

Appendix 5.9

Groundborne Construction Noise Assessment

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : West Portion
 NSR : W-N10A
 Construction Activities: Excavator mounted breakers
 NSR Distance, R : 11 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -6 | -6 | -6 | -6 | -6 | -6 |
| d | Soil Damping Loss [3], Type = "Clay" | -0.8 | -1.5 | -3.1 | -6.1 | -12.2 | -24.4 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 54 | 54 | 49 | 41 | 36 | 29 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -3 | 15 | 23 | 25 | 27 | 26 |
| | | | | | | | 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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2102 Non-blasting tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | 32 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 35 dB(A) |

| | | |
|---|---|-----------|
| Correction from hydraulic breaker to rock drill | | 5.1 dB(A) |
| rock drill | | 37 dB(A) |
| no. of PME | 8 | 9.0 dB(A) |
| Corrected SPL | | 46 dB(A) |

| | | |
|---|---|------------|
| Correction from hydraulic breaker to handheld breaker | | -0.6 dB(A) |
| handheld breaker | | 31 dB(A) |
| no. of PME | 0 | 0.0 dB(A) |
| Corrected SPL | | 0 dB(A) |

Total SPL 46 dB(A)

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : West Portion
 NSR : W-N19
 Construction Activities: Excavator mounted breakers
 NSR Distance, R : 22 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -12 | -12 | -12 | -12 | -12 | -12 |
| d | Soil Damping Loss [3], Type = "Clay" | -2.4 | -4.7 | -9.4 | -18.7 | -37.4 | -40.0 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 46 | 45 | 36 | 22 | 5 | 8 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -11 | 6 | 10 | 6 | -4 | 4 |
| | | | | | | | 13 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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2102 Non-blasting tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | 13 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 16 dB(A) |

| | | |
|---|---|-----------|
| Correction from hydraulic breaker to rock drill | | 5.1 dB(A) |
| rock drill | | 18 dB(A) |
| no. of PME | 8 | 9.0 dB(A) |
| Corrected SPL | | 27 dB(A) |

| | | |
|---|---|------------|
| Correction from hydraulic breaker to handheld breaker | | -0.6 dB(A) |
| handheld breaker | | 13 dB(A) |
| no. of PME | 0 | 0.0 dB(A) |
| Corrected SPL | | 0 dB(A) |

Total SPL 28 dB(A)

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : Central Portion
 NSR : M-N1
 Construction Activities: Excavator mounted breakers
 NSR Distance, R : 21 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -12 | -12 | -12 | -12 | -12 | -12 |
| d | Soil Damping Loss [3], Type = "Clay" | -2.3 | -4.5 | -9.0 | -17.9 | -35.8 | -40.0 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 46 | 45 | 37 | 23 | 6 | 8 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -10 | 6 | 11 | 7 | -2 | 5 |
| | | | | | | | 14 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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2205 Drill & blast tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | 14 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 17 dB(A) |

| | | |
|---|---|-----------|
| Correction from hydraulic breaker to rock drill | | 5.1 dB(A) |
| rock drill | | 19 dB(A) |
| no. of PME | 8 | 9.0 dB(A) |
| Corrected SPL | | 28 dB(A) |

| | | |
|---|---|------------|
| Correction from hydraulic breaker to handheld breaker | | -0.6 dB(A) |
| handheld breaker | | 13 dB(A) |
| no. of PME | 0 | 0.0 dB(A) |
| Corrected SPL | | 0 dB(A) |

Total SPL 28 dB(A)

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : Central Portion
 NSR : M-N3
 Construction Activities: Excavator mounted breakers
 NSR Distance, R : 47 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -19 | -19 | -19 | -19 | -19 | -19 |
| d | Soil Damping Loss [3], Type = "Clay" | -6.1 | -11.9 | -23.9 | -40.0 | -40.0 | -40.0 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 36 | 31 | 15 | -6 | -5 | 1 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -21 | -8 | -11 | -22 | -13 | -2 |
| | | | | | | | <u>-1 dB(A)</u> |

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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2205 Drill & blast tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | -1 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 2 dB(A) |

| | | |
|---------------|---|-----------|
| rock drill | Correction from hydraulic breaker to rock drill | 5.1 dB(A) |
| no. of PME | 8 | 5 dB(A) |
| Corrected SPL | | 9.0 dB(A) |
| | | 14 dB(A) |

| | | |
|------------------|---|------------|
| handheld breaker | Correction from hydraulic breaker to handheld breaker | -0.6 dB(A) |
| no. of PME | 0 | -1 dB(A) |
| Corrected SPL | | 0.0 dB(A) |

Total SPL 14 dB(A)

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : Central Portion
 NSR : M-N6
 Construction Activities: Excavator mounted breakers
 NSR Distance, R : 51 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -19 | -19 | -19 | -19 | -19 | -19 |
| d | Soil Damping Loss [3], Type = "Clay" | -6.6 | -12.9 | -25.9 | -40.0 | -40.0 | -40.0 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 35 | 29 | 13 | -6 | -5 | 0 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -22 | -10 | -14 | -22 | -14 | -3 |
| | | | | | | | -1 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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2205 Drill & blast tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | -1 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 2 dB(A) |

| | | |
|---------------|---|-----------|
| rock drill | Correction from hydraulic breaker to rock drill | 5.1 dB(A) |
| no. of PME | 8 | 4 dB(A) |
| Corrected SPL | | 9.0 dB(A) |
| | | 13 dB(A) |

| | | |
|------------------|---|------------|
| handheld breaker | Correction from hydraulic breaker to handheld breaker | -0.6 dB(A) |
| no. of PME | 0 | -2 dB(A) |
| Corrected SPL | | 0.0 dB(A) |

Total SPL 13 dB(A)

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : East Portion
 NSR : E-N14
 Construction Activities: Excavator mounted breakers
 NSR Distance, R : 21 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -11 | -11 | -11 | -11 | -11 | -11 |
| d | Soil Damping Loss [3], Type = "Clay" | -2.2 | -4.3 | -8.7 | -17.2 | -34.4 | -40.0 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 47 | 46 | 38 | 24 | 8 | 8 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -10 | 6 | 12 | 8 | -1 | 5 |
| | | | | | | | 15 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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2302 Non-blast tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | 15 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 18 dB(A) |

| | | |
|---|---|-----------|
| Correction from hydraulic breaker to rock drill | | 5.1 dB(A) |
| rock drill | | 20 dB(A) |
| no. of PME | 8 | 9.0 dB(A) |
| Corrected SPL | | 29 dB(A) |

| | | |
|---|---|------------|
| Correction from hydraulic breaker to handheld breaker | | -0.6 dB(A) |
| handheld breaker | | 14 dB(A) |
| no. of PME | 0 | 0.0 dB(A) |
| Corrected SPL | | 0 dB(A) |

Total SPL 29 dB(A)

Groundborne Noise Assessment

Job No. : 217720
 Project : CE 43/2010 (HY) - Central Kowloon Route - Design and Construction
 Date : 7-Jan-13
 Site : East Portion
 NSR : E-N13

Construction Activities: Excavator mounted breakers
 NSR Distance, R : 25 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 ⁻⁶ mm/s | 95 | 97 | 96 | 94 | 96 | 102 |
| c | Distance Correction = -20 log (R/Ro) [2] | -13 | -13 | -13 | -13 | -13 | -13 |
| d | Soil Damping Loss [3], Type = "Clay" | -2.9 | -5.7 | -11.5 | -22.7 | -40.0 | -40.0 |
| e | Building Coupling Loss, BCF [4] | -7 | -7 | -10 | -13 | -14 | -14 |
| f | Floor to Floor Attenuation [5] | -1 | -1 | -1 | -1 | -1 | -1 |
| g | Conversion to Noise [6] | -27 | -27 | -27 | -27 | -27 | -27 |
| h | Multiple Source Effect [7] | 0 | 0 | 0 | 0 | 0 | 0 |
| i | Noise Level at NSR, dB [8] | 44 | 43 | 33 | 17 | 1 | 6 |
| j | A-weighting Correction | -56.7 | -39.4 | -26.2 | -16.1 | -8.6 | -3.2 |
| k | A-weighted Noise Level, dB(A) | -13 | 3 | 7 | 1 | -8 | 3 |
| | | | | | | | 10 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 5.22).
Damping loss limited to no greater than 40 dB in any frequency bands.
- [4] Reference: "Transportation Noise Reference Book", 1987 (see EIA Report Table 5.23).
- [5] Floor to floor attenuation = -1 dB per floor for a conservative assessment.
- [6] Standard acoustic principles (see EIA Report Table 5.24).
- [7] Breakers in simultaneous operation.
- [8] Octave Noise Level in dB = Items [b] + [c] + [d] + [e] + [f] + [g] + [h].

Construction Activity: 2302 Non-blast tunnelling

| | | |
|-------------------|---|----------|
| Hydraulic breaker | | 10 dB(A) |
| no. of PME | 2 | 3 dB(A) |
| Corrected SPL | | 13 dB(A) |

| | | |
|---------------|---|-----------|
| rock drill | Correction from hydraulic breaker to rock drill | 5.1 dB(A) |
| no. of PME | 8 | 15 dB(A) |
| Corrected SPL | | 24 dB(A) |

| | | |
|------------------|---|------------|
| handheld breaker | Correction from hydraulic breaker to handheld breaker | -0.6 dB(A) |
| no. of PME | 0 | 10 dB(A) |
| Corrected SPL | | 0.0 dB(A) |

Total SPL 25 dB(A)