Hong Kong Jockey Club

Main Arena of the 2008 Olympic Equestrian Event

Noise Monitoring Report
For Test Event on 11 and 13 August 2007

FINAL

Hong Kong Jockey Club

Main Arena of the 2008 Olympic Equestrian Event

Noise Monitoring Report For Test Event on 11 and 13 August 2007

December 2007

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Job number 24469 – 70

INDEPENDENT ENVIRONMENTAL CHECKER
CHECK CERTIFICATE

Independent Environmental Checker for
Main Arena of the 2008 Olympic Equestrian Event
Test Event Noise Monitoring Report

We confirm having used reasonable skill and care in the preparation of the Test Event Noise Monitoring Report and we certify that we can verify the report.

Signed: _____

Independent Environmental Checker
H. J. Cochrane
Director and IEC

Date: 4/12/07

ARUP

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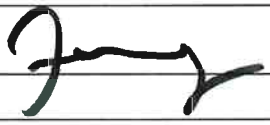
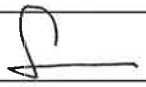
		Signature			
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Contents

Appendices

Executive Summary

Noise monitoring for the Test Event for the Main Arena of the 2008 Olympic Equestrian Event was conducted on August 2007 at the three noise monitoring locations in Shatin. Noise levels were measured and tabulated in terms of $L_{eq,\ 30min}$ dB(A). The weather during the ambient noise monitoring was mainly cloudy with occasional showers. Certain periods of the Test Event noise monitoring was affected by rainfall. As such, noise monitoring data during the raining periods were omitted in the analysis.

Ambient noise measurements were conducted on 4th (Saturday) and 6th (Monday) August 2007 for comparison with the corresponding Test Event monitoring on 11th (Saturday) and 13th (Monday) August 2007. Additional ambient noise measurements were taken on 27th (Monday) August 2007 to evaluate the variation of ambient noise levels.

Daytime variation of the ambient noise levels at NM1 can reach up to 5dB(A) above the Limit Level and that at NM2 up to 14dB(A). The daytime variation at NM3 was slightly below the Limit Level but within a 3dB(A) range. Also, a comparison of the ambient noise monitoring results taken on 6th and 27th August 2007, both conducted during identical times on Monday, has shown consistent variations as given in Tables A-2 and A-3 in Appendix A. Nighttime variation of the ambient noise levels at all three locations have also exceeded the Limit Level by up to 12dB(A).

With a significant upward variation of daytime ambient noise levels at NM1 and NM2 to the Limit Level; and a within 3dB(A) downward variation of the same at NM3, the uncertainty of a conclusive deduction of event contribution will be subject to a level difference of at least 5dB above the ambient, in accordance with the acoustic principles. This level difference criterion of 6dB above ambient applies to both daytime and nighttime deduction of event contribution.

It is not conclusive to suggest the noise from the Test Event has contributed to the higher noise levels measured at the monitored locations. Rather, professional judgment from site observation would indicate the results are significantly affected by the variation of the background noise during the Test Event.

The need for noise limiter device for the PA system is identified in section 4.5.3.2 of the Environmental Impact Assessment report, and the device should be set so that the noise output of the PA system would comply with the relevant TM-EIAO criterion.

1 Introduction

1.1 Project Background

Having considered the advantage of established international equine import and export protocols as well as the supporting facilities already in place, the International Olympic Committee (IOC) has accepted the Beijing Organising Committee for the Games of the 29th Olympiad (BOCOG)'s proposal of staging the 2008 Olympic and Paralympic Equestrian Events in Hong Kong.

Given the very tight schedule of the project, Hong Kong Sports Institute (HKSI) in Shatin has been temporarily converted into the core competition venues for the Olympic Equestrian Event. Facilities provided on the core venues include:

- Main Competition Arena for 20,000 spectators
- Stable Complex
- Training Arenas
- Logistic Compound
- Spectator Entry & Broadcast Compound
- Food & Merchandise

The venues will be in operation for approximately one month during the Olympic event, with the competition expected to last from between 10 to 14 days. 14 days after the Olympic Events, the Paralympic competition will be staged, which will last for a few days.

One year before the 2008 Olympic Event, the site has been occupied for the Test Event, which was used by all divisions of the Olympic Organising Committee to test their organisational capabilities for the Game and Event Management to trail the equine facilities and the footing (riding surface) of the Main Arena, Stables and Training Facilities. These mock up events are known as the 'Test Event Mode', and limited public access would be given.

Figure 1-1 shows the site location plan of the project.

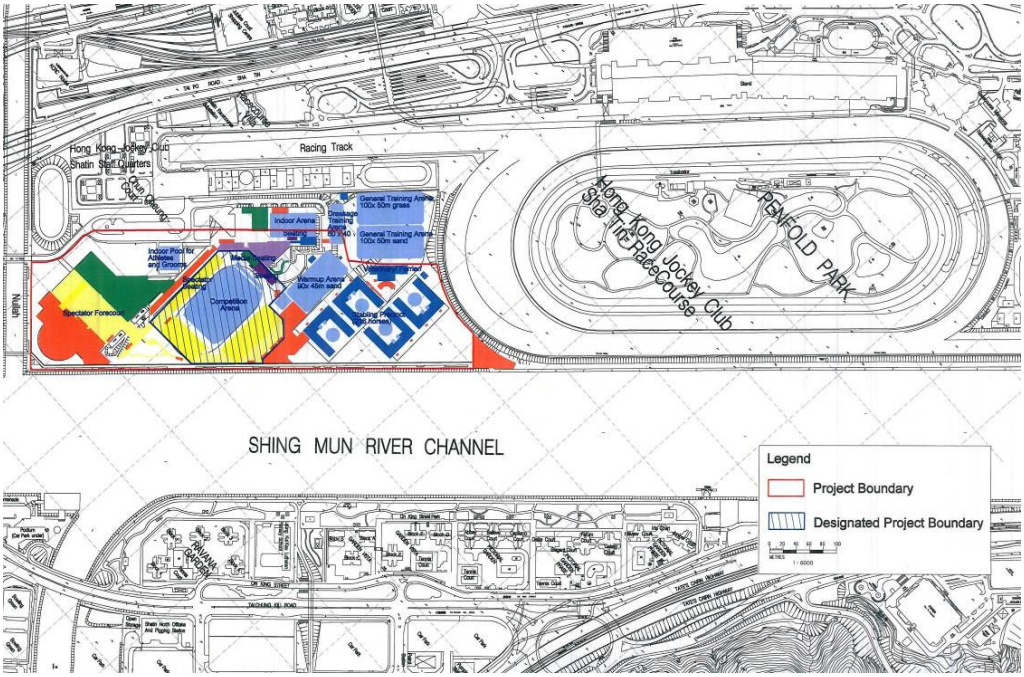
In accordance with the requirements of Section 5(1) of the EIAO, a project profile (No. PP-266/2005) was submitted to Environmental Protection Department (EPD) for the application of an EIA Study Brief on 17 October 2005. Pursuant to Section 5(7)(a) of the EIAO, EPD issued to The Hong Kong Jockey Club (HKJC) a study brief (ref: EIA Study Brief No: ESB-136/2005 dated 7 November 2005) to carry out an EIA study.

The EIA Report for the Project (EIA-118/2005) was approved and an Environmental Permit (EP) (EP-236/2006) granted by EPD on 24th and 25th March 2006 respectively.

1.2 Purpose of this Report

During the discussion meeting between EPD, ET, HKJC, EC and IEC on 5 June 2007, it was resolved to conduct a Test Event monitoring. The purpose is to establish a reference condition for compliance with the noise criteria during the Olympic and Paralympics events. This report gives a summary of the analysis on the noise monitoring results during the Test Event periods.

Figure 1-1: Location plan of the project



2 Operational Noise Criteria

The noise limit levels for operational noise as defined in the Environmental Impact Assessment (EIA) Report and the Environmental Monitoring and Audit (EM&A) Manual are summarised in Table 2-1 below.

Table 2-1: Limit levels for operational noise

Location Reference	Area	Time Period	Limit Level in EM&A Manual (dB(A))
NM1	Chun Cheung Court, HKJC Staff Quarter	Day & evening	59
		Night	50
NM2	Racecourse Villa	Day & evening	55
		Night	50
NM3	Ravana Garden	Day & evening	57
		Night	50

Note: Day – 0700~1900; Evening – 1900~2300; Night – 2300~0700.

3 Noise Monitoring Methodology

3.1 Monitoring Parameters and Equipment

Noise level measurements were taken in terms of A-weighted equivalent continuous sound pressure level (L_{eq}). The measurement periods were tabulated for 30-minute intervals. All sound level meters and calibrators used comply with the International Electrotechnical Commission (IEC) Publication 651:1979 (Type 1) specification and IEC 804 (L_{eq} functions). The calibration certificates for the noise monitoring equipment are given in Appendix A. Equipment used for the noise monitoring is summarised in Table 3-1 below.

Table 3-1: Equipment list for noise monitoring

Equipment	Manufacturer & Model No.	Precision Grade	Qty.
Integrating sound level meter	Brüel & Kjær 2238	IEC 651 Type 1	3
Windshield	Brüel & Kjær UA0237	IEC 804 Type 1	3
Acoustical calibrator	Brüel & Kjær 4231	IEC 942 Type 1	1
Integrating sound level meter	RION NA-27	IEC 651 Type 1	1
1/2" Prepolarized Condenser Microphone	RION Type UC-53 and Preamplifier NH-20	IEC 651 Type 1	1
Foam Windshield	RION Type WS-02	IEC 804 Type 1	1
LCD wind speed indicator	Smart Sensor AR816 Anemometer	--	3

Noise measurements were omitted in the presence of rain or wind with a steady speed exceeding 5m/s, or wind with gusts exceeding 10m/s. The wind speed was checked with a portable meter capable of measurement in m/s.

3.2 Monitoring Locations and Schedule

Noise levels at the representative Noise Sensitive Receivers (NSRs) specified in the EM&A Manual were monitored during the Test Event periods. The sound level meters were set on tripods and the microphones at 1m from the exterior of the building façade, except for those measurements at NM2 and NM3 on 4 and 6 August 2007 where microphones were set at 1.2m above floor. NSR locations are described in Table 3-2 below. Figure 3-1 shows the locations of the NSRs.

Table 3-2: NSR locations

Noise Monitoring Location Reference	Name of Premises	Site Description
NM1	Chun Cheung Court, HKJC Staff Quarter	On the roof of Chun Cheung Court
NM2	Racecourse Villa	On the roof of Racecourse Villa
NM3	Ravana Garden	On the podium area near Block 3. When there was construction activity nearby, it was moved to the podium area near Block 1.

The noise monitoring schedule for Test Event is presented in Table 3-3. Due to a tropical storm on 10 August 2007, the Test Event on 11 August 2007 was delayed for a few hours and the monitoring period was adjusted accordingly.

Table 3-3: Test Event noise monitoring schedule

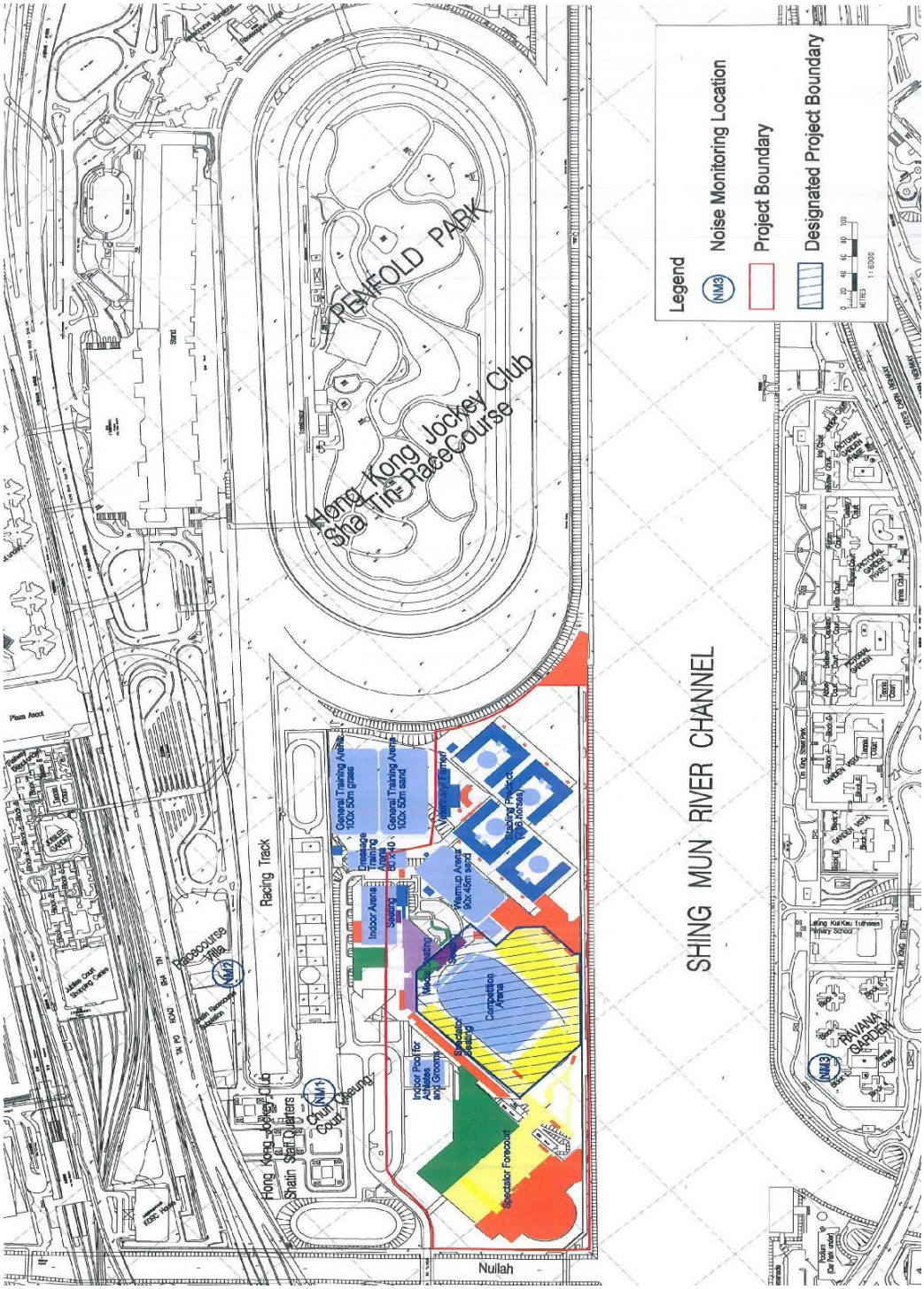
Date	Start of Event	End of Event	Noise Monitoring Period
11 Aug 2007 (Sat)	9:20am	2:40pm	8:00am – 3:00pm
13 Aug 2007 (Mon)	7:00pm	10:50pm	4:00pm – 12:00am

Reference ambient noise levels for the above corresponding periods were taken one week before the Test Event when there were no competition events. Additional ambient noise levels were also taken after the Test Event to evaluate its level of variation. The periods for which ambient noise measurement were taken are shown in Table 3-4.

Table 3-4: Ambient noise monitoring schedule

Date	Ambient Noise Monitoring Period
4 Aug 2007 (Sat)	4:00am – 12:00pm
6 Aug 2007 (Mon)	4:00pm – 12:00am
27 Aug 2007 (Mon)	4:00pm – 12:00am

Figure 3-1: Noise monitoring locations



3.3 Noise Monitoring Procedures

All field measurements have been conducted according to the following procedures:

- The sound level meters and batteries were checked to ensure that they were in proper condition.
- The sound level meters were set on tripods and the microphones at 1m from the exterior of the building façade, except for those measurements at NM2 and NM3 on 4 and 6 August 2007 where microphones were set at 1.2m above floor.
- Before conducting the measurement, the sound level meters were calibrated by an acoustical calibrator.
- The measurement parameter was set to A-weighted sound pressure level. The time weighting was set in fast response. $L_{Aeq\ 30min.}$ was used as the monitoring parameter.
- The wind speed was checked during noise monitoring to ensure the steady wind speed did not exceed 5m/s, or wind with gusts did not exceed 10m/s.
- Any abnormal conditions that generated intrusive noise during the measurement were recorded on the field record sheet.
- The equivalent continuous sound pressure levels (L_{Aeq}) were recorded on the field record sheet.
- The sound level meters were re-calibrated by the acoustical calibrator to confirm that there was no significant drift of reading.

4 Noise Monitoring Results

4.1 Weather Conditions and Major Ambient Noise Sources

Noise monitoring was conducted on 4 August, 6 August & 27 August 2007 for ambient noise and on 11 August & 13 August 2007 for operational noise during the Test Event. The weather during the ambient noise monitoring was mainly cloudy with occasional showers. Certain periods of the Test Event noise monitoring periods was affected by rainfall. Dominated ambient noise sources during monitoring were vehicular traffic and construction (unsteady). Table 4-1 gives the major influencing ambient noise sources at the sensitive receivers during the noise monitoring.

Table 4-1: Major influencing ambient noise sources

Major Ambient Noise Sources	NSR
Construction work along racecourse, KCR railway noise, traffic noise along Tate's Cairn Highway, fixed plant noise	NM1, NM2
Speed boats in Shing Mun River Channel, Local construction activities at Block 3	NM3
Aircraft noise, Traffic activities along Tai Po Road – Shatin	NM1, NM2, NM3

The monitored area has regular overhead aircrafts flyover typically of approximately 20 ~ 30 aircrafts pass-by events in an hour. The project area is also surrounded by major highways, including Tai Po Road (Shatin), Tate's Cairn Highway; railways, including Ma On Shan railway, KCR East Rail. A mix of continuous vehicular traffic, regular aircraft flyover and occasional activities of construction dominates the ambient noise environment of the area.

Ambient noise levels at NM1 and NM2 were influenced by various construction activities and highway traffics. Construction activities along the racecourse were mainly tree planting and included the use of hydraulic breakers. Construction activities of the Ho Tung Lau project mainly comprised of lifting and occasional hammering. Traffic along Tate's Cairn Highway and Ma On Shan railway and ventilation and chillers system from existing HKSI facilities were also noticeable at these two monitoring locations during the ambient noise measurements.

Ambient noise levels at NM3 comprised of speed boats travelling along the Shing Mun River Channel and various activities (such as cycling, jogging and chatting) along the river bank. Refurbishment work was also observed at the external wall of Tower 3 of Ravana Garden. Monitoring point NM3 was relocated to Tower 1 podium area during construction activities at Tower 3.

4.2 Ambient Noise Level Measurements

Ambient noise levels were taken one week before the Test Event. Additional ambient measurements were conducted on 27 August 2007 to check if there is any significant ambient variation. The detailed measurement results are given in Appendix A and Table 4-2 summarises the range of ambient noise level variations over the monitoring period.

Table 4-2: Summary of measured ambient average and range

Monitoring Period	Date	Monitoring Location					
		NM1		NM2		NM3	
		Average (Measured Range)	Limit Level	Average (Measured Range)	Limit Level	Average (Measured Range)	Limit Level
Day & Evening Time	4/8/07	61 (58 ~ 63)	59	63 (60 ~ 65)	55	56 (54 ~ 58)	57
	6/8/07	60 (58 ~ 62)	59	63 (59 ~ 65)	55	56 (54 ~ 57)	57
	27/8/07	62 (60 ~ 64)	59	65 (62 ~ 69)	55	56 (54 ~ 57)	57
Night Time	4/8/07	56 (54 ~ 58)	50	57 (56 ~ 59)	50	56 (52 ~ 57)	50
	6/8/07	59 (57 ~ 60)	50	61 (59 ~ 62)	50	53	50
	27/8/07	---	50	---	50	---	50

Ambient noise readings at NM1 indicated increasing levels from 54 to 64dB(A) over the measurement period, as a result of the contribution from the major influencing noise sources in the surrounding. The same is recorded at NM2 in the range of 56 to 69dB(A). Similarly, the ambient noise readings at NM3 were also increasing over the measurement period from 52 to 58dB(A), but at a lower level compared with NM1 and NM2, indicating the major influencing noise sources nearby were less significant.

Daytime variation of the ambient noise levels at NM1 can reach up to 5dB(A) above the Limit Level and that at NM2 up to 14dB(A). The daytime variation at NM3 was slightly below the Limit Level but within a 3dB(A) range. Also, a comparison of the ambient noise monitoring results taken on 6th and 27th August 2007, both conducted during identical times on Monday, has shown consistent variations as given in Tables A-2 and A-3 in Appendix A. Nighttime variation of the ambient noise levels at all three locations have also exceeded the Limit Level by up to 12dB(A).

With a significant upward variation of daytime ambient noise levels at NM1 and NM2 to the Limit Level; and a within 3dB(A) downward variation of the same at NM3, the uncertainty of a conclusive deduction of event contribution will be subject to a level difference of at least 5dB above the ambient, in accordance with the acoustic principles[1]. This level difference criterion of 5dB above ambient applies to both day & evening time and nighttime deduction of event contribution.

4.3 Noise Level Measurements During Test Event

Noise measurement results taken during the Test Event are presented in Tables 4-3 and 4-4 below.

Table 4-3: Summary of noise level measurements taken during Test Event on 11 August 2007

Measurement Period	NM1 Results (dB(A))		NM2 Results (dB(A))		NM3 Results (dB(A))	
	Event	Ambient	Event	Ambient	Event	Ambient
7:30 AM ~ 8:00 AM	---[1]	---	---[1]	---	---[1]	---
8:00 AM ~ 8:30 AM	62	62	66	65	58	55
8:30 AM ~ 9:00 AM	62	62	65	65	57	57
9:00 AM ~ 9:30 AM	62	62	64	64	58	---[2]
9:30 AM ~ 10:00 AM	62	63	63	64	59	57[3]
10:00 AM ~ 10:30 AM	---[1]	---	---[1]	---	---[1]	---
10:30 AM ~ 11:00 AM	---[1]	---	---[1]	---	---[1]	---
11:00 AM ~ 11:30 AM	---[1]	---	---[1]	---	---[1]	---
11:30 AM ~ 12:00 PM	---[1]	---	---[1]	---	---[1]	---
12:00 PM ~ 12:30 PM	---[1]	---	---[1]	---	---[1]	---
12:30 PM ~ 1:00 PM	---[1]	---	---[1]	---	---[1]	---
1:00 PM ~ 1:30 PM	---[1]	---	---[1]	---	---[1]	---
1:30 PM ~ 2:00 PM	---[1]	---	---[1]	---	---[1]	---
2:00 PM ~ 2:30 PM	---[1]	---	---[1]	---	---[1]	---
2:30 PM ~ 3:00 PM	62	---	65	---	57	---

Notes: [1] Measurements were not valid due to raining.
[2] Measurements not taken as the monitoring location was relocated from Block 3 to Block 1.
[3] Measurement location was relocated to podium near Block 1 due to neighbouring construction activities at Block 3.

Table 4-4: Summary of noise level measurements taken during Test Event on 13 August 2007

Measurement Period	NM1 Results (dB(A))		NM2 Results (dB(A))		NM3 Results (dB(A))	
	Event	Ambient	Event	Ambient	Event	Ambient
4:00 PM ~ 4:30 PM	---[1]	---	---[1]	---	---[1]	---
4:30 PM ~ 5:00 PM	62	61	66	64	60[2]	57[2]
5:00 PM ~ 5:30 PM	62	61	66	65	60[2]	57[2]
5:30 PM ~ 6:00 PM	62	63[3]	65	67[3]	59[2]	56[3]
6:00 PM ~ 6:30 PM	---[1]	---[1]	---[1]	---[1]	---[1]	---[1]
6:30 PM ~ 7:00 PM	64	---[1]	65	---[1]	59	---[1]
7:00 PM ~ 7:30 PM	64	---[1]	65	---[1]	58	---[1]
7:30 PM ~ 8:00 PM	64	63	64	65	59[5]	54
8:00 PM ~ 8:30 PM	63	62[3]	65	63[3]	59	54[3]
8:30 PM ~ 9:00 PM	63	62[3]	64	63[3]	57	56[3]
9:00 PM ~ 9:30 PM	63	60[4]	64	63[4]	57	57[4]
9:30 PM ~ 10:00 PM	63	60[4]	64	63[4]	59	57[4]
10:00 PM ~ 10:30 PM	64[5]	60[4]	64	63[4]	59	57[4]
10:30 PM ~ 11:00 PM	64[5]	60[4]	64	63[4]	60	57[4]
11:00 PM ~ 11:30 PM	60[4]		63[4]		57[4]	
11:30 PM ~ 12:00 AM	60[4]		63[4]		57[4]	

Notes: [1] Measurements were not valid due to raining.
[2] Measurement location was moved to podium near Block 1 due to neighbouring construction activities at Block 3.
[3] The ambient noise level is averaged logarithmically from results on 6th and 27th August 2007.
[4] Ambient noise level at 11:30pm ~ 12:00am with no Test Event activities was adopted as background noise level for the period between 9:00pm ~ 11:30pm, as it represented a better estimation than results from other monitoring dates.
[5] Periods of level difference exceeding 3dB but within 5dB

The majority of level difference between event and ambient noise at all locations are within 3dB(A), except at several monitoring periods denoted [5] in Table 4-4. Therefore, actual noise contribution of the Test Event to the measured noise level at the monitored locations (NM1 to NM3) can not be deduced with reasonable confidence.

5 Observations and Conclusions

Ambient noise monitoring was conducted on 4th, 6th and 27th of August 2007 to determine the background noise level for analysis of Test Event monitoring. Daytime variation of the ambient noise levels at NM1 can reach up to 5dB(A) above the Limit Level and that at NM2 up to 14dB(A). The daytime variation at NM3 was slightly below the Limit Level but within a 3dB(A) range. Also, a comparison of the ambient noise monitoring results taken on 6th and 27th August 2007, both conducted during identical times on Monday, has shown consistent variations as given in Tables A-2 and A-3 in Appendix A. Nighttime variation of the ambient noise levels at all three locations have also exceeded the Limit Level by up to 12dB(A).

With a significant upward variation of daytime ambient noise levels at NM1 and NM2 to the Limit Level; and a within 3dB(A) downward variation of the same at NM2, the uncertainty of a conclusive deduction of event contribution will be subject to a level difference of at least 5dB above the ambient, in accordance with the acoustic principles. This level difference criterion of 5dB above ambient applies to both daytime and nighttime deduction of event contribution.

It is not conclusive to suggest the noise from the Test Event has contributed to the higher noise levels measured at the monitored locations. Rather, professional judgment from site

observation would indicate the results are significantly affected by the variation of the background noise during the Test Event.

Nonetheless, the need for noise limiter device for the PA system is identified in section 4.5.3.2 of the Environmental Impact Assessment report, and the device should be set so that the noise output of the PA system would comply with the relevant TM-EIAO criterion.

6 References

1. Bies D. A. and Hansen C. H. 1988. *Engineering Noise Control, Theory and Practice,* 2nd edn. London & New York: E & FN SPON.
2. Ove Arup Partners Hong Kong Ltd. December 2005. Main Arena of the 2008 Olympic Equestrian Event – Environmental Impact Assessment Report
3. Ove Arup Partners Hong Kong Ltd. June 2006. Main Arena of the 2008 Olympic Equestrian Event – Environmental Monitoring and Audit Manual
4. Ove Arup Partners Hong Kong Ltd. July 2006. Main Arena of the 2008 Olympic Equestrian Event – Environmental Baseline Monitoring Report

Appendix A

Detailed Ambient Noise Measurements

Table A-1: Summary of ambient noise monitoring results taken on 4 August 2007

Measurement Period		Measurement Results			Limit Levels dB(A)			BG Noise Higher Than Limit Level
		NM1	NM2	NM3	NM1	NM2	NM3	
4:00 AM ~ 4:30 AM		54.3	56.3	52.5	50			ALL
4:30 AM ~ 5:00 AM		54.7	56.1	52.2	50			ALL
5:00 AM ~ 5:30 AM		55.3	56.4	52.8	50			ALL
5:30 AM ~ 6:00 AM		57.6	57.7	57.4	50			ALL
6:00 AM ~ 6:30 AM		56.2	57.8	54.0	50			ALL
6:30 AM ~ 7:00 AM		57.3	58.7	54.7	50			ALL
7:00 AM ~ 7:30 AM		58.0	59.5	54.3	59	55	57	NM2
7:30 AM ~ 8:00 AM		61.3	60.8	56.3	59	55	57	NM1, NM2
8:00 AM ~ 8:30 AM		61.5	65.3	55.0	59	55	57	NM1, NM2
8:30 AM ~ 9:00 AM		61.9	65.3	56.8	59	55	57	NM1, NM2
9:00 AM ~ 9:30 AM		62.0	63.7	---[2]	59	55	57	NM1, NM2
9:30 AM ~ 10:00 AM		62.5	63.6	56.7[1]	59	55	57	NM1, NM2
10:00 AM ~ 10:30 AM		62.1	63.2	58.4[1]	59	55	57	ALL
10:30 AM ~ 11:00 AM		62.9	63.0	57.1[1]	59	55	57	NM1, NM2
11:00 AM ~ 11:30 AM		62.8	63.5	57.3[1]	59	55	57	NM1, NM2
11:30 AM ~ 12:00 PM		62.6	62.8	57.4[1]	59	55	57	NM1, NM2
Period Average	**Daytime [3]**	**61.9 (58.0~62.9)**	**63.4 (59.5~65.3)**	**56.7 (54.3~58.4)**				
	Night-time [4]	**56.1 (54.3~57.6)**	**57.3 (56.1~58.7)**	**54.3 (52.2~57.4)**				

Notes: [1] Measurement location was relocated to podium area near Block 1 due to neighbouring construction activities at Block 3.
[2] Measurements not taken as the monitoring location was relocated from Block 3 to Block 1.
[3] Logarithmic average over the measurement period (0700 to 1200).
[4] Logarithmic average over the measurement period (0400 to 0700).

Table A-2: Summary of ambient noise monitoring results taken on 6 August 2007

Measurement Period		Measurement Results			Limit Levels dB(A)			BG Noise Higher Than Limit Level
		NM1	NM2	NM3	NM1	NM2	NM3	
4:30 PM ~ 5:00 PM		61.4	63.8	56.6[2]	59	55	57	NM1, NM2
5:00 PM ~ 5:30 PM		61.3	65.1	57.2[2]	59	55	57	NM1, NM2
5:30 PM ~ 6:00 PM		61.7	63.1	55.7	59	55	57	NM1, NM2
6:00 PM ~ 6:30 PM		---[1]	---[1]	---[1]	59	55	57	---
6:30 PM ~ 7:00 PM		---[1]	---[1]	---[1]	59	55	57	---
7:00 PM ~ 7:30 PM		---[1]	---[1]	---[1]	59	55	57	---
7:30 PM ~ 8:00 PM		---[1]	---[1]	---[1]	59	55	57	---
8:00 PM ~ 8:30 PM		61.0	61.2	54.4	59	55	57	NM1, NM2
8:30 PM ~ 9:00 PM		60.5	60.8	54.8	59	55	57	NM1, NM2
9:00 PM ~ 9:30 PM		58.3	59.7	54.6	59	55	57	NM2
9:30 PM ~ 10:00 PM		58.2	59.6	54.7	59	55	57	NM2
10:00 PM ~ 10:30 PM		58.0	59.0	54.5	59	55	57	NM2
10:30 PM ~ 11:00 PM		---[1]	---[1]	---[1]	59	55	57	---
11:00 PM ~ 11:30 PM		60.0	62.3	52.9	50			ALL
11:30 PM ~ 12:00 AM		57.4	58.7	53.0	50			ALL
Period Average	**Day & Evening [3]**	**60.3 (58.0~61.7)**	**62.0 (59.0~65.1)**	**55.4 (54.4~57.2)**				
	Night-time [4]	**58.9 (57.4~60.0)**	**60.9 (58.7~62.3)**	**53.0 (52.9~53.0)**				

Notes: [1] Measurement results not valid due to raining.
[2] Measurement location was moved to podium near Block 1 due to neighbouring construction activities at Block 3.
[3] Logarithmic average over the measurement period (1600 to 2300).
[4] Logarithmic average over the measurement period (2300 to 0000).

Table A-3: Summary of ambient noise monitoring results taken on 27 August 2007

Measurement Period		Measurement Results			Limit Levels dB(A)			BG Noise Higher Than Limit Level
		NM1	NM2	NM3	NM1	NM2	NM3	
4:30 PM ~ 5:00 PM		---[2]	---[2]	---[2]	59	55	57	---
5:00 PM ~ 5:30 PM		---[2]	---[2]	---[2]	59	55	57	---
5:30 PM ~ 6:00 PM		64.4[1]	69.4[1]	56.5[1]	59	55	57	NM1, NM2
6:00 PM ~ 6:30 PM		---[2]	---[2]	---[2]	59	55	57	---
6:30 PM ~ 7:00 PM		---[2]	---[2]	---[2]	59	55	57	---
7:00 PM ~ 7:30 PM		---[2]	---[2]	---[2]	59	55	57	---
7:30 PM ~ 8:00 PM		62.9	64.8	54.2	59	55	57	NM1, NM2
8:00 PM ~ 8:30 PM		62.7	64.3	54.4	59	55	57	NM1, NM2
8:30 PM ~ 9:00 PM		62.4	63.9	56.5	59	55	57	NM1, NM2
9:00 PM ~ 9:30 PM		---[2]	---[2]	---[2]	59	55	57	---
9:30 PM ~ 10:00 PM		60.3	62.8	55.1	59	55	57	NM1, NM2
10:00 PM ~ 10:30 PM		60.1	62.8	54.1	59	55	57	NM1, NM2
10:30 PM ~ 11:00 PM		59.6	62.0	53.7	59	55	57	NM1, NM2
11:00 PM ~ 11:30 PM		---[2]	---[2]	---[2]	50			---
11:30 PM ~ 12:00 AM		---[2]	---[2]	---[2]	50			---
Period Average	**Day & Evening [3]**	**62.1 (59.6~64.4)**	**65.0 (62.0~69.4)**	**55.1 (53.7~56.5)**				
	Night-time [4]	**---[2]**	**---[2]**	**---[2]**				

Notes: [1] Measurement results affected by construction activities.
[2] Measurement results not valid due to raining.
[3] Logarithmic average over the measurement period (1600 to 2300).
[4] Logarithmic average over the measurement period (2300 to 0000).

Appendix B

Calibration certificates for noise monitoring equipment

Summary of Equipment Calibration Details

Equipment Type	Model	Serial No.	Last Calibration Date	Next Calibration Date
Integrating sound level meter with microphone	Brüel & Kjær 2238 Brüel & Kjær 4188	2320694 2274284	11 Sep 2006	10 Sep 2007
		2320696 2274286	11 Sep 2006	10 Sep 2007
		2320707 2179479	11 Sep 2006	10 Sep 2007
Type 1 Integrating sound level meter with microphone	RION NA-27 RION UC53A	00980789 307440	11 Sep 2006	10 Sep 2007
Acoustical calibrator	Brüel & Kjær 4231	2314016	11 Sep 2006	10 Sep 2007

CERTIFICATE OF CALIBRATION

Issued by: **Brüel & Kjær UK Ltd.**
Date of Issue: 21 SEP 2005 Certificate Number: 14260

UKAS CALIBRATION
0174

Brüel & Kjær

Bedford House, Rutherford Close, Stevenage.
Hertfordshire. SG1 2ND
Telephone: 01438 739100 Fax.: 01438 739199
E-Mail : ukservice@bksv.com

Page 1 of 4 pages
Approved signatory
Name: A. M. HAMM
Signature:

CALIBRATION OF MULTI FREQUENCY CALIBRATOR TYPE 4226
("Free Field and Random" version)

Client: ARUP ACOUSTICS
PARKIN HOUSE
8 ST THOMAS STREET
WINCHESTER. SO23 9HE

Calibrator Type 4226, S/No: 1531372
With Coupler UA0915, S/No: 1531372
Client Inventory Number: -
Manufacturer: Brüel & Kjær
Equipment Received on: 16 SEP 2005
Calibration Date: 21 SEP 2005
Brüel & Kjær Reference No: 1-65783810

Measurement Method

The Calibration was performed to Laboratory Procedure TWI-103.

Sound pressure level in the 1/2 inch coupler of the calibrator was measured with a laboratory grade condenser microphone Type 4180, used as a working standard, calibrated by the National Physical Laboratory.

Rev 11; 06.07.05

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0174

Certificate Number
14260

The measured sound pressure was compared with that generated in the coupler of a working standard pistonphone calibrated by the National Physical Laboratory whose output was cross checked against a reference standard pistonphone, also calibrated by the National Physical Laboratory, using the same microphone and at the same ambient conditions. Appropriate corrections for atmospheric pressure conditions during calibration and for the measurement frequency and level response were taken into account.

Sound pressure level results are the mean of 5 measurements.

Results apply directly to the following settings on the calibrator, pressure, linear, calibration, 94dB, microphone group a, b, c.

Results for frequency and distortion are the result of a single measurement.

Results for 104 and 114dB are only at 125Hz, 1kHz and 8kHz, compared with the output at 94dB.

Calibration results apply at ambient conditions during the process of calibration.

Calibrations marked (Not UKAS Accredited) in this certificate have been included for completeness.

CALIBRATION RESULTS

4226 Settings: Linear, Pressure, 94dB, Microphone Group c.

Frequency Setting Hz	Sound Pressure Level in dB re 20μPa	Frequency Hz (Not UKAS Accredited)	Distortion % (Not UKAS Accredited)
31.5	94.12	31.63	0.5
63	94.02	63.13	0.2
125	94.01	125.9	0.1
250	94.01	251.3	0.1
500	94.00	502.5	0.2
1k	94.05	1.005 k	0.2
2k	94.04	1.979 k	0.3
4k	94.04	3.957k	0.5
8k	94.11	7.915k	0.3
12.5k	94.08	12.66 k	0.2

Rev 11; 06.07.05

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0174

Certificate Number
14260

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Expanded uncertainty of calibration:

Sound Pressure Level:	±0.15dB from 31.5Hz to 2kHz, ±0.20dB at 4kHz and 8kHz, ±0.25dB at 12.5kHz
Frequency:	±1 last significant digit reported.
Distortion:	±0.3% distortion.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k*=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

ADDITIONAL TESTS

Sound Pressure Levels at Settings of 94, 104 and 114 dB

Frequency	Difference 104-94dB	Difference 114-94dB
125 Hz	9.99	19.97
1kHz	10.00	19.98
8kHz	9.96	19.93

Result of a single measurement, expanded uncertainty ±0.15dB

Inverted "A" Weighting, Readings Relative to 1kHz in dB

Frequency Hz	31.5	63	125	250	500	1 k	2 k	4 k	8 k	12.5 k
Target Value	+39.4	+26.2	+16.1	+8.6	+3.2	0	-1.2	-1.0	+1.1	+4.3
Reading	39.5	26.2	16.1	8.6	3.2	0.0	-1.2	-0.9	1.2	4.3

Target values according to BS EN 60651 - 1994 - results of a single measurement, values rounded to 0.1 dB, expanded uncertainty ±0.3dB.

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Free Field and Random settings

	Free Field Setting						Random	
	Microphone Group a		Microphone Group b		Microphone Group c		Microphone Group b	
Freq. Hz	Target Value dB	Reading dB	Target Value dB	Reading dB	Target Value dB	Reading dB	Target Value dB	Reading dB
250	0	0·00	0	0·00	0	0·00	0	0·00
500	0	0·00	0	0·00	0	0·00	0	0·00
1k	+0.15	0·14	+0.20	0·19	+0.10	0·09	+0.05	0·03
2k	+0.50	0·49	+0.45	0·44	+0.35	0·34	+0.10	0·08
4k	+1.35	1·34	+1.05	1·04	+0.95	0·92	+0.15	0·14
8k	+4.50	4·46	+2.80	2·77	+2.60	2·58	+0.40	0·38
12.5k	+7.35	7·28	+5.60	5·54	+5.05	5·00	+1.50	1·48

Target values as specified in the manufacturer's manual, result of a single measurement, expanded uncertainty ±0.2dB.

Ambient conditions during calibration were:

Atmospheric Pressure ..... 101·3 ..... kPa
Temperature ..... 23 ..... ° C
Relative Humidity ..... 46 ..... %

Checked by: MA Mitch

Rev 11; 06.07.05

ArupAcoustics

ARUP

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Fax: +852 2268 3950

AAc Certificate No. 2006006

CERTIFICATE OF CONFORMITY

Description of Test Instrument	Type No	Serial No
Brüel & Kjær Sound Level Meter Kit	2238	2320694
Brüel & Kjær ½ " Microphone Kit	4188	2274284

Date of Test: 11 September 2006

Carried out by: Cissy Chan
Signature:

Approved by: William Ng
Signature:

Ambient Conditions During Test	
Atmospheric Pressure:	1KPa
Air Temperature:	21°C
Relative Humidity:	58%

This document is to certify that the above Test Instrumentation did conform to the manufacturer's original specification on the date of the test. Any adjustments that were required to bring the instrumentation back into specification are duly noted in this document. The tests were carried out using the reference calibrator described below.

Description of Reference Calibrator	Type No	Serial No
Brüel & Kjær Multi Frequency Calibrator	4226	1531372
Brüel & Kjær Coupler	UA0915	1531372

Certificate of Calibration Serial No.	14260
By Brüel & Kjær (UK) Ltd Calibration Date:	21 September 2005
NAMAS Accredited Calibration Laboratory No.	0174

The reference calibrator, Type 4226, has traceable calibration back to National Measurement Standards. As such it is used as Arup Acoustics own 'Primary Standard' and is used only for controlled laboratory calibration tests on all sound measuring equipment owned by Arup Acoustics.

Footnote:

Arup Acoustics is not a registered NAMAS accredited calibration laboratory. This certificate is for internal use only (unless otherwise authorised) and is part of Arup Acoustics development and commitment to QC and QA procedures.

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CERTIFICATE OF CONFORMITY

Description of Test Instrument	Type No	Serial No
Brüel & Kjær Sound Level Meter Kit	2238	2320696
Brüel & Kjær ½ " Microphone Kit	4188	2274286

Date of Test: 11 September 2006

Carried out by: Cissy Chan

Signature:

Approved by: William Ng

Signature:

Ambient Conditions During Test	
Atmospheric Pressure:	1KPa
Air Temperature:	21°C
Relative Humidity:	58%

This document is to certify that the above Test Instrumentation did conform to the manufacturer's original specification on the date of the test. Any adjustments that were required to bring the instrumentation back into specification are duly noted in this document. The tests were carried out using the reference calibrator described below.

Description of Reference Calibrator	Type No	Serial No
Brüel & Kjær Multi Frequency Calibrator	4226	1531372
Brüel & Kjær Coupler	UA0915	1531372

Certificate of Calibration Serial No.	14260
By Brüel & Kjær (UK) Ltd Calibration Date:	21 September 2005
NAMAS Accredited Calibration Laboratory No.	0174

The reference calibrator, Type 4226, has traceable calibration back to National Measurement Standards. As such it is used as Arup Acoustics own 'Primary Standard' and is used only for controlled laboratory calibration tests on all sound measuring equipment owned by Arup Acoustics.

Footnote:

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AAc Certificate No. 2006005

CERTIFICATE OF CONFORMITY

Description of Test Instrument	Type No	Serial No
Brüel & Kjær Sound Level Meter Kit	2238	2320707
Brüel & Kjær ½ " Microphone Kit	4188	2179479

Date of Test: 11 September 2006

Carried out by: Cissy Chan
Signature:

Approved by: William Ng
Signature:

Ambient Conditions During Test	
Atmospheric Pressure:	1KPa
Air Temperature:	21°C
Relative Humidity:	58%

This document is to certify that the above Test Instrumentation did conform to the manufacturer's original specification on the date of the test. Any adjustments that were required to bring the instrumentation back into specification are duly noted in this document. The tests were carried out using the reference calibrator described below.

Description of Reference Calibrator	Type No	Serial No
Brüel & Kjær Multi Frequency Calibrator	4226	1531372
Brüel & Kjær Coupler	UA0915	1531372

Certificate of Calibration Serial No.	14260
By Brüel & Kjær (UK) Ltd Calibration Date:	21 September 2005
NAMAS Accredited Calibration Laboratory No.	0174

The reference calibrator, Type 4226, has traceable calibration back to National Measurement Standards. As such it is used as Arup Acoustics own 'Primary Standard' and is used only for controlled laboratory calibration tests on all sound measuring equipment owned by Arup Acoustics.

Footnote:

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AAc Certificate No. 2006009

CERTIFICATE OF CONFORMITY

Description of Test Instrument	Type No	Serial No
RION Sound Level Meter	NA-27	00980789
RION ½" Microphone	UC53A	307440

Date of Test: 11 September 2006

Carried out by: Cissy Chan

Signature:

Approved by: William Ng

Signature:

Ambient Conditions During Test	
Atmospheric Pressure:	1KPa
Air Temperature:	21°C
Relative Humidity:	58%

This document is to certify that the above Test Instrumentation did conform to the manufacturer's original specification on the date of the test. Any adjustments that were required to bring the instrumentation back into specification are duly noted in this document. The tests were carried out using the reference calibrator described below.

Description of Reference Calibrator	Type No	Serial No
Brüel & Kjær Multi Frequency Calibrator	4226	1531372
Brüel & Kjær Coupler	UA0915	1531372

Certificate of Calibration Serial No.	14260
By Brüel & Kjær (UK) Ltd Calibration Date:	21 September 2005
NAMAS Accredited Calibration Laboratory No.	0174

The reference calibrator, Type 4226, has traceable calibration back to National Measurement Standards. As such it is used as Arup Acoustics own 'Primary Standard' and is used only for controlled laboratory calibration tests on all sound measuring equipment owned by Arup Acoustics.

Footnote:

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AAc Certificate No. 2006002

CERTIFICATE OF CONFORMITY

Description of Test Instrument	Type No	Serial No
Bruel & Kjaer 4231 Acoustic Calibrator	4231	2314016

Date of Test: 11 September 2006

Carried out by: Cissy Chan

Signature:

Approved by: William Ng

Signature:

Ambient Conditions During Test	
Atmospheric Pressure:	1KPa
Air Temperature:	21°C
Relative Humidity:	58%

This document is to certify that the above Test Instrumentation did conform to the manufacturer's original specification on the date of the test. Any adjustments that were required to bring the instrumentation back into specification are duly noted in this document. The tests were carried out using the reference calibrator described below.

Description of Reference Calibrator	Type No	Serial No
Brüel & Kjær Multi Frequency Calibrator	4226	1531372
Brüel & Kjær Coupler	UA0915	1531372

Certificate of Calibration Serial No.	14260
By Brüel & Kjær (UK) Ltd Calibration Date:	21 September 2005
NAMAS Accredited Calibration Laboratory No.	0174

The reference calibrator, Type 4226, has traceable calibration back to National Measurement Standards. As such it is used as Arup Acoustics own 'Primary Standard' and is used only for controlled laboratory calibration tests on all sound measuring equipment owned by Arup Acoustics.

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11 Sep 2006

Appendix C

Photo Records

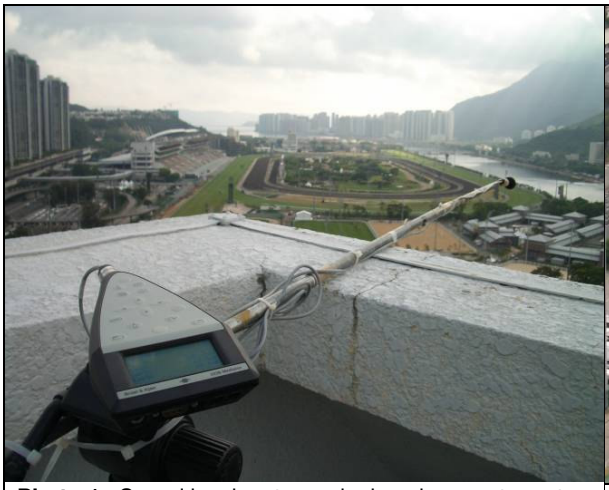

Photo 1: Sound level meter and microphone set-up at Chun Cheung Court, HKJC Staff Quarter (NM1).

Photo 2: Construction works along the race course.

Photo 3: Construction works of the Ho Tung Lau project near NM1 and NM2.

Photo 4: Sound level meter and microphone set-up at Racecourse Villa (NM2) during the Test Event and 27th August 2007.

Photo 5: Microphone set-up at Ravana Garden (NM3).