F at M2	AM Peak	0.2	**69.9**	69.9
	Afternoon	-0.1	**68.9**	
	PM Peak	1.4	**70.2**	
15/F at M2	AM Peak	0.2	**69.1**	70.4
	Afternoon	-0.1	**68.6**	
	PM Peak	1.4	**70.2**	

Note * Corrected by traffic flow, speed and percentage of heavy vehicles.
Year 2022 Two-way AM Peak Hour Flow (without Route 4 and with mitigated measures implemented) was adopted for comparison of other time periods, since it is the worst scenario as stated in the Traffic Noise Impact Review (March 2008) [2].

4.8 Comparison of the projected noise level was made against the Traffic Noise Impact Review's (March 2008) [2] prediction for year 2022. The projected noise level for the year 2022 is generally lower than or equal to the predicted year 2022 noise level in the Traffic Noise Impact Review (March 2008) [2].

4.9 Although the projected noise level was generally lower than or equal to the Traffic Noise Impact Review's (March 2008) [2] predictions, the projected noise level for 2022 was still below the noise standard of 70 dB(A).

5. CONCLUSION

5.1 Traffic noise measurements were conducted on normal weekdays during AM traffic peak hour period (around 0830 – 0930), afternoon period (around 12:00 – 13:00) and PM traffic peak hour period (around 17:30 – 18:30) on 10 September 2008 and 2 October 2008. The weather condition was sunny. The traffic conditions, including traffic flows, type of vehicles and average traffic speeds were also monitored during the measurements.

5.2 Activities which generated extraneous noise were recorded, and these irrelevant noise data were not taken into the evaluation of traffic noise levels.

5.3 Sound pressure levels, in $L_{10\ (1hr)}$, were recorded at the 2 designated monitoring locations (with one low floor and one medium floor monitoring points at each monitoring location). Results indicated that all measurement $L_{10\ (1\ hour)}$ levels were below the noise standard of 70 dB(A).

5.4 The traffic flow, speed and percentage of heavy vehicles were recorded during each monitoring period. The correction factors for M1 and M2 were evaluated based on the differences of traffic conditions between these noise measurement events and the predicted traffic condition in Year 2022.

5.5 Comparison of the projected noise level was made against the Traffic Noise Impact Review's (March 2008) [2] prediction for year 2022. The projected noise level for the year 2022 was compared with the predicted year 2022 noise level in the Traffic Noise Impact Review (March 2008) [2] and is generally lower than or equal to the noise level in the Traffic Noise Impact Review (March 2008) [2].

5.6 Although the projected noise level was lower than or equal to the Traffic Noise Impact Review's (March 2008) [2] predictions, the projected noise level for 2022 was still below the noise standard of 70 dB(A).

6. REFERENCES

1. Environmental Protection Department. (September 2008), ***Infrastructural Works for Cyberport Development at Telegraph Bay (Environmental Permit No.: EP-040/1999/E)***.

2. Allied Environmental Consultants Limited. (March 2008), ***Cyberport Residential Development at Telegraph Bay, Pok Fu Lam – Traffic Noise Impact Review***.

3. Department of Transport, UK (1988), ***Calculation of Road Traffic Noise***.