

## **4. NOISE IMPACT**

### **4.1 Introduction**

This Section presents an assessment of the potential noise impact associated with the construction and operation of Route 10 (NLYLH) (Southern Section). The quantitative assessment methodology that has been adopted for the assessment is presented and control measures for the protection of the identified sensitive receivers are recommended.

### **4.2 Governmental Legislation and Standards**

#### **4.2.1 Construction Noise**

The principal legislation on the control of construction noise is the Noise Control Ordinance (NCO). Also, there is provision in the Environmental Impact Assessment Ordinance (EIAO) for assessing noise from construction activities during daytime. Various Technical Memoranda (TMs), which stipulate control approaches and criteria, have been issued under the NCO and EIAO. The following TMs are applicable to the control of noise from construction activities:

- Technical Memorandum on Noise from Percussive Piling (PP-TM);
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM);
- Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM); and
- Technical Memorandum on Environmental Impact Assessment Process (TMEIA).

#### **4.2.2 Percussive Piling**

Percussive piling is prohibited at any time on Sundays and public holidays and during the weekday evening and nighttime hours (1900-0700 hours, Monday through Saturday). A Construction Noise Permit (CNP) is required for such works during the weekday daytime hours (0700-1900 hours, Monday through Saturday).

When assessing a CNP application for carrying out of percussive piling, the Environmental Protection Department (EPD) is guided by the PP-TM. The EPD will look at the difference between the Acceptable Noise Levels (ANLs), as promulgated in the PP-TM, and the Corrected Noise Levels (CNLs) that are associated with the proposed piling activities. Depending on the level of noise impact on nearby Noise Sensitive Receivers (NSRs), the EPD would allow 3, 5 or 12 hours of daily piling time (see *Table 4.1* below).

**Table 4.1 Permitted Hours of Operation for Percussive Piling**

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
more than 10 dB(A)	0800 to 0900 and 1230 to 1330 and 1700 to 1800
between 0 dB(A) and 10 dB(A)	0800 to 0930 and 1200 to 1400 and 1630 to 1800
no exceedance	0700 to 1900

The Government is committed to phasing out the use of diesel, pneumatic and steam hammer pile drivers, which are particularly noisy. Such pile drivers cannot be used after 1 October 1999. In preparation for the incoming legislative control, the Government has already (since July 1997) administratively banned the use of diesel hammers in Government projects.

#### *General Construction Works*

Noise impacts arises from general construction works during normal working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) at the openable windows of buildings is guided by the TMEIA. The recommended noise standards are presented in *Table 4.2* below.

**Table 4.2 TMEIA Daytime Construction Noise Standards ( $L_{eq, 30 min}$  dB(A))**

Uses	Recommended Noise Standards
Domestic Premises	75.
Educational institutions (normal periods)	70
Educational institutions (during examination periods)	65

The NCO provides statutory controls on general construction works during the restricted hours (ie 1900-0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of powered mechanical equipment (PME) for the carrying out of construction works during the restricted hours would require a CNP. The EPD is guided by the GW-TM when assessing such an application.

When assessing an application for the use of PME, the EPD will compare the ANLs, as promulgated in the GW-TM, and the CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed PME operations. A CNP will be issued if the CNL is equal to or less than the ANL. The ANLs are related to the noise sensitivity of the area in question and different Area Sensitivity Ratings have been drawn up to reflect the background characteristics of different areas. The relevant ANLs are shown in *Table 4.3*.

Despite the description or assessment made in the subsequent paragraphs, the EPD will be guided by the relevant Technical Memorandum (Memoranda) in assessing an application, once filed, for a CNP. All factors affecting the decision will be considered including contemporary situations / conditions. Nothing in this Report shall bind the EPD in making its decision. There is no guarantee that a CNP will be

issued. If a permit is to be issued, the EPD will include any conditions considered appropriate and such conditions are to be followed while the works covered by the permit are being carried out. Failure to comply with the conditions stipulated will lead to cancellation of the permit and prosecution action under the NCO.

**Table 4.3 Acceptable Noise Levels (ANL,  $L_{eq,5 min}$  dB(A))**

Time Period	Area Sensitivity Rating		
	A	B	C
All days during the evening (1900-2300 hours) and general holidays (including Sundays) during the day and evening (0700-2300 hours)	60	65	70
All days during the night-time (2300-0700 hours)	45	50	55

In addition to the general controls on the use of PME during the restricted hours, the EPD has implemented a more stringent scheme via the DA-TM. The DA-TM regulates the use of five types of Specified Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

**SPME:**

- hand-held breaker;
- bulldozer;
- concrete lorry mixer;
- dump truck; and
- hand-held vibratory poker.

**PCW:**

- erection or dismantling of formwork or scaffolding;
- loading, unloading or handling of rubble, wooden boards, steel bars, wood or scaffolding material; and
- hammering.

In the interest of offering additional protection to the population, the carrying out of PCW during restricted hours is generally banned inside a DA. As for the use of SPME, it would be necessary to comply with DA-TM noise level requirements that are 15 dB(A) more stringent than those listed in the GW-TM before a CNP would be issued.

### 4.2.3 Operational Phase

#### *Road Traffic Noise*

Road traffic noise levels at the openable windows of buildings have been guided by the TMEIA and the relevant criteria are shown in *Table 4.4*.

**Table 4.4 TMEIA Road Traffic Noise Planning Criteria\***

Uses	Road Traffic Noise $L_{10,(1hr)}$ dB(A)
Domestic Premises	70
Hotel and Hostels	70
Offices	70
Educational institutions	65
Hospitals & clinics	55

Note: \* The standards apply to uses which rely on openable windows for ventilation.

For both existing and planned NSRs that are affected by noise from "new" roads, direct noise mitigation measures should be provided as far as practicable when the predicted road traffic noise levels exceeded the relevant noise criteria.

If, after implementation of direct technical remedies, any facades of existing NSRs are still exposed to predicted noise levels exceeding the relevant noise criteria, provision of indirect technical remedies in the form of acoustic insulation and air-conditioning should be considered under the ExCo directive "Equitable Redress for Persons Exposed to Increased Noise Resulting from the use of New Roads". The eligibility for indirect technical remedies will be tested against the following three criteria:

- i) the predicted overall noise level from the new road, together with other traffic noise in the vicinity must be above the specified noise levels ( $L_{10}$ , peak hour 65 and 70 dB(A) for educational institutions and residential dwellings respectively);
- ii) the predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, ie the total traffic noise level existing before the works to be constructed were commenced; and
- iii) the contribution to the increase in the predicted overall noise level from the new road must be at least 1.0 dB(A).

For the purpose of this Report, all roads are described as either:

- 'existing' which are unchanged by the proposed project except for possibly taking additional traffic; or
- 'new' which in the context of this report describes all roads that are completely new or are substantially altered by the proposed project (eg the location of the road has altered or the road has been widened substantially).

Recommendations must be presented to ExCo for approval.

The 'new' roads considered in this Report are the Route 10 (NLYLH) (Southern Section), Siu Lam Link Road, So Kwun Wat Link Road and slip road connections to and from the So Kwun Wat Link Road. It has been assumed that all other roads in the vicinity of Route 10 (NLYLH) such as Tuen Mun Road and Castle Peak Road are classed as 'existing' roads. It has also been assumed that noise from existing roads (eg Tuen Mun Road and Castle Peak Road) cannot be mitigated by using direct mitigation measures, as there is currently no standing policy to redress traffic noise impact from existing road in the form of roadside noise barriers and enclosures. However, direct mitigation measures will be incorporated into the design of new roads where necessary to mitigate unacceptable noise levels arising from them.

Low noise road surface has been assumed to be a standard feature of the major roads including Tuen Mun Road, Route 10 (NLYLH) main alignment (excluding the main span of Tsing Lung Bridge and the toll plaza) and slip roads with speed limit higher than 50 kph.

The guiding principles concerning the mitigation of residual impacts on planned NSRs are specified in Works Bureau Technical Circular No. 18/98. Generally, mitigation measures for planned NSRs are to be specified after considering applicable direct technical remedies

#### *Fixed Plant*

Noise from fixed sources, such as ventilation buildings, is controlled by the NCO and noise restrictions are imposed during all operating hours. The appropriate ANLs generated by the fixed plant at neighbouring NSRs are provided in the *Technical Memorandum on Noise from places other than Domestic Premises, Public Places or Construction Sites* (IND-TM). The ANLs are dependent on two factors; the Area Sensitivity Rating (ASR) of the NSR and the time during which the source is operational.

However, the TMEIA recommends that noise emissions from planned or proposed fixed plant sources are limited to comply with levels 5 dB(A) below the ANL. Therefore the criteria which have been adopted in this assessment is ANL-5dB(A).

In any event, the ASR assumed here is for indicative assessment only given that, inter alia, the details of plant layouts are not yet available and buildings layouts are only provisional. It should be noted that fixed noise sources are controlled under Section 13 of the NCO. Nothing in this Report shall bind EPD in assessing noise from these sources upon the receipt of complaints. EPD will assess the noise impacts based on the contemporary conditions/situations.

### **4.3 Baseline Condition**

The baseline conditions in the affected areas are as follow:

**North Lantau:** the area is currently undeveloped and generally rural in nature. Scattered village areas including Fa Peng and Tso Wan are located along the eastern coastline where there is currently no dominant noise source in the vicinity. Ambient noise levels are considered to be low, generated by marine traffic and the Lantau Link.

There are currently no NSRs identified in the northern tip of Lantau. The major noise sources in this area include road traffic noise from the North Lantau Highway and Kap Shui Mun Bridge and rail noise generated from the LAR.

**Tsing Lung Tau:** low density residential areas consisting of low-rise and isolated high-rise developments are identified along the existing Castle Peak Road. The noise environment is dominated by road traffic along both Tuen Mun Road and Castle Peak Road.

**Tai Lam Chung:** low rise village areas, a correctional institution and educational institutions are located along the Tai Lam Nullah. Road traffic noise from the local access road (Tai Lam Chung Road) is considered to be the dominate noise source in the area.

**Siu Lam:** scattered low rise village areas are located within the valley along Siu Lam Road. In addition, medium rise developments such as the Siu Lam Hospital, Siu Lam Psychiatric Centre and the Correction Institution Staff Quarters are identified along the Hong Fai Road. The noise environment is dominated by road traffic along both Tuen Mun Road and Castle Peak Road.

**So Kwun Wat:** the area is rural in nature with village type buildings scattered around. Several container open storage areas are located along So Kwun Wat Road. The major noise sources in this area include road traffic noise from Tuen Mun Road and Castle Peak Road and noise from the open storage areas.

#### 4.4 Noise Sensitive Receivers

##### *Existing Noise Sensitive Receivers*

Representative NSRs, as defined by the TMEIA and NCO have been identified. These NSRs and their horizontal distance from the Route 10 (NLYLH) (Southern Section) during the construction and operational phases are presented in *Table 4.5* and *Table D1 to D5* of *Annex D* respectively. Locations of the NSRs during construction and operational phases are shown in *Figures 4.1 to 4.6a* and *Figures 4.11 to 4.16b* respectively. According to the land status plans and from site surveys some abandoned structures are located in Yi Chuen and Sam Chuen areas. These have been included in the assessments.

As Grand Bay Villa (TLT-N2) and Dragon View (TLT-N3) will be resumed prior to the construction of Route 10 (NLYLH), these NSRs have not been included in this assessment (*Figure 4.2*).

##### *Planned Sensitive Uses*

Information on future/planned sensitive uses has been obtained from relevant Draft Outline Zoning Plans, Layout Plans and information presented in the previous Feasibility Study EIA report; these sensitive uses are as follows:

- R(C) 1 zone to the west of Poseidon Coast in Siu Lam;

- Comprehensive Development Area (CDA) zone to the south of the proposed Tai Lam Chung Viaduct;
- So Kwun Wat Tsuen and the adjacent areas fall within an area zoned "Village Type Development" (V). The "V" zone is intended for village extension;
- R(A) Zone and CDA Zone in Tuen Mun Area 56. PSPS development is proposed in the R(A) Zone;
- Planning Area 55 in Tuen Mun has been zoned for R(B), CDA and GIC uses; and
- Planning Area 48 in Tuen Mun has been zoned for R(B) and GIC uses.

The planned sensitive receivers are also shown in *Table D1 to D6 of Annex D*. Poseidon Coast is currently under construction, it is assumed that this building will be occupied prior to the commencement of any Route 10 (NLYLH) construction works. The planned PSPS development in Tuen Mun Area 56 will be occupied prior to the completion of Route 10 (NLYLH) and consequently it has been included in both the construction and operational noise assessments. Based on current information, it has been assumed that all other planned or proposed NSRs will not be occupied before the completion of the Route 10 (NLYLH) and hence all other planned or proposed NSRs have been excluded from the construction noise impact assessment.

The latest layout plans for the majority of the above planned sensitive receivers (Tai Lam Chung CDA zone, Tuen Mun Area 56 PSPS housing development, Tuen Mun Area 55 CDA zone) are available for assessment. For planned sites without detailed master layout plans (Tuen Mun Area 48 R(B) and G/IC and Area 55 G/IC zones and Tuen Mun Area 56 CDA), the traffic noise assessment points selected are 10 m from the site boundary and, in general, an angle of view of 180 degrees has been assumed.

The design of the Poseidon Coast development includes the provision of a noise barrier along the site boundary closest to Tuen Mun Road. This barrier has been included in both the unmitigated and mitigated road traffic noise models.

**Table 4.5 Location of Noise Sensitive Receivers in Construction Phase**

NSR	Location	No. of NSRs represented	Ground level mPD	Buffer distance	Sensitive Uses
<i>North Lantau Section</i>					
NL - N1	Tso Wan	28	15	220	Residential
NL - N2	Fa Peng	18	11	110	Residential
<i>Tsing Lung Tau Section</i>					
TLT - N1	Hong Kong Garden	200	31.3	280	Residential
TLT - N4	Squatter area – northwest of Hong Kong Garden	9	90	240	Residential
TLT - N5	Bayside Villa	8	23.9	245	Residential
<i>Tai Lam Chung Section</i>					

NSR	Location	No. of NSRs represented	Ground level mPD	Buffer distance	Sensitive Uses
TLC - N1	Correctional Institution (Staff Quarters)	49	4.9	130	Residential
TLC - N2	Correctional Institution (Clinic)	-	4.9	85	Clinic
TLC - N3	Tai Lam Chung Tsuen	39	3.9	30	Residential
TLC - N4	Scattered village houses - west of Tai Lam Chung Road	6	6	70	Residential
TLC - N5	Scattered village houses - Tai Lam Chung Tsuen	2	6	70	Residential
<i>Siu Lam Section</i>					
SL - N1	Siu Lam Psychiatric Centre	-	45.2	220	Clinic
SL - N2	Siu Lam Hospital (library block)	-	60	130	Clinic
SL - N3	Correctional Institution (South Bound of the Siu Lam Interchange)	30	34.8	40	Residential
SL - N4	Correctional Institution (North Bound of the Siu Lam Interchange)	35	32.8	150	Residential
SL - N5	Police Quarters	36	5	55	Residential
SL - N6	Correctional Institution Staff Quarters	21	22	95	Residential
SL - N7	Kings Park Villa	10	10	220	Residential
SL - N8	The Castle Bay	8	12	230	Residential
SL - N9	Castle Peak Villa	12	10	350	Residential
SL - N10	Scattered House to the west of Siu Lam Tsuen	2	46.4	140	Residential
SL - N11	Scattered House to the south of Siu Lam Tsuen	6	22	25	Residential
SL - N12	Scattered House to the west of Poseidon Coast	6	14	55	Residential
SL - N13	West of Siu Lam Tsuen	12	22	65	Residential
SL - N15	Correctional Institution Staff Quarters	16	95	200	Residential
SL - N16	Correctional Institution Staff Quarters	8	70	185	Residential
SL - N17	Scattered House to the north of CI Staff Quarters	4	50	90	Residential
SL - N18	Church at Siu Lam	1	45	150	Church
SL - N19	Village House along Siu Lam Road	9	45	100	Residential



NSR	Location	No. of NSRs represented	Ground level mPD	Buffer distance	Sensitive Uses
SL - N20	Village House along Siu Lam Road	9	12	55	Residential
SL - N21	Village House along Siu Lam Road	3	30	80	Residential
SL - N22	Village House along Siu Lam Road	6	50	115	Residential
SL - N22	Village House along Siu Lam Road	6	50	115	Residential
SL - N23	Seamen's Training Centre	1	5	65	Educational
<i>So Kwun Wat Section</i>					
SKW - N1	So Kwun Wat Ching Uk Tsuen	42	10	110	Residential
SKW - N2	So Kwun Wat Tsuen	66	9.5	130	Residential
SKW - N3	So Kwun Wat Lee Uk Tsuen	48	7.3	75	Residential
SKW - N4	So Kwun Wat Govt. School	-	6	240	School
SKW - N5	Lo Tsing Shan Tsuen (So Kwun Wat Interchange - West Bound)	15	20	35	Residential
SKW - N6	Lo Tsing Shan Tsuen (So Kwun Wat Interchange - East Bound)	24	28	50	Residential
SKW - N7	Scattered village house in So Kwun Wat	6	18	15	Residential
SKW - N8	Scattered village house in So Kwun Wat	18	66	50	Residential
SKW - N9	Scattered House at So Kwun Wat	6	25	35	Residential
SKW - N10	Scattered House at So Kwun Wat	15	20	65	Residential
SKW - N11	Scattered village house (next to the Perowne Barracks)	24	20	15	Residential
SKW - N12	Scattered village house (next to Perowne Barracks)	6	30	85	Residential
SKW - N13	Scattered House located near Tuen Mun Road/So Kwun Wat Road junction	15	6	30	Residential
SKW - N14	Scattered village houses in Area 56	9	8	20	Residential
SKW - N15	Scattered village houses east of Area 55	3	4.4	75	Residential
SKW - N16	Scattered village houses east of Area 55	3	7.3	30	Residential

NSR	Location	No. of NSRs represented	Ground level mPD	Buffer distance	Sensitive Uses
SKW - P1	Planned residential development in Area 56 PPS site	2	20	100	Residential

#### 4.5 Construction Phase

##### 4.5.1 Potential Sources of Impact

Construction noise impacts arising from the various construction activities are expected to pose constraints at the nearby NSRs. A preliminary construction programme of Route 10 (NLYLH) is shown in *Figures 4.7 - 4.10*. For the purpose of this Report, the construction noise impacts are addressed separately for each alignment section namely; North Lantau, Kwai Shek, Tsing Lung Tau, Tai Lam Chung, Siu Lam and So Kwun Wat. The contractor may develop a different construction programme and construction method from the one presented in this Report. The assessment presented in this Report only illustrates one such package.

##### *North Lantau*

As indicated from the preliminary construction programme (*Figure 4.7*), the main construction activities will fall into five main geographic areas namely; the toll plaza (which is along the coastal line between Fa Peng and Tso Wan), Sam Chuen, Yi Chuen, San Po Tsui and Fa Peng. Based on available information, no existing NSRs have been identified in the vicinity (within a radius of 500m) of Yi Chuen and San Po Tsui. Owing to the large separation distance, the construction impacts related to these two areas have not been addressed in this Report.

The main construction activities that may have noise impacts on the nearby NSRs are:

- toll plaza reclamation;
- earthworks excavation at Sam Chuen and Fa Peng;
- control building construction; and
- construction of road pavement and finishes.

Construction activities at this section of Route 10 (NLYLH) are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday).

A plant inventory has been established based on previous relevant highway project experience and is presented in *Table B1* in *Annex B*.

##### *Kwai Shek*

As indicated from the construction programme (*Figure 4.8*), the main construction activities are:

- construction of Kwai Shek bridge tower;
- construction of Kwai Shek cable anchorage;
- Tsing Lung Bridge deck erection;

- Tsing Lung Bridge cable construction;
- earthworks; and
- viaduct construction.

Based on available information, no existing NSRs have been identified in the vicinity (within a radius of 500m) of Kwai Shek. The nearest NSRs will be the villages located on the western coast of Ma Wan, with a separation distance of more than 750 m. The noise attenuation that would be expected over a separation distance of 750 m due to geometrical spreading alone is greater than 65 dB(A), consequently construction noise impacts at these villages are not anticipated. Therefore the construction impacts from these construction activities have not been considered further in this assessment

### *Tsing Lung Tau*

As indicated from the preliminary construction programme (*Figure 4.9*), the main construction activities are:

- construction of Tsing Lung Bridge tower;
- construction of Tsing Lung Bridge cable anchorage;
- Tsing Lung Bridge cable construction;
- Tsing Lung Bridge deck erection; and
- Tai Lam Chung tunnel construction.

There will be a number of construction activities associated with each main construction task, as described below:

#### Tsing Lung Bridge Tower

Excavation of the seabed to provide foundations will be undertaken using underwater blasting (one blast per day) and drilling over a period of up to 2 months. The bridge tower foundation will be formed by placing pre-cast caissons on the excavated seabed.

The 170 metre high bridge tower will be of reinforced concrete construction. There are two methods which could be adopted, either slipforming (as was previously used for Tsing Ma and Ting Kau bridges) or jump-forming (as used on Kap Shui Mun Bridge and the Great Belt West Bridge, Denmark). Slipforming is a continuous process which would take a period of approximately 3 months to complete. During this period it would be imperative that 24 hour working was allowed. In contrast jump-forming constructs the tower in discrete sections. The towers of Tsing Lung Bridge form a major element in this proposed landmark structure and will be visible close to as well as from a distance. It would therefore be preferable aesthetically to construct them using the slipform process. In addition to which the consequences of not permitting 24 hour working include a 6 month delay to the programme at an additional cost of HK\$170 million.

#### Tsing Lung Bridge Cable Anchorage

The preliminary design is based on an intact rock form of anchorage which will

require further development during the detailed design. An alternative would be a tunnel anchorage which would require much greater quantities of rock to be excavated. In order to give a conservative result the latter has been adopted for this assessment. Two 50 to 80 m deep angled adits with a diameter of 20m would be formed near the tunnel portal area by a drill and blast method. Excavated materials would be removed by conveyor to the waterfront for transportation by barge. Concreting of the anchorage would take about three months. This construction work would be carried out during normal daytime working hours.

#### Tsing Lung Bridge Cable Construction

The main suspension cables of the bridge will be constructed using either the aerial spinning or the pre-formed parallel wire strand (PPWS) method. Cable construction will start from Kwai Shek and is expected to be a 24 hour operation. Nighttime working will be required to allow adjustment of the strands. The cables will take between 7 - 10 months to construct depending on the method used.

#### Tsing Lung Bridge Deck Erection

The main bridge deck will be constructed by pre-fabricated steel boxes which will be transported by barge and lifted from the bridge using crane gantries supported on the cable. Lifting, adjustment and jointing of the units will generally be carried out during the day but it will be necessary to carry out some works at night.

#### Side Spans

Concrete viaducts will be constructed between the tunnel portal and bridge tower. The main construction activities that may have noise impacts on the nearby NSRs are:

- pier foundation;
- viaduct superstructure; and
- road pavement and finishes.

#### Tai Lam Chung Tunnel

The Tai Lam Chung Tunnel will be excavated by drill and blast. The programme allows for excavation to be carried out from both portals. Tunnel excavation works are expected to take place during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) for the first 100 m. Beyond this initial length, 24 hour working is expected which is normal practice in tunnel construction and provides optimal programming and use of resources. During restricted hours the construction activities will be contained within the tunnel and tunnel portal blast doors will be closed. All materials excavated during restricted hours will be stockpiled within the tunnel or at the tunnel portal and will be removed only during normal working hours. These measures will significantly reduce noise emissions associated with construction of the tunnel therefore no noise impacts from the night-time construction of the tunnel are anticipated.

A plant inventory has been established based on previous relevant highway project experience and is presented in *Table B5* in *Annex B*.

### *Tai Lam Chung*

As indicated by the preliminary construction programme (*Figure 4.10*), the main construction activities are:

- Tai Lam Chung tunnel construction; and
- Tai Lam Chung viaduct.

There will be a number of construction activities associated with each main construction task as described in the following paragraphs.

#### Tai Lam Chung Tunnel

The Tai Lam Chung Tunnel will be excavated by drill and blast. The tunnel portal will be located to the north of Tai Lam Chung Tsuen. The excavated material is expected to be removed by conveyor from the tunnel portal to a temporary stockpile immediately outside the portal area from where it will be transported by truck. The Tai Lam Chung road and the existing WSD service road will be widened as the main haul road for this construction area. It is estimated that there will be a surplus of material approximately 1000 m<sup>3</sup> per day. Hence, approximately 200 trucks will be required per 12 hour day shift.

Tunnel excavation works are expected to take place during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) for the first 100m. Beyond this initial length, 24 hour working is expected as the construction activities will be underground. As previously mentioned, this is normal practice in tunnel construction and provides optimal programming and use of resources.

During restricted hours the construction activities will be contained within the tunnel and the tunnel portal blast doors closed. All materials excavated during restricted hours will be stockpiled at the tunnel portal and will be removed during normal working hours.

#### Tai Lam Chung Viaduct

From the tunnel portal, a viaduct will be constructed crossing over the existing nullah. The main construction activities which may have noise impacts on the nearby NSRs comprise:

- pier foundation;
- viaduct superstructure; and
- road pavement and finishes.

Construction activities for this section of Route 10 (NLYLH) are expected to operate during normal daytime working hours only (ie 0700 to 1900 hours on any day not being a Sunday or public holiday).

A plant inventory has been established based on previous relevant highway project experience and is presented in *Table B9* in *Annex B*.

### *Siu Lam*

The main construction activities which may have noise impacts on the nearby NSRs are:

- pier foundation;
- viaduct superstructure;
- cutting at Siu Lam;
- construction of administration building; and
- road pavement and finishes.

For the Siu Lam cutting, under the worst case scenario, excavated materials will be removed on a covered conveyor belt located along the Tai Lam Chung Nullah. Assuming the conveyor belt is a line source with an SWL of 90 dB(A) and the covers provide at least 10 dB(A), the noise level generated at the closest NSR (approximately 120 m away) would be approximately 54 dB(A).

Construction activities at this section of Route 10 (NLYLH) are expected to be carried out during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday). Blasting will be required.

A plant inventory has been established based on previous relevant highway project experience and is presented in *Table B13* in *Annex B*.

### *So Kwun Wat*

The main construction activities which may have noise impacts on the nearby NSRs are :

- i) pier foundation;
- ii) viaduct superstructure;
- iii) earthworks excavation at Siu Lam; and
- iv) road pavement and finishes.

Construction activities at this section of Route 10 (NLYLH) are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday). Blasting will not be required for this section of the alignment.

A plant inventory has been established based on previous relevant highway project experience and is presented in *Table B17* in *Annex B*.

A summary listing out the locations and activities which require 24 hour construction is presented in *Table C21* in *Annex C*.

#### 4.5.2 Assessment Methodology

A methodology for assessing construction noise other than percussive piling has been developed based on GW-TM. In general, the methodology is as follows:

- identify the likely type, sequence and duration of principal noisy construction activities required for the implementation of the project;
- identify a list of plant likely to be required for each construction activity;
- calculate the maximum total sound power level (SWL) for each construction activity using the plant list and SWL data given for each plant in the technical memorandum;
- identify representative NSRs as defined by the TMEIA based on existing and committed landuses in the Study Area that may be affected by the worksite. For the purposes of this Study, NSRs will be identified up to a distance of 300 m from the alignment. However, this distance may be reduced, subject to the first layer of NSRs providing adequate acoustic shielding;
- calculate the distance attenuation to NSRs from worksite notional noise source point; and
- predict construction noise levels at NSRs in the absence of any mitigation measures.

If the noise assessment criteria are exceeded at NSRs, mitigation measures will be required. A re-evaluation of the total SWL for each construction activity will be undertaken assuming the use of quiet equipment. If the criteria are still exceeded, further mitigation measures such as limiting the number of items of noisy plant working simultaneously will be proposed. In the case where the above mitigation measures are not sufficient to protect all NSRs from criteria exceedances, movable noise barriers will be used to provide further noise screening by up to 10 dB(A).

#### 4.5.3 Evaluation of Impacts

The unmitigated predicted noise levels at the worst case representative NSRs for each construction stage are as shown in *Annex C* taking into account the distance attenuation.

Cumulative Noise Impacts are examined for each area below. However, a contractor may develop a different construction programme from the one presented in this Report. The example given for each location serves to illustrate one possible combination to demonstrate the effect of construction activities operating concurrently. The examples provided are considered to represent the worst case scenario and are based on the preliminary construction programme.

*North Lantau*

Table C1 in Annex C indicates that unmitigated earthwork excavation at Fa Peng would cause exceedance of the daytime construction noise criteria by up to 7 dB(A), at village areas in Fa Peng (NL-N2). Mitigation measures are required therefore to alleviate the noise impacts.

During the year 2002, it is likely that three construction activities will be undertaken concurrently. These activities include the toll plaza reclamation, and excavation at Sam Chuen and Fa Peng. The cumulative effect of these activities is shown in Table 4.6 below. Exceedances of the daytime construction noise criteria are predicted at NL-N1 & N2, and mitigation measures will be required to alleviate the noise impacts.

**Table 4.6 Unmitigated Cumulative Noise Impacts at North Lantau (Year 2002)**

NSR	Toll Plaza Reclamation	Excavation at Sam Chuen	Excavation at Fa Peng	Cumulative Impact
NL-N1	71	73	68	76
NL-N2	71	66	82	82

During the year 2004, two construction activities are likely to be undertaken concurrently. These include the control building construction and toll plaza road finishes. The cumulative effect of these activities is shown in Table 4.7 below. Results indicate that the cumulative noise impacts from the control building construction and toll plaza road finishes are within the daytime construction noise criteria at all NSRs.

**Table 4.7 Unmitigated Cumulative Noise Impacts at North Lantau (Year 2004)**

NSR	Control Building Construction	Toll Plaza Road finishes	Cumulative Impact
NL-N1	71	63	72
NL-N2	71	62	72

*Tsing Lung Tau*

For NSRs in the vicinity, exceedances of the daytime construction noise criteria by up to 5 dB(A), are predicted from all the main construction activities. Of this exceedance up to 2 dB(A) is due to the most noisy construction activities such as adit and portal formation. Mitigation measures will be required to alleviate the noise impacts.

During the year 2002, there will be three periods for which cumulative impacts are expected from the various construction activities.

- August 2002
- October 2002
- December 2002



During August 2002, five construction activities are likely to operate concurrently. These include caisson installation, adit formation, portal formation, tunnel excavation and removal of spoil for main tunnel. The cumulative effect of these activities is shown in *Table 4.8* below. Exceedances of the daytime construction noise criteria are predicted at all NSRs, and mitigation measures are therefore required to alleviate the noise impacts.

**Table 4.8 Unmitigated Cumulative Noise Impacts at Tsing Lung Tau (August 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation	Tunnel Excavation	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	60	76	76	67	60	79
TLT-N4	58	77	77	69	58	80
TLT-N5	61	77	70	68	62	78

During October 2002, five construction activities are likely to be undertaken concurrently. These include caisson installation, adit excavation, portal formation for main tunnel, removal of spoil for anchorage and removal of spoil for main tunnel. The cumulative effect of these construction activities is shown in *Table 4.9* below. Exceedances of the daytime construction noise criteria are predicted at all NSRs, and mitigation measures are therefore required to alleviate the noise impacts.

**Table 4.9 Unmitigated Cumulative Noise Impacts at Tsing Lung Tau (October 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation for main tunnel	Removal of Spoil for Anchorage	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	60	76	76	57	60	79
TLT-N4	58	77	77	55	58	80
TLT-N5	61	77	70	59	62	78

During December 2002, five construction activities are likely to be undertaken concurrently. These include construction of the bridge tower, adit excavation, removal of spoil for the anchorage, removal of spoil for the main tunnel and viaduct foundation. The cumulative effect of these construction activities is shown in *Table 4.10* below. Results indicate that the cumulative noise impacts from the construction activities are within the daytime construction noise criteria and mitigation measures are therefore not required for these construction activities.

**Table 4.10 Unmitigated Cumulative Noise Impacts at Tsing Lung Tau (December 2002)**

NSR	Bridge Tower	Adit Excavation	Removal of Spoil for Anchorage	Removal of Spoil for Main Tunnel	Viaduct Foundation	Cumulative Impact
TLT-N1	61	67	57	60	69	72
TLT-N4	59	69	55	58	69	72
TLT-N5	62	68	59	62	68	72

During the year 2003, four activities are likely to be undertaken concurrently. These activities include construction of bridge tower, bridge, anchorage, Tsing Lung Tau reclamation and concreting for bridge anchor viaduct superstructure. The cumulative effect of these construction activities is shown in *Table 4.11* below. Results indicate that the cumulative noise impacts from the construction activities are within the daytime construction noise criteria and mitigation measures are therefore not required for these construction activities.

**Table 4.11 Unmitigated Cumulative Noise Impact at Tsing Lung Tau (Year 2003)**

NSR	Bridge Tower	Tsing Lung Tau Reclamation	Anchorage	Viaduct Superstructure	Cumulative Impact
TLT-N1	61	67	63	67	71
TLT-N4	59	65	64	67	71
TLT-N5	62	70	64	67	73

### *Tai Lam Chung*

Assessments indicated that unmitigated construction activities such as portal formation, viaduct foundation and viaduct superstructure would cause daytime construction exceedances of up to 4 dB(A), at the correctional institution staff quarters (TLC-N1), correctional institution clinic (TLC-N2) and Tai Lam Chung Tsuen (TLC-N3). Mitigation measures are therefore required to alleviate the noise impacts.

During the year 2002, five construction activities are likely to be undertaken concurrently (see construction programme). These activities include the portal formation, tunnel excavation, removal of spoil, haul road traffic and viaduct foundation. The cumulative effect of these construction activities is shown in *Table 4.12* below. Exceedances of the daytime construction noise criteria are predicted at all NSRs except for TLC-N5, and mitigation measures are therefore required to alleviate the noise impacts.

**Table 4.12 Unmitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2002)**

NSR	Portal Formation	Tunnel Excavation	Removal of Spoil	Haul Road Traffic	Viaduct Foundation	Cumulative Impact
TLC-N1	78	70	75	57	75	81
TLC-N2	79	71	76	59	79	83
TLC-N3	79	70	76	64	76	82
TLC-N4	74	66	71	60	73	78
TLC-N5	70	62	67	60	66	73

During the year 2003, three construction activities are likely to be undertaken concurrently (see construction programme). These activities include the viaduct superstructure structure, removal of spoil and haul road traffic. The cumulative effect of these construction activities is shown in *Table 4.13*. Exceedances of the daytime

construction noise criteria are predicted at all NSRs except for TLT- N4 and N5, and mitigation measures are therefore required to alleviate the noise impacts.

**Table 4.13 Unmitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2003)**

NSR	Viaduct superstructure	Removal of Spoil	Haul Road Traffic	Cumulative Impact
TLC-N1	74	75	57	78
TLC-N2	78	76	59	80
TLC-N3	75	76	64	79
TLC-N4	71	71	60	74
TLC-N5	64	67	60	69

During the year 2004, two construction activities are likely to be undertaken concurrently (see construction programme). These activities include the construction of tunnel portal and viaduct superstructure. The cumulative effect of these construction activities is shown in *Table 4.14* below. Exceedances of the daytime construction noise criteria are predicted at NSRs TLC-N1, TLC-N2, TLC-N3 and TLC-N4, and mitigation measures are therefore required to alleviate the noise impacts.

**Table 4.14 Unmitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2004)**

NSR	Tunnel Portal	Viaduct Superstructure	Cumulative Impacts
TLC-N1	78	74	79
TLC-N2	79	78	82
TLC-N3	79	75	80
TLC-N4	74	71	76
TLC-N5	70	64	71

#### *Siu Lam*

Owing to the proximity of the construction activities, most NSRs are exposed to high levels of construction noise of up to 90 dB(A). Mitigation measures are therefore required to alleviate the noise impacts during the construction phase.

During the year 2002, two construction activities are likely to be undertaken concurrently. These activities include the viaduct foundation and Siu Lam cutting. The cumulative effect of these construction activities is shown in *Table 4.15* below. Exceedances of the daytime construction noise criteria are predicted at most NSRs including Siu Lam Psychiatric Centre (SL-N1), Siu Lam Hospital (SL-N2), Correctional Institution (SL-N3), Police Quarters (SL-N5), Correctional Institution Staff Quarters (SL-N6), village house (SL-N11, N12 & N13), Poseidon Coast (SL-P3), Correctional Institution Staff Quarters (SL-N15 & N16), scattered village houses (SL-N17), home for the aged at Siu Lam (SL-N18) and village houses at Siu Lam (SL-N19 to N22). Therefore, mitigation measures are required to alleviate the noise impacts.

**Table 4.15 Unmitigated Cumulative Noise Impacts at Siu Lam (Year 2002)**

NSR	Viaduct Foundation	Siu Lam Cutting	Cumulative Impact
SL-N1	-	76	76
SL-N2	-	81	81
SL-N3	86	-	86
SL-N4	74	-	74
SL-N5	83	-	83
SL-N6	78	-	78
SL-N7	71	-	71
SL-N8	71	-	71
SL-N9	67	-	67
SL-N10	75	-	75
SL-N11	90	-	90
SL-N12	83	-	83
SL-N13	82	-	82
SL-N14	78	-	78
SL-N15	71	77	78
SL-N16	73	77	78
SL-N17	79	82	84
SL-N18	74	79	80
SL-N19	78	80	82
SL-N20	83	-	83
SL-N21	80	-	80
SL-N22	-	82	82

During the year 2004, two construction activities are likely to be undertaken concurrently (see construction programme). These activities include the viaduct foundation, road pavement and finishes. The cumulative effects of these construction activities are shown in *Table 4.16* below. Exceedances of the daytime construction noise criteria are predicted at most NSRs including the Correctional Institution (SL-N3), Police Quarters (SL-N5), Correctional Institution Staff Quarters (SL-N6), village house (SL-N11, N12 & N13), Poseidon Coast (SL-P3), scattered village houses (SL-N17) and village houses at Siu Lam (SL-N19 to N21). Mitigation measures are therefore required to alleviate the noise impacts.

**Table 4.16 Unmitigated Cumulative Noise Impacts at Siu Lam (Year 2004)**

NSR	Viaduct Foundation	Road Pavement & Finishes	Cumulative Impact
SL-N1	-	66	66
SL-N2	-	70	70
SL-N3	86	-	86
SL-N4	74	-	74
SL-N5	83	-	83
SL-N6	78	-	78
SL-N7	71	-	71
SL-N8	71	-	71
SL-N9	67	-	67
SL-N10	75	-	75
SL-N11	90	-	90

NSR	Viaduct Foundation	Road Pavement & Finishes	Cumulative Impact
SL-N12	83	-	83
SL-N13	82	-	82
SL-N14	78	-	78
SL-N15	71	66	72
SL-N16	73	66	74
SL-N17	79	71	80
SL-N18	74	68	75
SL-N19	78	70	79
SL-N20	83	-	83
SL-N21	80	-	80
SL-N22	-	71	71

#### *So Kwun Wat*

Owing to the proximity of the construction activities, all NSRs except for So Kwun Wat Government School (SKW-N4) are exposed to high levels of construction noise of up to 97 dB(A). Mitigation measures are therefore required to alleviate the noise impacts during the construction phase. As construction activities are sequential, concurrent activities at individual NSR's will not occur. Cumulative impacts are therefore not expected.

#### 4.5.4 Mitigation Measures

Mitigation measures for each construction site are detailed below. It is recommended that appropriate measures be incorporated into Contract Specifications including:

- selection of quieter plant and working methods;
- reduction in number of items of plant operating in critical areas close to NSRs;
- use of movable noise barriers; and
- good site practice to limit noise emissions at source.

The Contractor could develop a number of packages of mitigation measures to meet the required noise standards. The following illustrates one such package to demonstrate an approach to mitigation that would be feasible.

##### *4.5.4.1 Selecting Quieter Plant and Working Methods*

The Contractor may be able to obtain particular models of plant that are quieter than standards given in GW-TM. The benefits achievable in this way will depend on the details of the Contractor's chosen methods of working. It is considered too restrictive to specify that a Contractor has to use specific items of plant. It is more practical to specify an overall plant noise performance specification to apply to the total SWL of all plant being used on the site so that the Contractor is allowed the flexibility to select plant to suit its needs.

Quiet plant is defined as PME whose actual SWL is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME taken from a British Standard, namely *Noise Control on Construction and Open Sites, BS5228 : Part 1 : 1997*, which are known to be used are given in *Table 4.17*.

**Table 4.17 Sound Power Levels for Specific Silenced PME**

PME	BS5228 Table no.	Ref no.	SWL dB(A) max
Breaker, hand-held	C.2	10	110
Bulldozer	C.3	65	111
Mobile Crane	C.7	110	106
Air Compressor	C.7	25	98
Concrete Pump	C.6	36	106
Circular Saw, Bench Mounted	C.7	78	106
Dump Truck	C.9	29	109
Excavator - for trenching	C.3	97	105
- for ground excavation	C.3	35	106
Generator	C.7	62	100
Lorry	C.9	27	105
Loader	C.3	97	105
Concrete Lorry Mixer	C.6	35	100
Vibratory Roller	C.3	115	102
Asphalt Paver	C.8	24	101
Road Roller	C.8	27	104
Breaker, Excavator mounted (pneumatic)	C.2	4	119
Grader	C.3	76	111
Poker Vibrator	C.6	32	100

It should be noted that various types of silenced equipment are available in Hong Kong. However, EPD, when processing a CNP application, will apply the noise levels contained in the relevant statutory TM unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration.

With the above quiet plant substituted in the equipment inventories given in *Tables B2, B6, B10, B14 and B18 (Annex B)*, the mitigated noise levels at each NSR would be shown in *Tables C2, C6, C10, C14 and C18 (Annex C)*.

With the use of the above quiet plant, the noise levels could be reduced, depending on the type of construction activities operating. The construction noise levels at the NSRs have generally been reduced although further mitigation is still required.

#### *North Lantau*

With the use of quiet plant, the assessment indicates that construction noise levels of up to 81 dB(A) are predicted during earthwork excavation at the village areas in Fa Peng (NL-N2) (see *Table C2 in Annex C*). Mitigation measures are therefore required to alleviate the noise impacts.

### Cumulative Noise Impacts

During the year 2002, exceedances of the daytime construction noise criteria are predicted at NL-N1. With the use of quiet plant, the assessment indicates that construction noise levels of up to 81 dB(A) are still predicted at Fa Peng (NL-N2), as shown in *Table 4.18*.

**Table 4.18 Mitigated Cumulative Noise Impacts at North Lantau (Year 2002)**

NSR	Toll Plaza Reclamation	Excavation at Sam Chuen	Excavation at Fa Peng	Cumulative Impact
NL-N1	67	72	67	74
NL-N2	66	64	81	81

### *Tsing Lung Tau*

With the use of quiet plant, the assessment indicates that the noise impacts at all NSRs comply with the daytime construction noise criteria and mitigation measures are therefore not required for these construction activities. *See Table C6 in Annex C.*

### Cumulative Noise Impacts

During August 2002, exceedances of the daytime construction noise criteria are predicted at all NSRs. With the use of quiet plant, the assessment indicates that cumulative noise impacts from all the construction activities exceed the daytime construction noise criteria by up to 3 dB(A) and mitigation measures are therefore required for these construction activities. *See Table 4.19.*

**Table 4.19 Mitigated Cumulative Noise Impacts at Tsing Lung Tau (August 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation	Tunnel Excavation	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	58	74	74	67	60	77
TLT-N4	56	75	75	69	58	79
TLT-N5	59	74	68	68	62	76

During October 2002, results indicate that the cumulative noise impacts from all the construction activities exceed the daytime construction noise criteria by up to 5 dB(A) and mitigation measures are therefore required for these construction activities. *See Table 4.20.*

**Table 4.20 Mitigated Cumulative Noise Impacts at Tsing Lung Tau (October 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation for main tunnel	Removal of Spoil for Anchorage	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	58	74	74	57	60	79
TLT-N4	56	75	75	55	58	80
TLT-N5	59	74	68	59	62	78

*Tai Lam Chung*

With the use of quiet plant, the assessment indicates that exceedances of the daytime construction noise criteria by up to 2 dB(A), are still predicted during the portal formation, viaduct foundation and viaduct superstructure construction at the correctional institution staff quarters (TLC-N1), correctional institution clinic (TLC-N2) and Tai Lam Chung Tsuen (TLC-N3) (see *Table C10* in *Annex C*). Further mitigation measures are therefore required to alleviate the noise impacts.

**Cumulative Noise Impacts**

During the year 2002, exceedances of the daytime construction noise criteria are predicted at most NSRs except for TLC-N5. With the use of quiet plant, the assessments indicate that construction noise levels of up to 80 dB(A) are still predicted at the correctional institution staff quarters (TLC-N1), correctional institution clinic (TLC-N2) and Tai Lam Chung Tsuen (TLC-N3). Further mitigation measures are therefore required to alleviate the noise impacts. See *Table 4.21*.

**Table 4.21 Mitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2002)**

NSR	Portal Formation	Tunnel Excavation	Removal of Spoil	Haul Road Traffic	Viaduct Foundation	Cumulative Impact
TLC-N1	76	64	67	49	73	78
TLC-N2	77	65	68	51	76	80
TLC-N3	77	65	68	56	73	79
TLC-N4	72	60	63	52	70	75

During the year 2003, the results indicate that the cumulative noise impacts from all the construction activities at all residential NSRs are within the daytime construction noise criteria. Criteria exceedances by up to 8 dB(A) are predicted at the clinic represented by TLC-N2. See *Table 4.22*



**Table 4.22 Mitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2003)**

NSR	Viaduct superstructure	Removal of Spoil	Haul Road Traffic	Cumulative Impact
TLC-N1	67	67	49	70
TLC-N2	71	68	51	73
TLC-N3	68	68	56	71

The cumulative noise impact of the two construction activities likely to be undertaken concurrently during 2004 is shown in Table 4.23. Exceedances of the daytime construction noise criteria are predicted at NSRs TLC-N1, TLC-N2 and TLC-N3, Therefore, further mitigation measures are required to alleviate the noise impacts.

**Table 4.23 Mitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2004)**

NSR	Tunnel Portal	Viaduct Superstructure	Cumulative Impacts
TLC-N1	76	67	77
TLC-N2	77	71	78
TLC-N3	77	68	78
TLC-N4	72	64	73

### *Siu Lam*

With the use of quiet plant, the assessment indicates that exceedances of the daytime construction noise criteria by up to 12 dB(A) are predicted during various construction activities (see *Table C14* in *Annex C*). Further mitigation measures are therefore required to alleviate the noise impacts.

### Cumulative Noise Impacts

During the year 2002, exceedances of the daytime construction noise criteria are predicted at most NSRs. With the use of quiet plant, the assessment indicates that construction noise levels, in the region of 76 to 87 dB(A) are predicted at Siu Lam Hospital (SL-N2), Correctional Institution (SL-N3), Police Quarters (SL-N5), village house (SL-N11, N12 & N13), Correctional Institution Staff Quarters (SL-N15 & N16), scattered village houses (SL-N17), home for the aged at Siu Lam (SL-N18) and village houses at Siu Lam (SL-N19 to N22). Further mitigation measures are therefore required to alleviate the noise impacts. See *Table 4.24*.

**Table 4.24 Mitigated Cumulative Noise Impacts at Siu Lam (Year 2002)**

NSR	Viaduct Foundation	Siu Lam Cutting	Cumulative Impact
SL-N1	-	75	75
SL-N2	-	79	79
SL-N3	82	-	82
SL-N5	80	-	80
SL-N6	75	-	75
SL-N11	87	-	87

NSR	Viaduct Foundation	Siu Lam Cutting	Cumulative Impact
SL-N12	80	-	80
SL-N13	78	-	78
SL-N14	74	-	74
SL-N15	68	75	76
SL-N16	69	75	76
SL-N17	75	81	82
SL-N18	71	77	78
SL-N19	74	79	80
SL-N20	80	-	80
SL-N21	76	-	76
SL-N22	-	80	80

During the year 2004, exceedances of the daytime construction noise criteria are predicted at most NSRs. With the use of quiet plant, the assessments indicate that construction noise levels, in the region of 76 to 87 dB(A) are still predicted at Correctional Institution (SL-N3), Police Quarters (SL-N5), village house (SL-N11, N12 & N13), scattered village houses (SL-N17) and village houses at Siu Lam (SL-N20 & N21). Further mitigation measures are therefore required to alleviate the noise impacts. See *Table 4.25*.

**Table 4.25 Mitigated Cumulative Noise Impacts at Siu Lam (Year 2004)**

NSR	Viaduct Foundation	Siu Lam Cutting Road Pavement & Finishes	Cumulative Impact
SL-N3	82	-	82
SL-N5	80	-	80
SL-N6	75	-	75
SL-N11	87	-	87
SL-N12	80	-	80
SL-N13	78	-	78
SL-N14	74	-	74
SL-N17	75	71	76
SL-N19	74	70	76
SL-N20	80	-	80
SL-N21	76	-	76

#### *So Kwun Wat*

The assessments indicate that with the use of quiet plant, exceedances of the daytime construction noise criteria by up to 20 dB(A), are still predicted at most NSRs including So Kwun Wat Tsuen (SKW-N2), So Kwun Wat Lee Uk Tsuen (SKW-N3), Lo Tsing Shan Tsuen (SKW-N5 & N6), scattered village house (SKW-N7 to N10), scattered village house next to Perowne Barracks (SKW-N11 & N12), scattered village house in So Kwun Wat (SKW-N13 & N14) during various construction activities (see *Table C18* in *Annex C*). Further mitigation measures are therefore required to alleviate the noise impacts.

#### 4.5.4.2 Reducing the Number of Items of Plant Operating in Critical Areas Close to NSRs

With the use of quiet plant, exceedances of the daytime construction noise criteria are still predicted and further mitigation measures have been investigated. In some cases it may be appropriate to restrict the number of items of particularly noisy plant operating within parts of the site that are very close to the NSRs. The effect of limiting the items of plant working concurrently has been investigated and the results are presented in *Tables C3, C7, C11, C15 and C19 (Annex C)*. It has been confirmed that the reduction in the number of items of plant operating in critical areas will still allow the programme to be achieved.

##### *North Lantau*

With the incorporation of quiet plant and limiting the number of items of plant operating concurrently for the earthworks excavation at Fa Peng, the assessments indicate that high levels of construction noise levels of up to 78 dB(A) are still predicted during earthwork excavation at village areas in Fa Peng (NL-N2) (see *Table C3 in Annex C*). Mitigation measures are therefore required to alleviate the noise impacts.

##### Cumulative Noise Impacts

During the year 2002, exceedances of the daytime construction noise criteria are predicted at NL-N1. With the use of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that construction noise levels of up to 78 dB(A) are still predicted at Fa Peng (NL-N2), as shown in *Table 4.26*.

**Table 4.26 Mitigated Cumulative Noise Impacts at North Lantau (Year 2002)**

NSR	Toll Plaza Reclamation	Excavation at Sam Chuen	Excavation at Fa Peng	Cumulative Impact
NL-N2	63	61	78	78

##### *Tsing Lung Tau*

With the incorporation of quiet plant and limiting the number of items of plant operating concurrently for the excavation of seabed, caisson installation, bridge tower construction, Tsing Lung Tau reclamation, adit and portal formation, viaduct foundation and superstructure, and road pavement and finishes, the assessments indicate that all the construction activities are within the daytime construction noise criteria. See *Table C7 in Annex C*.

##### Cumulative Noise Impacts

During August 2002, exceedances of the daytime construction noise criteria are predicted at all NSRs. With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessment indicates that cumulative noise impacts from all the construction activities will comply with the daytime construction noise criteria, as shown in *Table 4.27*.

**Table 4.27 Mitigated Cumulative Noise Impacts at Tsing Lung Tau (August 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation	Tunnel Excavation	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	56	70	71	67	60	75
TLT-N4	55	72	72	69	58	75
TLT-N5	57	71	65	68	62	73

During October 2002, exceedances of the daytime construction noise criteria are predicted at Hong Kong Garden (TLT-N4). With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that construction noise level of up to 77 dB(A) is still predicted at the squatter area northwest of Hong Kong Garden (TLT-N4). See *Table 4.28*.

For other NSRs in the vicinity, the results indicate that the cumulative noise impacts from all the construction activities will comply with the daytime construction noise criteria.

**Table 4.28 Mitigated Cumulative Noise Impacts at Tsing Lung Tau (October 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation for main tunnel	Removal of Spoil for Anchorage	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	56	70	71	57	60	75
TLT-N4	55	72	72	55	58	77
TLT-N5	57	71	65	59	62	75

### *Tai Lam Chung*

With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that exceedances of the daytime construction noise criteria by up to 8 dB(A), are still predicted during various construction activities (see *Table C11* in *Annex C*). Further mitigation measures are therefore required to alleviate the noise impacts.

### Cumulative Noise Impacts

During the year 2002, exceedances of the daytime construction noise criteria are predicted at most NSRs except for TLC-N4 & N5. With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessment indicates that construction noise levels of up to 78 dB(A) are still predicted at the correctional institution staff quarters (TLC-N1), correctional institution clinic (TLC-N2) and Tai Lam Chung Tsuen (TLC-N3). To further reduce the noise impacts, it is therefore recommended that the construction works associated with the viaduct foundation be scheduled such that they should not be operated concurrently with the other construction activity such as portal formation. With the incorporation of these mitigation measures, the noise levels from the construction activities at Tai Lam Chung would be mitigated to comply with the daytime construction noise criteria. See *Table 4.29*.

**Table 4.29 Mitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2002)**

NSR	Portal Formation	Tunnel Excavation	Removal of Spoil	Haul Road Traffic	Viaduct Foundation	Cumulative Impact
TLC-N1	73	64	67	49	69	76
TLC-N2	74	65	68	51	73	78
TLC-N3	74	65	68	56	70	77

During the year 2003, the predicted noise levels are within the daytime construction noise criteria at most NSRs except for TLC-N2. With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that construction noise levels predicted are within the daytime construction noise criteria. Further mitigation measures are therefore not required. See *Table 4.30*.

**Table 4.30 Mitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2003)**

NSR	Viaduct superstructure	Removal of Spoil	Haul Road Traffic	Cumulative Impact
TLC-N2	68	68	51	74

During the year 2004, with the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that construction noise levels predicted at all NSRs are within the daytime construction noise criteria. Further mitigation measures are therefore not required. See *Table 4.31*.

**Table 4.31 Mitigated Cumulative Noise Impacts at Tai Lam Chung (Year 2004)**

NSR	Tunnel Portal	Viaduct Superstructure	Cumulative Impacts
TLC-N1	73	64	74
TLC-N2	74	68	75
TLC-N3	74	65	75

### *Siu Lam*

With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that exceedances of the daytime construction noise criteria of up to 8 dB(A), are still predicted during various construction activities (see *Table C15 in Annex C*). Further mitigation measures are therefore required to alleviate the noise impacts.

### Cumulative Noise Impacts

During the year 2002, exceedances of the daytime construction noise criteria are predicted at most NSRs. With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that construction noise levels, in the region of 76 to 83 dB(A) are still predicted at Siu Lam Hospital (SL-N2), Correctional Institution (SL-N3), Police Quarters (SL-N5), village house (SL-N11 & N12), scattered village houses (SL-N17) and village houses

at Siu Lam (SL-N19, N20 & N22). Further mitigation measures are therefore required to alleviate the noise impacts. See *Table 4.32*.

**Table 4.32 Mitigated Cumulative Noise Impacts at Siu Lam (Year 2002)**

NSR	Viaduct Foundation	Siu Lam Cutting	Cumulative Impact
SL-N2	-	76	76
SL-N3	79	-	79
SL-N5	76	-	76
SL-N11	83	-	83
SL-N12	76	-	76
SL-N13	75	-	75
SL-N15	64	72	73
SL-N16	66	72	73
SL-N17	72	78	79
SL-N18	68	74	75
SL-N19	71	76	77
SL-N20	76	-	76
SL-N21	73	-	73
SL-N22	-	77	77

During the year 2004, exceedances of the daytime construction noise criteria are predicted at most NSRs. With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that construction noise levels, in the region of 76 to 87 dB(A) are still predicted at Correctional Institution (SL-N3), Police Quarters (SL-N5), village house (SL-N11 & N12) and village houses at Siu Lam (SL-N21). Further mitigation measures are therefore required to alleviate the noise impacts. See *Table 4.33*.

**Table 4.33 Mitigated Cumulative Noise Impacts at Siu Lam (Year 2004)**

NSR	Viaduct Foundation	Siu Lam Cutting Road Pavement & Finishes	Cumulative Impact
SL-N3	79	-	79
SL-N5	76	-	76
SL-N11	83	-	83
SL-N12	76	-	76
SL-N13	75	-	75
SL-N17	72	71	75
SL-N19	71	68	73
SL-N20	76	-	76
SL-N21	73	-	73

### *So Kwun Wat*

With the incorporation of quiet plant and limiting the number of items of plant operating concurrently, the assessments indicate that exceedances of the daytime construction noise criteria by up to 18 dB(A), are still predicted at most NSRs including So Kwun Wat Tsuen (SKW-N2), Lo Tsing Shan Tsuen (SKW-N5 & N6), scattered village house (SKW-N7 to N9), scattered village house next to Perowne Barracks (SKW-N11), scattered village house in So Kwun Wat (SKW-N13 & N14) during various construction activities (see *Table C19* in *Annex C*). Further mitigation measures are therefore required to alleviate the noise impacts.

#### *4.5.4.3 Constructing Temporary and Movable Noise Barriers*

Based on site geometry, it is unlikely that NSRs in the vicinity of the worksite could be adequately protected by the use of temporary noise barriers located along site boundaries. However, movable barriers could be very effective in screening noise from particular plant. A noise barrier located close to the noise generating part of a PME could produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant provided it blocked the direct line of sight between the PME and the NSR. The noise screening benefit for each plant considered in this assessment is listed as follows:

- stationary plant - assuming 10 dB(A) reduction: generator, air compressor, concrete pump, poker vibrator and ballast tamper;
- mobile plant - assuming 5 dB(A) reduction: excavator, loader, excavator mounted breaker, mobile crane, compactor, and road roller; and
- large plant - assuming 5 dB(A) reduction when the noise generating part of the PME such as engine and exhaust are blocked by the barriers: rock driller and tower crane.

The use of these measures has only been applied to the following construction activities:

- excavation at Fa Peng;
- reclamation at Tsing Lung Tau;
- adit formation at Tsing Lung Tau;
- viaduct foundation at Siu Lam;
- earthwork excavation at Siu Lam;
- road pavement & finishes at Siu Lam;
- viaduct foundation at So Kwun Wat;
- earthwork excavation at So Kwun Wat; and
- road pavement & finishes at So Kwun Wat

For certain construction activities such as cable spinning the use of movable barriers would not be practicable since most of the noisy PME will operate at a high level. In these cases, the effect of the use of movable barriers has not been investigated.

The effect of the use of quiet plant, limiting the number of items of plants working concurrently and using movable barriers has been investigated for the practicable construction activities and the results are presented in *Tables C4, C8, C12, C16 and C20 (Annex C)*.

#### *North Lantau*

With the incorporation of quiet plant, limiting the number of items of plant operating concurrently and the use of movable barriers for the earthworks excavation at Fa Peng, the assessments indicate that for North Lantau, the predicted construction noise levels are within the daytime construction noise criteria (see *Table C4 in Annex C*). Further mitigation measures are therefore not required for any of the dwellings identified.

#### Cumulative Noise Impacts

During the year 2002, exceedances of the daytime construction noise criteria are predicted at NL-N1. With the use of quiet plant, limiting the number of items of plant operating concurrently and movable barriers, the assessment indicates that construction noise levels are within the daytime construction noise criteria and further mitigation measures are not required. See *Table 4.34*.

**Table 4.34 Mitigated Cumulative Noise Impacts at North Lantau (Year 2002)**

NSR	Toll Plaza Reclamation	Excavation at Sam Chuen	Excavation at Fa Peng	Cumulative Impact
NL-N2	63	61	73	74

#### *Tsing Lung Tau*

#### Cumulative Noise Impacts

During October 2002, with the incorporation of quiet plant, limiting the number of items of plant operating concurrently and the use of movable barriers for the excavation of seabed, caisson installation, Tsing Lung Tau reclamation, adit and portal formation, viaduct foundation and superstructure and road pavement and finishes, the assessments indicate that the cumulative noise impacts from all the construction activities at all NSRs will comply with the daytime construction noise criteria as shown in *Table 4.35*. (See *Table C8 in Annex C*). Further mitigation measures are therefore not required for these construction activities.

**Table 4.35 Mitigated Cumulative Noise Impacts at Tsing Lung Tau (October 2002)**

NSR	Caisson Installation	Adit Formation	Portal Formation for main tunnel	Removal of Spoil for Anchorage	Removal of Spoil for Main tunnel	Cumulative Impact
TLT-N1	56	66	66	57	60	70
TLT-N4	55	67	68	55	58	71
TLT-N5	57	67	60	59	62	70



*Siu Lam*

With the incorporation of quiet plant, limiting the number of items of plant operating concurrently and the use of movable barriers, the assessments indicate that exceedances of the daytime construction noise criteria by up to 3 dB(A), are still predicted during various construction activities at the village house (SL-N11) (see *Table C16 in Annex C*).

**Cumulative Noise Impacts**

During the year 2002, exceedances of the daytime construction noise criteria are predicted at most NSRs. With the incorporation of quiet plant, limiting the number of items of plant operating concurrently and the use of movable barriers, the assessments indicate that construction noise levels, in the region of 78 dB(A) are still predicted at a village house (SL-N11). Owing to the close proximity of the village house (SL-N11) to the alignment, high levels of construction noise are still predicted. It is anticipated that there are no practicable mitigation measures which could be applied to these construction activities. See *Table 4.36*.

**Table 4.36 Mitigated Cumulative Noise Impacts at Siu Lam (Year 2002)**

NSR	Viaduct Foundation	Siu Lam Cutting	Cumulative Impact
SL-N2	-	72	72
SL-N3	74	-	74
SL-N5	72	-	72
SL-N11	78	-	78
SL-N12	72	-	72
SL-N13	70	-	70
SL-N15	60	68	69
SL-N16	61	68	69
SL-N17	67	73	74
SL-N18	63	70	71
SL-N19	66	71	72
SL-N20	72	-	72
SL-N21	68	-	68
SL-N22	-	73	73

During the year 2004, exceedances of the daytime construction noise criteria are predicted at most NSRs. With the incorporation of quiet plant, limiting the number of items of plant operating concurrently and movable barriers, the assessments indicate that construction noise levels, in the region of 78 dB(A) are still predicted at village house (SL-N11). Owing to the close proximity of the village house (SL-N11) to the alignment, high levels of construction noise are still predicted. See *Table 4.37*.

**Table 4.37 Mitigated Cumulative Noise Impacts at Siu Lam (Year 2004)**

NSR	Viaduct Foundation	Siu Lam Cutting Road Pavement & Finishes	Cumulative Impact
SL-N3	74	-	74
SL-N5	72	-	72
SL-N11	78	-	78
SL-N12	72	-	72
SL-N13	70	-	70
SL-N17	67	64	69
SL-N20	72	-	72
SL-N21	68	-	68

Further mitigation measures are therefore required at SL-N11, such as a reduction in the duration of the use of equipment referred to as "50% on-time" (ie. use of equipment for 15 mins every 30 mins) for the PMEs on viaduct foundations, which would reduce the overall noise emissions from this construction activity by 3 dB(A), i.e. reduce from 78 dB(A) to 75 dB(A) and allow the noise criteria to be satisfied.

#### *So Kwun Wat*

With the use of quiet plant, limiting the number of items of plant and the use of movable noise barriers, the assessment indicates that exceedances of the daytime construction noise criterion by up to 13 dB(A), are still predicted at most NSRs including Lo Tsing Shan Tsuen (SKW-N5 & N6), scattered village house (SKW-N7 to N9), scattered village house next to Perowne Barracks (SKW-N11), scattered village house in So Kwun Wat (SKW-N13 & N14) and scattered village house east of Area 55 (SKW-N16) during various construction activities (see *Table C20 in Annex C*).

Additional mitigation measures in these critical areas close to NSRs are considered. Barriers along the worksite boundary can result in a reduction in the overall noise emissions from the construction activities by up to 10 dB(A) (see *Table B20a in Annex B*). With this mitigation, noise levels at SKW-N5, SKW-N6, SKW-N9 and SKW-N13 are predicted to comply with the daytime construction noise criterion (see *Table C20a in Annex C*). However, at SKW-N7, SKW-N8, SKW-N11, SKW-N14 and SKW-N16, criterion exceedance by up to 7 dB(A) are still predicted. A more stringent mitigation package is required for these NSRs.

During construction work (including viaduct foundations, viaduct superstructure and road pavement) at worksites near SKW-N7, SKW-N8, SKW-N11 and SKW-N16, the percentage on-time of the equipment could be limited to 50% (see *Table B20b in Annex B*). This would result in a reduction in the overall noise emissions from the construction activities by 3 dB(A) and the daytime construction noise criterion would be satisfied (see *Table C20b in Annex C*).

For SKW-N14, if the use of PME for earthwork excavation is required within a radius of 40m from the NSR, it is recommended that the use of a rock drill should be carried out alone (ie. without the use of other noisy PME working concurrently). In addition, the percentage on-time of the rock drill should be restricted to 20% (see *Table B20b in Annex B*). Predictions show that by limiting the number of items of noisy PME

operating concurrently and the restriction of 20% on-time within a distance of 40m to SKW-N14, the construction noise levels could be further reduced by 7dB(A), implying that there will be no exceedances of the daytime construction noise criterion (see *Table C20b* in *Annex C*).

In order to avoid potential construction noise impact at the schools, it is recommended that the particularly noisy construction activities be scheduled to avoid examination periods.

Should a contractor wish to use construction methods or construction plant other than those outlined in this Report it will be its responsibility to demonstrate that the relevant noise criteria can be complied with.

Regular monitoring at the NSRs will be required during different phases of the construction programme.

#### 4.5.4.4 Good Site Practice

Good site practice and noise management can considerably reduce the impact of construction site activities on nearby NSRs. The following package of measures should be followed during each phase of construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- machines and plant that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction should, where possible, be orientated to direct noise away from the NSRs;
- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The above house-keeping measures will be implemented through the construction contracts.

#### 4.5.5 Construction Works During Restricted Hours

Construction works during restricted hours will be required for construction activities associated with the Tsing Lung Bridge and the Tai Lam Chung Tunnel (see *Table C21* in *Annex C*).

##### *Area Sensitivity Ratings (ASRs)*

It should be noted that the ASRs will depend on the exact locations, orientations of the NSRs with respect to the construction activities and potential screening from structures or topographical features. There are some factors affecting the assessment

results of a CNP application, such as the assigning of Area Sensitivity Rating, Acceptable Noise Levels etc. EPD would decide these at the time of assessment of such an application based on the contemporary situations/ conditions. It should be noted that the situations/conditions around the sites may change from time to time. Nothing in this Report shall bind EPD in making its decision.

For the purpose of this assessment the ASRs for each of the NSRs likely to experience noise from construction works during restricted hours have been determined in accordance with the GW-TM, based on current information available. These are summarised in *Table 4.38*.

**Table 4.38 Area Sensitivity Ratings**

NSR	Influencing Factor (IF)	Degree to which NSR is affected by IF	ASR
TLT-N1	Castle Peak Road	Directly	C
TLT-N4	Tuen Mun Road	Directly	C
TLT-N5	Castle Peak Road	Directly	C
TLC-N1	No IF in vicinity	Not affected	A
TLC-N2	No IF in vicinity	Not affected	A
TLC-N3	No IF in vicinity	Not affected	A
TLC-N4	No IF in vicinity	Not affected	A
TLC-N5	No IF in vicinity	Not affected	A

#### *Tsing Lung Tau*

For the construction of the bridge tower, it has been identified that the use of poker vibrators will be required which is specified as a SPME under the DA-TM. As Tsing Lung Tau is located within the Designated Areas, the more stringent noise criteria would apply to receivers within these areas. Assuming an ASR of C for most NSRs, the evening and night-time construction noise criteria would be 55 and 40 dB(A) respectively, ie 20 and 35 dB(A) below the daytime noise criteria. The noise at the NSRs in the vicinity could be mitigated by the following measures:

- use of quiet plant;
- limiting the number of items of PME used;
- putting enclosures around concrete pump, generator and compressor; and
- avoiding the use of tower crane concurrently with other equipment.

To seek compliance with the stringent criterion associated with the use of SPME (poker vibrator in this case), it is proposed that barriers be built around the construction platform. The construction platform will rise to different levels in line with the required concreting works and barriers located along the perimeter of the platform (except the seaward facing side) will screen the relevant activities from the NSRs.

With the incorporation of the above mitigation measures, the predicted noise impacts from each activity would comply with the noise criteria (see *Table C21* in *Annex C*).

For the cable spinning, the use of SPME as specified under the DA-TM has not been identified. Therefore assuming an ASR of C for all NSRs, the evening and night-time construction noise criteria would be 70 and 55 dB(A) respectively, ie 5 and 20 dB(A) below the daytime noise criteria. With the use of quiet plant and limiting the number of items of PME used, the predicted noise levels at all the worst case representative NSRs will comply with the night-time and evening noise criteria.

For the tunnel excavation, it is anticipated that beyond the initial length of 100m, excavation will be carried out well within the tunnel and the only noisy PME perceived by nearby NSRs will be noise from the ventilation fans. As the use of SPMEs as specified under the DA-TM have not been identified, the evening and night-time construction noise criteria would be 70 and 55 dB(A) respectively (assuming an ASR of C). Based on this assumption, the prediction noise levels at the worst case representative NSRs will comply with the night-time and evening noise criteria (see *Table C21 in Annex C*).

### *Tai Lam Chung*

As with the Tsing Lung Tau section, it is anticipated that beyond the initial length of 100m, excavation will be carried out well within the tunnel and the only noisy PME perceived by nearby NSRs will be noise from the ventilation fans. As the use of SPMEs as specified under the DA-TM have not been identified, the evening and night-time construction noise criteria would be 65 and 50 dB(A) respectively (assuming an ASR of B). Based on this assumption, the predicted noise levels at the worst case representative NSRs will comply with the evening noise criteria. However, exceedances (by up to 7 dB(A)) are predicted during the night-time period at all NSRs except for Tai Lam Chung Tsuen (TLT-N5) (see *Table C21 in Annex C*). It is expected the use of appropriate silencers would further reduce the noise from the ventilation fans.

#### 4.5.6 Environmental Monitoring and Audit

The recommended mitigation measures, monitoring procedures and locations are presented in the Environmental Monitoring and Audit Programme (EM&A) shown in Section 13. This will enable a contractor to have early warning and provide the necessary action to reduce noise emissions at specific areas if the required noise levels are approached. The effectiveness of on-site control measures could also be evaluated through the monitoring exercise. All the recommended mitigation measures should be incorporated into the EM&A programme for implementation during construction.

## 4.6 Operational Phase

### 4.6.1 Potential Sources of Impact

#### *Road Traffic Noise*

Traffic travelling along Route 10 (NLYLH) and its associated slip roads has the potential to generate noise impacts at residential dwellings and other noise sensitive receivers within the Study Area. This Section addresses potential traffic noise impacts from Route 10 (NLYLH) and its associated slip roads and also recommends

appropriate mitigation measures, which will be incorporated into the road design, to minimise potential impacts.

#### *Fixed Plant Noise*

Two ventilation buildings will be required to provide adequate ventilation for the proposed tunnel through the Tai Lam Country Park. One ventilation building will be located at the Tai Lam Chung portal and the other at the Tsing Lung Tau portal. The preliminary design for the Tsing Lung Tau (TLT) ventilation building is presented in *Annex D*. It is assumed that the Tai Lam Chung (TLC) ventilation building will be of similar design. The main sources of external noise associated with the ventilation buildings are considered to be the louvres located on the building walls and ventilation shafts.

### 4.6.2 Assessment Methodology

#### *Road Traffic Noise*

Road traffic noise calculations have been undertaken in accordance with the UK methodology *Calculation of Road Traffic Noise (CRTN)*, which is currently required by the EPD.

The road scheme within the Study Area and the surrounding road network have been divided into 573 road segments, each of which has been assigned with one of 137 road layouts. A road layout defines the road width, surface type, traffic conditions and, if applicable, the height and location of roadside barriers. The segmentation process was carried out in accordance with the CRTN procedure and the noise modelling was carried out using *HFANoise* road traffic noise model, which fully implements CRTN procedures and methodologies. Hard ground, as defined in CRTN, has been assumed throughout the Study Area and all other features that may result in noise screening have been defined in the model.

In order to predict potential traffic noise impacts from proposed new roads the EPD recommends that, in line with CRTN procedures, traffic noise levels should be predicted based on the worst case year traffic forecast within 15 years after the opening of the development. Year 2022 is considered as the worst case year and has been used as the design year in this noise assessment.

Where appropriate, the prevailing existing noise levels for the construction year (year 2001) have also been predicted. These prevailing noise levels are used in the assessment to determine whether or not NSRs exposed to residual traffic noise impacts will qualify for Noise Insulation Works (NIW) under the Route 10 (NLYLH) scheme.

The projected traffic data in terms of the pm peak hourly flow which have been used in this assessment are presented in *Annex A*. Further details are provided in the TIA Study.

It has been assumed in the assessment that the main alignment of Route 10 (NLYLH) and its associated slip roads will be surfaced using low noise road surfacing. This surface has been included on road sections where there will be free flowing traffic

conditions and the speed will be greater than 50 kph. Low noise road surfacing has been included in both the mitigated and unmitigated traffic noise models.

Pervious (low roads noise) surfacing has not been used for the toll plaza section of Route 10 (NLYLH) since it is unlikely to be effective due to the relatively slow speed and anticipated stop/start nature of the traffic conditions. Pervious surfacing exposed to traffic conditions of this type are, in general, much less resilient to wear than their impervious counterparts, thus requiring more regular maintenance which may negate any potential benefits.

Future traffic noise levels predicted at each NSR were compared with the relevant TMEIA criteria (ie road traffic noise limits of  $L_{10, \text{peak hour}}$  70 dB(A) for residential uses, 65 dB(A) for educational institutions and places of worship and 55 dB(A) for medical facilities). All criteria exceedances are considered to constitute a noise impact and therefore the use of direct mitigation measures has been investigated. In cases where direct noise mitigation measures were found to be either ineffective or unfeasible, indirect technical remedies (ITR) have been considered. Representative floor height levels (low, medium and high levels for highrise buildings) were used in the ITR assessment. A Noise Insulation Work (NIW) Study will be carried at the detailed design stage to ascertain the more exact requirements of the provisions. The criteria of eligibility of NIW are listed under Section 4.2.3.

Sample calculations to verify the model results are provided in *Tables D8a and b in Annex D*.

#### *Fixed Plant Noise*

Since no details concerning the plant that will be used within the ventilation buildings are available at this stage it was not possible to predict noise emissions from these facilities. Therefore the approach taken in this assessment is to provide noise specifications for the ventilation louvres of each building to ensure that the criteria at neighbouring NSRs can be complied with.

The methodology used in this assessment incorporated standard acoustical principles assuming each louvre of the ventilation buildings to be an area source. Corrections were applied to allow for geometrical spreading, facade reflections and potential screening from the building structure. Since the ventilation buildings will operate during the night-time period, the noise emissions from the ventilation buildings will be restricted to comply with the night-time ANL - 5 dB(A).

### 4.6.3 Evaluation of Impacts

#### *Road Traffic Noise*

Traffic noise levels have been calculated at a total of 312 assessment points (APs) representing approximately 6170 residential dwellings, 3 schools, 7 hospital buildings, one training centre, one temple and one church. The location of all the APs considered in this assessment are presented in *Figures 4.11 to 4.16b*. Details of the APs including the number of items of NSRs represented by each are presented in *Table D1 to D5 in Annex D*.

In this assessment the NSRs have been categorised into two main groups. These are residential dwellings and other NSRs (including schools, hospitals, training centres, temples and homes for the aged).

The noise levels predicted at each AP (for the year 2022) are presented in *Table D6* of Appendix D. The results show that the unmitigated Route 10 (NLYLH) will cause criteria exceedances at approximately 5680 residential dwellings and 17 other NSRs. In the context of this assessment, criteria exceedances have been categorised in terms of the extent to which Route 10 (NLYLH) roads contribute to the exceedance. Three categories are used. These are defined below.

- *Not Attributable to Route 10 (NLYLH) Roads* - Traffic noise from existing roads dominates the overall traffic noise level predicted at the AP (ie the contribution from existing roads is 6 dB(A) greater than that from Route 10 (NLYLH) (*new*) Roads).
- *Attributable to Route 10 (NLYLH) Roads* - The contribution from Route 10 (NLYLH) (*new*) Roads to the overall traffic noise level is equal to or greater than that from the existing roads.
- *Partially attributable to Route 10 (NLYLH) Roads* - The contribution from Route 10 (NLYLH) (*new*) Roads to the overall traffic noise level is less than that from the existing roads.

All NSRs exposed to mitigated residual noise impacts have been considered in the NIW eligibility test. The definition of the first bullet explains the fact that the difference between the total and existing noise levels is less than 1 dB(A) (ie. the third part of the noise insulation criteria), and thus NSRs under this category will not be qualified for NIW.

The results of the traffic noise modelling are discussed in the following paragraphs.

#### *North Lantau*

The NSRs considered in this area include the village houses in Tso Wan and Fa Peng in close proximity to Route 10 (NLYLH) (NL-N1A to 1D, NL-N3A to 3H, NL-N7A to 7F, NL-N8A, 8B & 8D and NL-9A & 9B).

The results of the traffic noise modelling indicate that if no mitigation measures are applied to Route 10 (NLYLH) in this area then criteria exceedances at approximately 30 residential dwellings are likely. Direct mitigation measures have therefore be reviewed to alleviate the noise impact from Route 10 (NLYLH) at these NSRs.

#### *Tsing Lung Tau*

The results of the traffic noise modelling indicate that if no mitigation is applied to Route 10 (NLYLH) in this area then criteria exceedances at approximately 320 residential dwellings are likely. Direct mitigation measures will therefore be assessed to alleviate the noise impact from Route 10 (NLYLH) at these NSRs.



Noise emitted from the expansion joint of the Tsing Lung Bridge could contribute to the overall noise generated by vehicle traffic. It is therefore recommended that mitigation measures are examined during the detailed design of the bridge and viaduct deck.

#### *Tai Lam Chung*

The results of the traffic noise modelling indicate that even without mitigation measures applied to Route 10 (NLYLH) compliance with noise criteria is still expected. Direct mitigation measures will therefore not be required in this area.

Elevated noise levels in the vicinity of Tai Lam Chung Tunnel portal is a potential concern. However, studies<sup>1</sup> have shown that noise emanating from the tunnel will diminish at a distance of more than 100m. As the closest NSR is located at a distance of more than 180m from the tunnel portal, the noise effect from the tunnel portal is not considered as an additional environmental constraint and therefore no additional mitigation measures will be required.

#### *Siu Lam*

The results of the traffic noise modelling indicate that if Route 10 (NLYLH) Roads in this area remain unmitigated that noise criteria exceedances at approximately 485 residential dwellings and 6 other NSRs are likely. Direct mitigation measures will therefore be assessed to alleviate the noise impact from Route 10 (NLYLH) at these NSRs.

#### *So Kwun Wat*

The results of the traffic noise modelling indicate that if no mitigation measures are applied to Route 10 (NLYLH) in this area then approximately 4830 residential dwellings and 11 other NSRs will be adversely affected. Direct mitigation measures have been assessed to alleviate the noise impact from Route 10 (NLYLH) at these NSRs.

#### 4.6.4 Traffic Noise Mitigation Measures

The above assessment indicates that some NSRs in North Lantau, Tsing Lung Tau, Siu Lam and So Kwun Wat will be affected by road traffic noise from the Route 10 (NLYLH). Mitigation measures will be required to reduce their impacts to within the TMEIA criteria.

Direct mitigation measures according to Section 6.1, *Annex 13* of TMEIA have been considered in this assessment. Three types of direct mitigation measures are considered to be appropriate to this Study, they are

- alternative alignment;
- noise barrier/enclosure; and
- open-textured road surfacing.

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<sup>1</sup> Sound Propagation at Tunnel Openings: Helmut Woehner, 7 August 1992

Other mitigation measures, such as special building design and setback of buildings are not applicable for mitigating noise at existing NSRs.

The proposed mitigation measures are described in the following paragraphs.

#### *North Lantau*

The noise mitigation investigated for this area and its effects are summarised in *Table 4.39*.

**Table 4.39 Summary of Noise Mitigation Measures for North Lantau Section**

Noise Mitigation Measure	Considerations	Included in proposed mitigation
Low-noise road surfacing	Not effective in start/stop traffic conditions	X
<i>Barrier B1</i> - A 150 m long cantilever noise barrier comprising of an 8 m vertical section with a 1 m horizontal projection, located 1m from the edge of the eastern carriageway of Route 10 (NLYLH) (CH 6880 – CH 7030);	None	√
<i>Barrier B2</i> - An 80 m long cantilever noise barrier comprising of an 8 m vertical section with a 0.5 m horizontal projection, located 1m from the edge of the eastern carriageway of Route 10 (NLYLH) (CH 6800 – CH 6880);	None	√
<i>Barrier B3</i> - A 130 m long, 8 m tall vertical noise barrier, located 1m from the edge of the eastern carriageway of Route 10 (NLYLH) (CH 6670 - CH 6800)	None	√
<i>Barrier B4</i> - A 140 m long, 3 m tall vertical noise barrier, located 1m from the edge of the eastern carriageway of Route 10 (NLYLH) (CH 6530 - CH 6670)	None	√
<i>Barrier B5</i> - A 150 m long, 6 m tall vertical noise barrier, located 1m from the edge of the eastern carriageway of Route 10 (NLYLH) (CH 6380 - CH 6530)	None	√
<i>Barrier B6</i> - A 130 m long, 5 m tall vertical noise barrier, located 1m from the edge of the eastern carriageway of Route 10 (NLYLH) (CH 6250 - CH 6380)	None	√

The results of the mitigated scenario of the traffic noise modelling presented in *Table D6* in *Annex D* indicate that this mitigation will protect all residential dwellings from

criteria exceedances and is likely to benefit (by at least 1dB(A)) approximately 30 NSRs in the area.

Although there are approximately 30 dwellings identified in this area (*see Table D6 in Annex D*), based on latest survey information, there are only 7 villagers currently living in North Lantau. However, since the occupied dwellings could not be identified, this assessment considers approximately 30 residential dwelling in the area.

#### *Tsing Lung Tau*

The noise mitigation investigated for this area and its effects are summarised in *Table 4.40*.

**Table 4.40 Summary of Noise Mitigation Measures for Tsing Lung Tau Section**

Noise Mitigation Measure	Other Considerations	Included in proposed mitigation
Low-noise road surfacing on Route 10 (NLYLH) approach to tunnel portal	None	√
Low-noise road surfacing on the bridge section	Engineering unfeasible	X
Noise barriers along the bridge section	would interfere with the bridge aerodynamics	X
Noise barriers along the Route 10 (NLYLH) approach to the tunnel portal	no improvement	X
Semi-enclosure along the Route 10 (NLYLH) approach to the tunnel portal	Engineering unfeasible	X
Noise Insulation Works	Considered only as a last resort.	√

The results of the mitigated scenario of the traffic noise modelling presented in *Table D6 in Annex D* indicate that residual impacts are likely at 13 APs. However, the noise levels at these APs will be dominated by traffic using existing roads. 7 APs at Hong Kong Garden experience noise impacts partially attributable to Route 10 (NLYLH). Further analysis indicated that the contribution from the Route 10 (NLYLH) is dominated by the bridge section.

The provision of noise barriers along the bridge section is precluded for aerodynamic reasons, as any noise barriers on the main span beyond the position of the northern tower would have a significant impact on the aerodynamic behaviour of the bridge. The maximum thickness of the surfacing on the bridge is limited to 40mm and therefore providing low noise surfacing is not a practical solution. Hence it is not possible to mitigate further the noise levels in this area using direct measures.

According to the study on Evaluation of Suspension Bridge Options<sup>2</sup>, the alignment of the bridge is constrained by the need to tunnel under Tuen Mun Highway at an

<sup>2</sup> Agreement No. CE 82/97 Route 10 (NLYLH) - North Lantau to Yuen Long Highway Investigation and Preliminary Design Assessment: Evaluation of Suspension Bridge Options, Mott Connell Ltd, October 1998.

optimum location. Also, the bridge tower cannot be located elsewhere due to geological factors, marine requirements and engineering constraints. An alternative alignment for the bridge is therefore not feasible.

Semi-enclosure along the Route 10 (NLYLH) approach to the tunnel portal was not found to be feasible due to the engineering constraints limited by the cross-over of the northbound and southbound alignment.

After exhausting all possible direct mitigation measures, it is recommended that 7 APs at Hong Kong Garden are assessed against the noise insulation criteria to determine whether or not they will qualify for ITR under the Route 10 (NLYLH) scheme (see *Table D7 of Annex D*).

#### *Siu Lam*

The noise mitigation investigated for this area and its effects are summarised in *Table 4.41*.

**Table 4.41 Summary of Noise Mitigation Measures for Siu Lam Section**

Noise Mitigation Measure	Considerations	Included in proposed mitigation
Low-noise road surfacing	None	√
<i>Barrier B7</i> - A 370 m long, 1.5 m tall vertical barrier located 1 m from the southern edge of northbound carriageway of Route 10 (NLYLH) (CH 12870 - CH 13320)	None	√
<i>Barrier B8</i> - A 400 m long, 5 m tall absorptive vertical barrier located 3 m from the eastern edge of southbound Siu Lam Link road (CH 2000 - CH 2400)	None	√
<i>Barrier B9</i> - A 150 m long, 5 m tall absorptive vertical barrier located 3 m from the eastern edge of southbound Siu Lam Link road (CH 2400 - CH 2550)	None	√
<i>Barrier B10</i> - A 230 m long, full enclosure for southbound Siu Lam Link road (CH 2550 - CH 2780)	None	√
<i>Barrier B11</i> - A 370 m long, semi-enclosure with absorptive lining (covering the entire width of the carriageway) located 3m from the eastern edge of southbound Siu Lam Link road (CH 2780 - CH 3150)	None	√

Noise Mitigation Measure	Considerations	Included in proposed mitigation
<i>Barrier B12</i> - A 360 m long, semi-enclosure with absorptive lining (covering the entire width of the carriageway) located 0.5 m from the eastern edge of northbound Siu Lam Link road (CH 1320 - CH 1680)	None	√
<i>Barrier B13</i> - A 230 m long, full enclosure for northbound Siu Lam Link road (CH 1680 - CH 1910)	None	√
<i>Barrier B14</i> - A 140 m long, 5 m tall absorptive vertical barrier located 3 m from the western edge of northbound Siu Lam Link road (CH 1910 - CH 2050)	None	√
<i>Barrier B15</i> - A 250 m long, 3 m tall absorptive vertical barrier located 3 m from the western edge of northbound Siu Lam Link road (CH 2200 - CH 2450)	None	√

The results of the mitigated scenario of the traffic noise modelling presented in *Table D6* in *Annex D* indicate that at the majority of the NSRs in this area the noise impacts are not attributable to Route 10 (NLYLH).

#### *So Kwun Wat Section*

The noise mitigation investigated for this area and its effects are summarised in *Table 4.42*.

**Table 4.42 Summary of Noise Mitigation Measures for So Kwun Wat Section**

Noise Mitigation Measure	Other Considerations	Included in proposed mitigation
Low-noise road surfacing	None	√
<i>Barrier B16</i> - A 200m long absorptive cantilever noise barrier comprising of a 6m vertical section with a 2m horizontal projection, located 3m from the northern edge of the eastbound carriageway of So Kwun Wat Link Road (CH 800 - CH 1020)	None	√
<i>Barrier B17a</i> - A 40m long, 5m tall absorptive vertical noise barrier located 3m from the northern edge of the eastbound carriageway of So Kwun Wat Link Road (CH 1250 - CH 1290)	None	√

Noise Mitigation Measure	Other Considerations	Included in proposed mitigation
<i>Barrier B17b</i> - a 40m long, 5m tall absorptive vertical noise barrier located 0.5m from the southern edge of the eastbound carriageway of So Kwun Wat Link Road (CH1250 - CH1290)	None	✓
<i>Barrier B18</i> - A 80m long, 5m tall absorptive vertical barrier located 3m from the northern edge of eastbound carriageway of So Kwun Wat Link Road (CH 1520 - CH 1600)	None	✓
<i>Barrier B19</i> - A 200m long, absorptive cantilever noise barrier comprising of a 6m vertical section with a 2m horizontal projection, located 3m from the southern edge of the westbound carriageway of So Kwun Wat Link Road (CH 3420 - CH 3620)	None	✓
<i>Barrier B20</i> - A 550 m long semi enclosure with absorptive lining (covering the entire width of carriageway) located 3m from the southern edge of the westbound carriageway of So Kwun Wat Link Road (CH2870 - CH3420)	None	✓
<i>Barrier B21</i> - A 270m long semi enclosure with absorptive lining (covering the entire width of the carriageway) located 3m from the western edge of slip road LR2 (CH1580 - CH1850)	None	✓
<i>Barrier B22</i> - A 565m long, 5m tall absorptive vertical barrier located 3m from the eastern edge of slip road LR1 (CH1035 - CH1600)	None	✓
<i>Barrier B23</i> - a 380m long, 5m tall absorptive vertical barrier located 0.5m from the western edge of slip road LR1 (CH 1050 - CH1430)	None	✓
<i>Barrier B24</i> - A 400m long, 5m tall absorptive vertical barrier located 3m from the eastern edge of slip road LR2 (CH950 - CH1350)	None	✓
<i>Barrier B25</i> - A 180m long, 5.5m tall absorptive vertical barrier located 0.5m from the northern edge of westbound So Kwun Wat Link Road (CH2560 - CH 2740)	None	✓
<i>Barrier B26</i> - A 130m long, 5m tall absorptive vertical barrier located 0.5m from the northern edge of westbound So Kwun Wat Link Road (CH2740 - CH2870)	None	✓
<i>Barrier B27</i> - An 80m long semi-enclosure with absorptive lining (covering the entire width of carriageway) located 3m from the northern edge of the eastbound carriageway of So Kwun Wat Link Road (CH1600 - CH1680)	None	✓

Noise Mitigation Measure	Other Considerations	Included in proposed mitigation
<i>Barrier B28</i> - A 230m long, 5m tall absorptive vertical barrier located 3m from the northern edge of slip road LR2 (CH1850 - CH2080)	None	✓
<i>Enclosure E1</i> - A 230m full enclosure for eastbound So Kwun Wat Link Road (CH1020 - CH1250)	*	✓
<i>Enclosure E2*</i> - A 230m full enclosure for eastbound So Kwun Wat Link Road (CH1290 - CH1520)	None	✓
<i>Enclosure E3</i> - A 230m full enclosure for slip road LR2 (CH1350 - CH1580)	None	✓

Note: (\*) The minimum external height for enclosure E2 should be 7.5m such that it can provide screening of road traffic noise from the adjacent westbound So Kwun Wat Link Road.

The results of the mitigated scenario of the traffic noise modelling results presented in *Table D6* in *Annex D* indicate that at the majority of the NSRs in this area the noise impacts are not attributable to Route 10 (NLYLH) Roads.

A noise barrier along the northern edge of westbound So Kwun Wat Link Road (CH 3400 to CH 3500) would be effective in screening noise from the road for SKW-P144 and SKW-P145 but would block the sightline of the merging traffic. This measure was thus not implemented.

Having exhausted of all possible mitigation measures, residual impacts which are at least partially attributable to Route 10 (NLYLH) Roads are likely at three residential dwellings (SKW-N90 to SKW-N95). Therefore, it is recommended that SKW-N90 to SKW-N95 are assessed against the noise insulation criteria to determine whether or not they will qualify for ITR under the Route 10 (NLYLH) Scheme (see *Table D7* of *Annex D*).

In Area 48 R(B)2, south of Tuen Mun Road, the predicted noise levels attributable to the Route 10 (NLYLH) Roads alone exceed the TMEIA criteria at SKW-P139 and SKW-140. Therefore, building setback and limiting the angle of view has been tested for these APs.

To the north of Tuen Mun Road in Area 48 G/IC, residual impact partially attributable to Route 10 (NLYLH) Roads are predicted at SKW-P144 to SKW-P146. For SKW-P143, although residual impacts are not attributable to Route 10 (NLYLH) Roads, the predicted noise levels from Route 10 (NLYLH) Roads alone exceed the TMEIA criteria. Therefore, building setback and limiting the angle of view has been tested for these APs.

Assessments have been carried out for SKW-P139 in Area 48 G/IC and SKW-P140 in Area 48 R(B)2 to the south of Tuen Mun Road, with So Kwun Wat Link Road mitigated. If noise sensitive development is to be built, a setback distance of 40m from the northern site boundary with a restricted angle of view of 110° facing Tuen Mun Road will be required to protect APs from criteria exceedance from the Route 10 (NLYLH) Road alone. Non-sensitive uses, e.g. carport, recreational facilities etc. could be allowed within the setback area. Subject to acceptance of the building design by the appropriate authority, residential blocks could also be erected within the setback area.

For SKW-P144 to SKW-P146 in Area 48 G/IC to the north of Tuen Mun Road, with the proposed mitigation measures along So Kwun Wat Link Road, a setback distance of 40 m from the site boundary facing Tuen Mun Road could not effectively protect the NSRs from criteria exceedance. Therefore, if residential blocks are to be built the first row (row closest to Tuen Mun Road) should adopt a self protective design with no sensitive facade overlooking Tuen Mun Road.

A summary of development constraints for each planned site is listed in *Table 4.43*.

**Table 4.43 A Summary of Development Constraints for Each Planned Site**

Site Ref.	Description	Constraints
Area 48 (south of Tuen Mun Road) (SKW-P139 and SKW-P140)	G/IC and R(B)2	For residential blocks a setback distance of at least 40m from the northern site boundary with a restricted angle of view of no more than 110° facing Tuen Mun Road is required to protect the site from Route 10 traffic noise. Non-sensitive uses e.g. carport, recreational facilities etc. are allowed within the setback area. Subject to building design acceptability to the appropriate authority, residential blocks may be erected within the setback area.
Area 48 (north of Tuen Mun Road) (SKW-P143 to SKW-P146)	G/IC	If residential blocks are to be located, self protective design are recommended for the first row of site development (row closest to Tuen Mun Road). The buildings behind those in the front row should be positioned and orientated to maximise screening from the first row buildings.

The District Lands Office and District Planning Office have reviewed the development parameters proposed in Table 4.43. They are in agreement that the development potential of the sites will not be affected to any significant degree and that the conditions can be translated into enforceable conditions via the lease conditions.

#### *Overall Mitigation Package*

The noise mitigation package for Route 10 (NLYLH) has been developed in accordance with the recommendations provided by the TMEIA. The mitigation proposed is shown in *Figures 4.11 - 4.16* and details provided in *Table 4.44*.



**Table 4.44 Proposed Operational Noise Mitigation Measures**

Barrier Ref	Barrier Location	Start Chainage	End Chainage	Barrier Description
<i>North Lantau Section</i>				
B1	1m from edge of the eastern carriageway of Route 10 (NLYLH) north of Toll Plaza	CH 6880	CH 7030	150m long, cantilever barrier comprising of an 8m vertical section with a 1m horizontal barrier protruding from the top
B2	1m from edge of the eastern carriageway of Route 10 (NLYLH) Toll Plaza area	CH 6880	CH 6880	80m long, cantilever barrier comprising of an 8m vertical section with a 0.5m horizontal barrier protruding from the top
B3	1m from edge of the eastern carriageway of Route 10 (NLYLH) Toll Plaza area	CH 6670	CH 6800	130m long, 8m Vertical Barrier
B4	1m from edge of the eastern carriageway of Route 10 (NLYLH) Toll Plaza area	CH 6530	CH 6670	140m long, 3m Vertical Barrier
B5	1m from edge of the eastern carriageway of Route 10 (NLYLH) Toll Plaza area	CH 6380	CH 6530	150m long, 6m Vertical Barrier
B6	1m from edge of the eastern carriageway of Route 10 (NLYLH) Toll Plaza area	CH 6250	CH 6380	130m long, 5m Vertical Barrier
<i>Siu Lam Section</i>				
B7	1m from the northbound carriageway of Route 10 (NLYLH)	CH 12870	CH 13240	370m long, 1.5m Vertical Barrier
B8	3m from the eastern edge of southbound Siu Lam Link Road	CH 2000	CH 2400	400m long, 5m absorptive Vertical Barrier
B9	located 3m from the eastern edge of southbound Siu Lam Link Road	CH 2400	CH 2550	150m long, 5m absorptive Vertical Barrier
B10	Full enclosure for southbound Siu Lam Link Road	CH 2550	CH 2780	230m full enclosure
B11	3m from the eastern edge of southbound Siu Lam Link Road	CH 2780	CH 3150	370m long semi-enclosure with absorptive lining (covering the entire width of the carriageway)

Barrier Ref	Barrier Location	Start Chainage	End Chainage	Barrier Description
B12	0.5m from the eastern edge of northbound Siu Lam Link Road	CH 1320	CH 1680	360m long, semi-enclosure with absorptive lining (Covering the entire width of the carriageway)
B13	Full enclosure for northbound Siu Lam Link Road	CH 1680	CH 1910	230m long, full enclosure
B14	located 3m from the western edge of northbound Siu Lam Link Road	CH 1910	CH 2050	140m long, 5m absorptive Vertical Barrier
B15	located 3m from the western edge of northbound Siu Lam Link Road	CH 2200	CH 2450	250m long, 3m absorptive Vertical Barrier
<i>So Kwun Wat Section</i>				
B16	3m from the northern edge of the eastbound carriageway of So Kwun Wat Link Road	CH 800	CH 1020	220m long, absorptive cantilever noise barrier comprising of a 6m vertical section with a 2m horizontal projection
B17a	3m from the northern edge of the eastbound carriageway of So Kwun Wat Link Road	CH 1250	CH 1290	40m long, 5m absorptive vertical barrier
B17b	0.5m from the southern edge of the eastbound carriageway of So Kwun Wat Link Road	CH 1250	CH 1290	40m long, 5m absorptive vertical barrier
B18	3 m from the northern edge of eastbound carriageway of So Kwun Wat Link Road	CH 1520	CH 1600	80 m long, 5.5m vertical barrier
B19	3 m from the southern edge of the westbound carriageway of So Kwun Wat Link Road	CH 3420	CH 3620	200 m long, absorptive cantilever noise barrier comprising of a 6 m vertical section with a 2m horizontal projection.
B20	3 m from the southern edge of the westbound carriageway of So Kwun Wat Link Road	CH 2870	CH 3420	550 m long, semi-enclosure with absorptive lining (covering the entire width of carriageway)

Barrier Ref	Barrier Location	Start Chainage	End Chainage	Barrier Description
B21	3 m from the western edge of slip road LR2	CH 1580	CH 1850	270 m long, semi-enclosure with absorptive lining (covering the entire width of carriageway)
B22	3 m from the western edge of slip road LR2	CH 1035	CH 1600	565 m long, 5 m absorptive vertical barrier
B23	0.5 m from the western edge of slip road LR1	CH 1050	CH 1430	380 m long, 5m absorptive vertical barrier
B24	3 m from the eastern edge of slip road LR2	CH 950	CH 1350	400 m long, 5 m vertical barrier
B25	0.5 m from northern edge of westbound So Kwun Wat Link Road	CH 2560	CH 2740	A 180 m long, 5.5 m absorptive vertical barrier
B26	0.5 m from the northern edge of westbound So Kwun Wat Link Road	CH 2740	CH 2870	A 130 m long, 5 m absorptive vertical barrier
B27	3 m from the northern edge of the eastbound carriageway of So Kwun Wat Link Road	CH 1570	CH 1660	90 m long, semi-enclosure with absorptive lining (covering the entire width of carriageway)
B28	3 m from the northern edge of slip road	CH 1850	CH 2080	230 m long, 5m absorptive vertical barrier
E1	Full enclosure for eastbound So Kwun Wat Link Road	CH 1020	CH 1250	230 full enclosure
E2	Full enclosure for eastbound So Kwun Wat Link Road	CH 1290	CH 1520	230 full enclosure
E3	Full enclosure for slip road LR2	CH 1350	CH 1580	230 full enclosure

The effectiveness, in terms of how many NSRs will either be protected by, or benefit (by at least 1 dB(A)) from, the proposed mitigation package is summarised in *Table 4.45* and *4.46*.

**Table 4.45 Effectiveness of Proposed Mitigation, (Residential dwellings)**

Area	Approximate Number of Residential Dwellings	
	Protected from criteria exceedances	Benefited (by > 1dB(A))
North Lantau	20	30
Tsing Lung Tau	0	0
Tai Lam Chung	0	0
Siu Lam	50	610
So Kwun Wat	80	1440
Total	150	2080

**Table 4.46 Effectiveness of Proposed Mitigation, (Other NSRs)**

Area	Approximate Number of Other NSRs	
	Protected from criteria exceedances	Benefited (by > 1dB(A))
North Lantau	0	0
Tsing Lung Tau	0	0
Tai Lam Chung	0	0
Siu Lam	1	4
So Kwun Wat	0	4
Total	1	8

As can be seen in the above Tables the proposed mitigation will protect approximately 150 residential dwellings and 1 other NSR from criteria exceedances. It will benefit (by more than 1dB(A)) approximately 2080 residential dwellings and 8 other NSRs.

#### *Fixed Plant Noise*

The noise specifications of the TLT and TLC ventilation buildings have been calculated to ensure that the night-time noise criteria can be met at the closest NSRs. The NSRs which are most likely to be affected by noise from each of the ventilation buildings are identified in *Table 4.47*. The Table also provides details regarding the ASR assumed for the most exposed facade of each NSR during the operational phase and its approximate distance to the ventilation building.

**Table 4.47 NSRs Potentially Affected by Noise from Ventilation Buildings**

NSR	Distance, m	Facade	ASR	Criteria, dB(A)
<i>Tsing Lung Tau Ventilation Building</i>				
TLT-N1	260	NE	B	50
TLT-N5	325	SW	A	45
<i>Tai Lam Chung Ventilation Building</i>				
TLC-N2	200	SE	B	50
TLC-N3	260	N	B	50

Note: Criteria is the IND-TM ANL - 5 dB(A) (for night-time)

The results of the calculations to determine the noise specifications (details are provided in *Annex D*) indicate that the criteria can be met at all NSRs if the noise emissions from the ventilation building louvres are restricted as follows:

- TLT Ventilation Building:  $L_{Aeq(30 \text{ minutes})}$  of 69 dB(A) at 1 m from the louvre; and
- TLC Ventilation Building:  $L_{Aeq(30 \text{ minutes})}$  of 65 dB(A) at 1 m from the louvre.

Silencers and acoustical louvres would be installed to ensure the noise level ( $L_{eq}$ , 30min), as measure at 1m from the openings or louvres, would be less than 69 dB(A) and 65 dB(A) for the TLT and TLC respectively. The 1m facade noise levels of each NSR take into account distance and screening correction. It is anticipated that sizeable attenuators will be needed to achieve the recommended limiting SWL for each louvre and adequate space should be allocated to attenuators in the design.

In any event, the ASR assumed here is for indicative assessment only given that the details of the plant are not yet available and the buildings layout is only provisional. It should be noted that fixed noise sources are controlled under section 13 of the NCO. Nothing in this Report shall bind the EPD in assessing noise from these sources upon the receipt of complaints. EPD shall assess the noise impacts based on the contemporary conditions/situations.

#### 4.6.5 Residual Impacts

##### *Road Traffic Noise*

As discussed above, the use of direct mitigation measures has been evaluated and the best practicable package has been recommended. However, owing to either environmental constraints or high existing background noise levels, traffic noise criteria exceedances are predicted at some NSRs even with the use of the recommended direct mitigation measures. At the majority of these NSRs the noise from existing roads dominates the overall traffic noise level and as such these impacts are not considered to be attributable to Route 10 (NLYLH) and will not be considered any further in this assessment.

The residual impacts which are considered to be at least partially attributable to Route 10 (NLYLH) have been assessed against the noise insulation criteria as stated in Section 4.2.3. This ITR programme applies to existing NSRs and consequently planned or proposed NSRs have not been included in this ITR assessment but are addressed in subsequent paragraphs.

The results of the ITR assessment indicate that approximately 260 existing residential dwellings will meet all the criteria and so are likely to qualify for indirect technical remedies subject to ExCo approval in the form of window insulation and air conditioning. Those NSRs that are likely to qualify are summarised in *Table 4.48*.

**Table 4.48 Estimated Existing Noise Sensitive Receivers Likely to Qualify for ITR**

Ref	Description	Floors	Number of NSRs represented
TLT-N1A	Hong Kong Garden	1 - 22/F	44
TLT-N1B	Hong Kong Garden	1 - 22/F	44
TLT-N1C	Hong Kong Garden	1 - 22/F	44
TLT-N1D	Hong Kong Garden	1 - 22/F	44
TLT-N1E	Hong Kong Garden	8 - 22/F	30
TLT-N1F	Hong Kong Garden	8 - 22/F	30
TLT-N1H	Hong Kong Garden	10 - 29/F	20

Note: ITR qualification is subject to final approval from ExCo

The results of the ITR assessment above identify the likely affected dwellings by representative floor height level calculations.

The residual impacts predicted at the planned or proposed developments are all dominated by noise from the existing Tuen Mun Road. In each case the contribution from Tuen Mun Road alone exceeds the recommended criteria by up to 15 dB(A).

In Area 48 G/IC and R(B)2, residual impacts partially attributable to Route 10 (NLYLH) are predicted at SKW-P144 to SKW-P146. For SKW-P139, SKWP140 and SKW-P143, although residual impacts are not attributable to Route 10 (NLYLH), the predicted noise levels from Route 10 (NLYLH) Roads alone would affect the potential development after exhausting all practicable mitigation measures. Therefore, development constraints such as self protective blocks, building setback and limiting the angle of view are recommended. These are listed in *Table 4.43*.

Pending ExCo's approval, it is recommended that a detailed Noise Insulation Work Study be carried out at the Detailed Design stage to identify the exact requirements of noise insulation.

#### *Fixed Plant Noise*

No residual fixed plant noise impacts are anticipated as long as the following noise specifications for the ventilation building louvres are complied with:

- TLT Ventilation Building:  $L_{Aeq(30\text{ minutes})}$  of 69 dB(A) at 1 m from the louvre; and
- TLC Ventilation Building:  $L_{Aeq(30\text{ minutes})}$  of 65 dB(A) at 1 m from the louvre.

Past experience suggests that conventional plant can achieve the noise performance requirements derived above.

## 4.7 Conclusion

### 4.7.1 Construction Phase

An assessment of the impacts arising from the construction of the Project has been undertaken using conservative construction equipment schedules. The predictions indicate that during the daytime some activities will cause an exceedance of the noise criteria ( $L_{Aeq, (30\text{min})}$  75 dB) at some of the NSRs.

In order to reduce the impacts on the sensitive receivers, and to demonstrate compliance with the noise criteria, various mitigation measures have been examined (eg. re-phasing of the works, use of super-silenced plant and equipment and the installation mobile barriers). With the application of such measures, which are feasible and practical and will still allow the implementation programme to be achieved, the results from the modelling carried out indicate that the daytime construction noise levels will not exceed the given criteria.

Twenty-four hour working will be required for the construction of Tsing Lung Bridge if the committed commissioning date in 2007 is to be achieved.

The modelling carried out indicates that the predicted noise levels at Hong Kong Gardens will just achieve the noise criteria for restricted hours working. A construction noise permit (CNP) is required before work can commence during restricted hours. There is no guarantee that a CNP will be issued. If a permit is issued, EPD will include any condition it thinks fit and such conditions are to be followed while the works covered by the permit are being carried out. Failure to comply with the permit conditions will lead to cancellation of the permit and prosecution under the NCO. It should be noted that despite any description or assessment made in the EIA Report, EPD will be guided by the relevant TM (Memoranda) in assessing an application, once filed, for a CNP. It will consider all the factors when arriving at its decision taking contemporary situations/conditions into account. Nothing in this Report shall bind EPD in making its decision.

In view of the marginal compliance with the noise criteria at Hong Kong Gardens and the consequential programme and contractual risks should a CNP not be issued or be withdrawn, it is, in our view, essential that an application is made to ExCo for exemption for the construction of Tsing Lung Bridge. This would follow the procedure adopted for Tsing Ma Bridge which was granted an exemption by ExCo.

#### 4.7.2 Operational Phase

##### *Road Traffic Noise*

Noise impact arising from the operational stage of the Route 10 (NLYLH) is mainly from the traffic noise from the open road sections. The potential road traffic noise impacts associated with the Route 10 (NLYLH) have been assessed for the worst case traffic flows for the year 2022. Noise predictions indicated that the unmitigated noise levels at some NSRs are above the TMEIA criterion and therefore the noise benefit from various direct mitigation measures have been investigated.

An effective package of direct mitigation measures are recommended to minimise the traffic noise impact from the Route 10 (NLYLH). This includes low noise road surfaces (everywhere except the Tsing Lung Bridge and the toll plaza), roadside barriers and semi-enclosures. By such mitigation measures, the majority of NSRs are protected from being adversely impacted by traffic noise from Route 10 (NLYLH).

However, as demonstrated by the noise modelling and having exhausted all possible direct mitigation measures, it is not possible to reduce the overall traffic noise levels at certain NSRs to below the TMEIA criterion by mitigating the noise impact from the Route 10 (NLYLH). It is predicted that about 260 dwellings are likely to be

eligible for indirect technical remedies in the form of window insulation and air conditioning. This is, however, subject to final approval from ExCo. It is recommended a detailed Noise Insulation Work Study be carried out to identify the exact extent of noise insulation at the Detailed Design stage.

In Area 48 G/IC and R(B)2, residual impacts partially attributable to Route 10 (NLYLH) are predicted at SKW-P144 to SKW-P146. For SKW-P139, SKWP140 and SKW-P143, although residual impacts are not attributable to Route 10 (NLYLH), the predicted noise levels from Route 10 (NLYLH) alone would affect the potential development after exhausting all practicable mitigation measures. Therefore, development constraints such as self protective blocks, building setback and limiting the angle of view are recommended. These are listed in *Table 4.43*.

Investigations of the development of these areas will be required during the Detailed Design stage to test the effectiveness of adopting suitable building layouts to reduce the angle of exposure to the roadways.

#### *Fixed Plant Noise*

The selection, design and installation of mechanical plant to be used in the ventilation building will be carried out to ensure that the following noise specifications can be met for each of the louvres of each of the ventilation buildings:

- TLT Ventilation Building:  $L_{Aeq(30 \text{ minutes})}$  of 69 dB(A) at 1 m from the louvre; and
- TLC Ventilation Building:  $L_{Aeq(30 \text{ minutes})}$  of 65 dB(A) at 1 m from the louvre.

Past experience suggests that conventional plant can achieve these noise performance requirements.

#### 4.7.3 Environmental Monitoring and Audit

It is recommended that traffic noise monitoring is carried out at representative NSRs within one year of the road opening. Operational noise monitoring will also be required during the commissioning stage of the ventilation buildings to ensure that compliance with the noise limits specified in this report has been achieved.

The recommended mitigation measures, monitoring procedures and locations are presented in the Environmental Monitoring and Audit Programme (EM&A) shown in Section 13. The effectiveness of on-site control measures could also be evaluated through the monitoring exercise.