

## **Appendix 17 – Construction Groundborne Noise Assessment for FMPHQ**

### **1 INTRODUCTION**

The application for the approval of EIA Report for the Kowloon Southern Link (KSL) was made on 21 July 2004. After the public consultation period as stipulated under EIAO and the meeting with ACE, EPD issued a letter EP2/G/A/121 Pt 3 on 30 March 2005 confirming that the captioned EIA Report is approved with a condition.

The condition requires the Project Proponent to provide the information to present the degree of construction groundborne noise impact on the Former Marine Police Headquarters (FMPHQ) arising from all stages of construction of the KSL, with special reference to the following:

- a) the relevant duration for the construction of the KSL in the vicinity of the FMPHQ that may arise to groundborne noise impacting occupancy of the FMPHQ as a hotel, noise sensitive receiver (NSR);
- b) the degree of potential groundborne noise impact from the construction of the KSL on the occupancy of the FMPHQ as a hotel NSR;
- c) the cumulative construction groundborne noise impacts arising from all KSL works in the vicinity of the FMPHQ; and
- d) the assumptions, identified construction methods and equipment used in the prediction of the construction groundborne noise assessment and how much assumptions and construction methods / equipment are consistent with those from the EIA Report.

The purpose of this Appendix is to provide the information as requested in the condition stated in EPD's letter EP2/G/A/121 Pt 3 dated 30 March 2005.

### **2. CONSTRUCTION METHODOLOGY, PROGRAMME & PLANT INVENTORY**

#### **2.1 Construction Methodology**

The assumptions on the construction methodology as stated in Chapter 4 of the EIA Report have not been changed. The following table summarises those assumptions relating to this Appendix.

**Table 2.1:** Summary of Tunneling Method in EIA

<b>Tunnel Section</b>	<b>Tunneling Method</b>	<b>Ref in EIA</b>
Along Salisbury Road	Cut-&-Cover	S4.3.3
Under FMPHQ	Drill-&-Blast	S4.3.2
Along Canton Road	Bored tunneling	S4.3.1

#### **2.2 Construction Programme & Plant Inventory**

Appendices 4-2 and 4-3 of the EIA Report have presented the construction plant inventory and the construction programme adopted in the EIA. According to the programme, the construction of the drill-&-blast tunnel is scheduled for 11 months commencing after completion of the construction works of the TBM retrieval shaft at Canton Road and overlapping with the bulk excavation of the Cut-&-Cover tunneling works at Salisbury Road for the initial 7 months. Although there could be uncertainty on the construction programme of the FMPHQ Redevelopment, for a conservative approach, it is recommended to assume that the occupancy

date of the hotels in the FMPHQ would be earlier than the completion of the drill-&-blast tunnel underneath FMPHQ. Hence, the worst case scenario of construction groundborne noise impact on the FMPHQ as a hotel NSR would be the situation when the tunneling works along Salisbury Road, underneath FMPHQ and along Canton Road are conducted concurrently.

As stated in Appendix 7-2-1 of the EIA Report, the rock breaking equipment that has been adopted in the noise assessment is shown in Table 2.2 below. The same assumptions have been adopted in this Appendix.

**Table 2.2:** Rock Breaking Plant Inventory Adopted in the EIA

Section	Inventory
Rock breaking for cut-&-cover tunneling along Salisbury Road	4 nos hydraulic breakers
Rock breaking for drill-&-blast tunnelling underneath FMPHQ	2 nos hydraulic breakers 4 nos rock drills

### 3. NOISE CRITERIA

Section 7.1.1 of the EIA Report has stated the legislative noise criteria for groundborne noise for hotel guestrooms. For easy reference, the following table summarises these criteria for groundborne noise.

**Table 3.1:** Groundborne Noise Criteria for Hotels

Period	Noise Criteria, dB(A)
Daytime (except General Holiday & Sunday)	65
Daytime during general holidays and Sundays and all days during evening (1900 to 2300 hrs)	55
Night-time (2300 to 0700 hrs)	40

### 4. ASSESSMENT

#### 4.1 Assessment Methodology

The hotel guestrooms of FMPHQ are located within the main building which are approximately 16m above the nearest tunnel underneath.

The same methodology as outlined in Section 7.1.4 of the EIA Report has been adopted. The prediction has taken into account various correction factors including distance attenuation, soil damping, coupling loss into building foundation, coupling loss per floor, multiple sources and cumulative effect due to neighbouring sites.

#### 4.2 Assessment Results

The calculation sheets for the groundborne noise impacts caused by KSL construction on FMPHQ are attached in this Appendix. The following table summarises the results.

**Table 4.1:** Summary of Groundborne Noise Impacts on FMPHQ during Daytime

<b>Groundborne Noise Activities</b>	<b>Noise Contribution, dB(A)</b>
Rock breaking for cut-&-cover tunneling along Salisbury Road	32
Rock breaking for drill-&-blast tunnelling underneath FMPHQ	44
Bored tunnelling along Canton Road	<30
<b>Total Noise Impacts</b>	<b>44</b>

It can be seen from the above table that the predicted groundborne noise impacts on the hotel guestrooms of FMPHQ would be within the daytime time noise criterion. Additional noise mitigation measures are not required.

During night-time period, there will not be any construction activities for the tunnel section along Salisbury Road and underneath FMPHQ. Only the bored tunneling along Canton Road would be operating. As shown above, the predicted noise impacts for bored tunneling works still comply with the 40dB(A) criterion. Additional noise mitigation measures are also not required.

## 5. CONCLUSION

In response to the condition to approval of the KSL EIA Report given in EPD's letter EP2/G/A/121 Pt 3 dated 30 March 2005, this Appendix has been prepared to present the groundborne noise prediction for the hotel guestrooms in the FMPHQ.

All the assumptions (construction methodology, work programme etc) and the assessment methodology are the same as the EIA Report. Results indicate that both the daytime and night-time noise criteria would be met. No additional mitigation measures are therefore required.

## **ANNEX 17-1**

# Sample Construction Groundborne Noise Calculation Sheets for FMPHQ

## Appendix 17 - Construction Groundborne Noise Assessment for FMPHQ

### KSL Construction ground-borne noise for drilling and breaking operation Summary of predicted groundborne noise levels

#### Zone 1 (FMPHQ)

Construction Plant	NSR	Soil Material	Area	Max Predicted Noise Level, dB(A)	Estimated Distance from Plant to NSR	Ref.
2 nos. Hydraulic Breakers	FMPHQ	Granite	Guestroom	35	16 m	E1
4 nos Rock Drills	FMPHQ	Granite	Guestroom	43	16 m	E2

Note: See attached sample calculations

Construction Plant	NSR	Soil Material	Area	Max Predicted Noise Level, dB(A)	Estimated Distance from	Ref.
2 nos. Hydraulic Breakers + 4 nos Rock Drills	FMPHQ	Granite	Guestroom	44	16 m	Note [1]

Note [1]: Noise summation from individual noise levels above due to construction plant in Zone 1.

#### Zone 2 (Salisbury Road between KPD to Hankow Road)

Construction Plant	NSR	Soil Material	Area	Max Predicted Noise Level, dB(A)	Estimated Distance from	Ref.
4 nos. Hydraulic Breakers	FMPHQ	Granite	Guestroom	32	30 m	E3

Note: See attached sample calculations

#### Zone 1 + Zone 2

Construction Plant	NSR	Soil Material	Area	Max Predicted Noise Level, dB(A)	Ref.
Zone 1: 2 nos. Hydraulic Breakers 4 nos Rock Drills					
Zone 2: 4 nos. Hydraulic Breakers	FMPHQ	Granite	Guestroom	44	Note [2]

Note [2] Noise summation from individual noise levels above due to simultaneous operation of construction plant in Zone 1 and Zone 2.

# Appendix - Groundborne Noise Evaluation

Ref. E1

Job No. : 23573  
 Project : KOWLOON SOUTHERN LINK KSL GSA-5100 EIA & ASSOCIATED SERVICES  
 Date : 04-May-05  
 Site : Zone 1 (FMPHQ)  
 NSR : FMPHQ

Construction Activities: Excavator mounted breakers  
 NSR Distance, R : 16 m

Item		Octave Band Frequency, Hz					
		16	31.5	63	125	250	500
a	Source Vibration Velocity, mm/s [1]	0.05886	0.06816	0.06195	0.05033	0.06225	0.12091
b	Vibration Velocity Level, dB ref. 10 <sup>-6</sup> mm/s	95	97	96	94	96	102
c	Distance Correction = -20 log (R/Ro) [2]	-9	-9	-9	-9	-9	-9
d	Soil Damping Loss [3], Type = "Rock"	0.0	0.0	-0.1	-0.1	-0.2	-0.4
e	Building Coupling Loss, BCF [4]	-7	-7	-10	-13	-14	-14
e'	Coupling Loss from bedrock to piles [*]	-18	-18	-18	-18	-18	-19
f	Floor to Floor Attenuation [5]	-1	-1	-1	-1	-1	-1
g	Conversion to Noise [6]	-23	-23	-23	-23	-23	-23
h	Multiple Source Effect [7]	3	3	3	3	3	3
l	Noise Level at NSR, dB [8]	40	41	38	33	33	38
j	A-weighting Correction	-56.7	-39.4	-26.2	-16.1	-8.6	-3.2
k	A-weighted Noise Level, dB(A)	-17	2	11	17	25	35

**35 dB(A)**

Notes:

- [1] Based on site measurement with an excavator-mounted breaker operating at the reference distance Ro = 5.5m.
- [2] Reference: "Transit Noise and Vibration Impact Assessment" issued by the FTA of the U.S. Department of Transport.
- [3] Calculated in accordance with "Transportation Noise Reference Book", 1987 (see EIA Report Table 7-2).  
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 7-3).
- [\*] Reference: "Sound Transmission through Buildings using Statistical Energy Analysis", 1996 (see attached calculation Ref. F).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Table 7-4).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

## Ref. E2

### KSL Construction ground-borne noise Calculations for Rock Drill

Job No. : 23573

Project : KOWLOON SOUTHERN LINK KSL GSA-5100 EIA & ASSOCIATED SERVICES

Date : 02-Mar-05

#### Zone 1 (FMPHQ)

Item	Description	Quantity
1.	Calculated 2 nos. Hydraulic Breakers	= 35 dB(A)
	Noise Level at FMPHQ	Extracted from calculation sheet Ref. E1
	when breaking granite at 18m away	
2.	Calculated 1 nos. Hydraulic Breakers	= 35 dB(A) minus 3 dB(A)
	Noise Level at FMPHQ	= 32 dB(A)
	when breaking granite at 16m away	
3.	Correction to Rock Drill Noise	= + 20 log ( V1 / V2)
	V1 = Vibration (rms) of Drilling Rig	= + 20 log ( 0.536 mm/s / 0.298 mm/s)
	V2 = Vibration (rms) of Hydraulic Breaker	= + 5.1 dB
	Ref.	
	See vibration measurement table in Appendix 7-1	
4.	Multiple source correction	= + 10 log (N)
	for 4 Rock Drills	= + 10 log (4)
		= + 6 dB
5.	Predicted Groundborne Noise	= 43 dB(A)
	Adding items [2], [3] and [4]	

Notes:

[1] Groundborne noise level at other distance is calculated similarly.

# Appendix - Groundborne Noise Evaluation

Ref. E3

Job No. : 23573  
 Project : KOWLOON SOUTHERN LINK KSL GSA-5100 EIA & ASSOCIATED SERVICES  
 Date : 04-May-05  
 Site : Zone 2 (Salisbury Road between KPD to Hankow Road)  
 NSR : FMPHQ  
 Construction Activities: Excavator mounted breakers  
 NSR Distance, R : 30 m

Item	Octave Band Frequency, Hz						
	16	31.5	63	125	250	500	
a	Source Vibration Velocity, mm/s [1]	0.05886	0.06816	0.06195	0.05033	0.06225	0.12091
b	Vibration Velocity Level, dB ref. 10 <sup>-6</sup> mm/s	95	97	96	94	96	102
c	Distance Correction = -20 log (R/Ro) [2]	-15	-15	-15	-15	-15	-15
d	Soil Damping Loss [3], Type = "Rock"	0.0	-0.1	-0.1	-0.2	-0.5	-1.0
e	Building Coupling Loss, BCF [4]	-7	-7	-10	-13	-14	-14
e'	Coupling Loss from bedrock to piles [*]	-18	-18	-18	-18	-18	-19
f	Floor to Floor Attenuation [5]	-1	-1	-1	-1	-1	-1
g	Conversion to Noise [6]	-23	-23	-23	-23	-23	-23
h	Multiple Source Effect [7]	6	6	6	6	6	6
l	Noise Level at NSR, dB [8]	38	39	35	30	31	35
j	A-weighting Correction	-56.7	-39.4	-26.2	-16.1	-8.6	-3.2
k	A-weighted Noise Level, dB(A)	-19	-1	9	14	22	32

**32 dB(A)**

Notes:

- [1] Based on site measurement with an excavator-mounted breaker operating at the reference distance Ro = 5.5m.
- [2] Reference: "Transit Noise and Vibration Impact Assessment" issued by the FTA of the U.S. Department of Transport.
- [3] Calculated in accordance with "Transportation Noise Reference Book", 1987 (see EIA Report Table 7-2).  
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 7-3).
- [\*] Reference: "Sound Transmission through Buildings using Statistical Energy Analysis", 1996 (see attached calculation Ref. F).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Table 7-4).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

### KSL Construction ground-borne noise Calculations for TBM

Job No. : 23573/20

Project : KOWLOON SOUTHERN LINK KSL GSA-5100 EIA & ASSOCIATED SERVICES - CAR

Date : 06-Nov-04

NSR : FMPHQ

Item	Description	Quantity
1.	Source Term, from Graph DB320 Kwai Tsing Tunnel by Extrapolation PPV at 5.5m	= 2.5 mm/s
2.	Conversion to rms velocity based on Crest factor of 4 Reference: FTA Guidance Manual	= 0.625 mm/s
3.	Vibration Velocity ref. $10^{-9}$ m/s	= $20 \log ( V / V_{ref} )$ = 116 dB
4.	Distance Attenuation R = 40m between TBM and NSR	= $- 20 \log ( R / R_0 )$ = $- 20 \log ( 40 / 5.5 )$ = -17 dB
5.	Soil Damping Through granite, assumed zero	= 0 dB
6.	Building Coupling Loss at dominant frequencies between 63 Hz to 250 Hz See Note [1]	= -10 dB
7.	Coupling Loss from Bedrock to pile (see attached calculation using SEA Ref. F)	= -18 dB
8.	Floor to floor attenuation See Note [1]	= -1 dB -1 dB per floor for a conservative assessment
9.	Conversion from Vibration to Noise See Note [1]	= - 23 dB
10.	Conversion to A-weighted Noise Ref. FTA Guidance Manual Table 6-1	= -20 dB for a conservative assessment
11.	Predicted Groundborne Noise Adding items [3] to [10]	= 27 dB(A)

Notes:

[1] Also see Section 7 of EIA Report on detailed description of items