15. NOISE IMPACT ASSESSMENT

15.1 Introduction

This section presents the assessment of potential noise impacts associated with the construction and operational phases of the EAR. Practical mitigation measures are recommended, where appropriate, to reduce the noise impacts at the identified NSRs in order to satisfy the relevant noise standards described in *Section 3.1*.

For the operational phase impact assessment of road traffic noise, the key requirements of the study are as follows:

- use approved noise calculation methodologies, traffic data prepared by the traffic specialists and consultants of KCRC which is acceptable to Transport Department (see *Annex A*), sites visits and the latest mapping information available to identify the existing sensitive uses, identify planned development and draw direct reference to appropriate Governmental guidance in the application of mitigation measures;
- predict the existing road traffic noise levels ($L_{A10,peak\ hour}$) based on the peak hour traffic flow in the year prior to commencement of EAR's construction (the prevailing year) and describe the existing noise environment;
- predict future road traffic noise levels ($L_{A10,peak\ hour}$) based on the peak hour traffic flow of the maximum traffic projection within 15 years of the Project opening;
- assess the potential impact of the maximum future change in noise levels within 15 years of opening of the EAR;
- recommend direct technical remedies (mitigation measures) as required to reduce traffic noise levels to the established criteria or to maximise the protection of the noise sensitive receivers as far as practicably possible;
- as a last resort, nominate indirect technical remedies for existing eligible sensitive receivers (in accordance with the ExCo directive, *Equitable Redress for Persons Exposed to Increased Noise resulting from the Use of New Roads*) where the practicable application of direct methods would leave residual impacts or where the use of direct measures is not feasible; and
- to include all the recommended direct and indirect technical remedies in the Implementation Schedule for relevant parties to act upon.

The mitigation options that may be considered to reduce any identified noise impacts include, but are not limited to, the following:

- all forms of acoustic barriers and screening measures;
- low noise road surfacing;
- buffer zones and landscaping; and

- site layout and building design.

The alignment of the EAR is located between the roundabout junction of Kam Tin Road/Kam Tin By-pass and the roundabout junction adjacent to West Rail Kam Tin Station. The project involves the construction of a new dual-two carriageway and minor modifications to the existing Kam Sheung Road.

The potential application of buffer zones and landscaping for noise mitigation purposes will be constrained by the existing spatial constraints between the proposed EAR alignment and the as-built environment. In addition, and for the same reasons, the mitigation available through adopting alternative building designs or site layouts at existing (potential) NSRs are not feasible. Therefore, the application of direct mitigation within the boundary of the EAR (principally at, or close to, the roadside) will be the primary method available for the control of noise impacts.

Other mitigation measures such as screening by noise tolerant buildings, decking over of roadways, use of extended podium, architectural features/balcony and special building design are not applicable to this study. Consideration of alternative land use arrangement, siting and road alignment for EAR for mitigating the potential noise impacts on nearby NSRs is outside the scope of this Project.

Where direct technical remedies for existing dwellings and schools are considered necessary and are predicted not to be fully effective, the properties that may be eligible for indirect technical remedies will be identified and the details of the mitigation proposals outlined in the Implementation Schedule in order to ensure that they are fully and appropriately addressed at the correct stages of the Project's development. The detailed specification of noise insulation works and schedule of eligible properties would be undertaken by the Project Proponent following approval of the EIA Study and in accordance with guidelines approved by the EPD and the *ExCo Directive*. This will include, inter alia, a review of existing glazing performance, condition of existing windows and casements as well as a review of electrical service provisions for air conditioners and a full and detailed inventory and specification of all other noise insulation works.

15.2 Construction Phase

15.2.1 Potential Sources of Impact

The source of noise during each construction stage of the EAR will mainly arise from the use of PME on site. The works will require a number of noisy activities including the use of heavy plant for excavation, filling and compaction, concreting and road paving. The key construction stages and activities defined for the EAR are outlined below:

- Drainage Works
  - i) excavation;
  - ii) preparation of formation;

iii) laying of pipes;
iv) construction of manholes;
v) backfilling; and
vi) reinstatement of pavement.

- Road Construction

  i) excavation;
  ii) placement of road base;
  iii) levelling of new road; and
  iv) curbing and road paving.

- Barrier Construction

  i) excavation for foundation;
  ii) bored piling;
  iii) barrier erection; and
  iv) concreting.

The construction of a pedestrian subway to the north of Kam Sheung Road is not considered in this Study as it is not a Designated Project, noise impacts associated with these works are therefore not addressed in this report. Construction activities in association with any utilities have also been excluded in this study as these are outside the scope of the Project.

15.2.2 Assessment Methodology

The assessment of daytime noise impacts from the works associated with EAR will be undertaken based on the procedure outlined in the GW-TM and *Annex 13* of the EIAO TM. In general, the methodology is as follows:

- locate representative NSRs that may be affected by the works (the temporal scope of the EIA study assumes all the NSRs will be operational during the works);
- determine plant teams for corresponding construction activities; based on agreed plant inventories;
- assign sound power levels (SWL) to the PME proposed based on the GW-TM or other sources;
- calculate the correction factors based on the distance between the NSRs and the notional noise source position of the work sites;
- apply corrections such as potential screening effect and acoustic reflection, if any, in the calculations; and
- predict construction noise levels at NSRs in the absence of any mitigation measures.

The total SWL associated with each activity has been established based on the agreed plant inventory which is presented in *Annex B*. The notional "noise source" of each work site is established in accordance with the procedure stated in the GW-TM. Noise impacts at selected representative NSRs have been quantified by comparing the predicted noise levels with the EIAO TM daytime construction noise limits ($L_{eq, 30\,min}$ dB(A)), as given in *Section 3.1.1*. The noise sensitivity of Lutheran Kam Sheung Church is considered to be similar to a school, thus the daytime construction noise limit of 70 dB(A) is used for this NSR.

Given that details of the construction programme are not presently available for the EAR, the West Rail construction works, and also the works for other on-going and future projects such as Main Drainage Channel, Kam Tin Road Improvement Works and the Kam Tin By-pass, an assessment of cumulative noise impacts has been undertaken by assuming that construction activities from these projects occur simultaneously. In practice however, noise from the West Rail, Kam Tin By-pass and Kan Tin Road worksites will be more distant given the closer proximity of EAR and Main Drainage Channel to the majority of NSRs assessed. Based upon this assumption therefore, the cumulative noise impacts are calculated using a worst case factor of +3 dB(A) for the EAR construction works.

The requirement for construction works to be undertaken during the evening and night-time are not expected and therefore noise from the EAR work sites has not been assessed during these periods. However, should works be found to be necessary during the restricted hours, it will be the responsibility of the Contractor to apply for a Construction Noise Permit (CNP). Despite any description or assessment made in this EIA Report on construction noise aspects, there is no guarantee that a CNP will be issued for the project construction. The Noise Control Authority will consider a well-justified CNP application, once filed, for construction works within restricted hours as guided by the relevant Technical Memoranda issued under the Noise Control Ordinance. The Noise Control Authority will take into account of contemporary conditions/situations of adjoining land uses and any previous complaints against construction activities at the site before making his decision in granting a CNP. Nothing in this EIA Report shall bind the Noise Control Authority in making his decision. If a CNP is to be issued, the Noise Control Authority shall include in it any condition he thinks fit. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution action under the NCO.In the assessment of planned daytime construction activities, mitigation measures are considered where noise impacts are identified at the NSRs. The assessment of the effectiveness of mitigation is based upon a re-evaluation of the total SWL for each construction activity. Mitigation measures such as quiet plant, purpose-built noise barriers and limiting the usage of noisy plant in particular locations or within particular construction period have been used.

In the detailed design stage, plant team as well as the construction methodology or construction programme should be available for the Contractor to revisit the potential construction noise problems and for the Contractor to develop sufficient mitigation measures. An Environmental Management Plan, detailing all the specific remedial

measures, should be prepared by the Contractor and be implemented throughout all construction stages of Eastern Access Road to ensure no unacceptable noise impacts on the nearby sensitive uses. This Environmental Management Plan should be updated from time to time as and when necessary, taking into account the latest situation, for example, changes in construction methodology, changes in the powered mechanical equipment to be used, or changes in the proposed noise mitigation measures.

15.2.3 Prediction and Evaluation of Impacts

The prediction of construction noise levels at NSRs have been undertaken by taking account of distance and facade reflection at the worst receiver level of NSRs. The results shown in *Table 15.2a* are based upon the detailed construction noise calculations presented in *Annex C*.

The results indicate that the majority of NSRs would be adversely impacted by the daytime works in the absence of any noise abatement measures, primarily due to the close proximity of the works to the NSRs. During drainage works and road construction, noise levels at NSRs exceed the daytime noise criteria by between 1 and 16 dB(A). The construction of the proposed operational noise barriers along the EAR would also cause adverse noise impacts by up to 23 dB(A) above the criterion at nearby NSRs.

The construction activities found to cause the highest unmitigated adverse impacts include excavation works during various stages of construction, placement of road base and road paving during road construction. The cumulative noise impacts at the NSRs are predicted to range between 1 to 26 dB(A), when works are occuring on two or more closely adjacent worksites. The estimated number of affected dwellings during the construction phase, based on the noise predictions at the worst representative NSRs, would be about 70. The St. Joseph's Primary School and Lutheran Kam Sheung Church close to the Kam Tin Road/Kam Tin By-pass roundabout would also be impacted by the works. As advised by the Education Department, fixed or openable aluminium-framed windows with 6 mm pane have been installed at all noise sensitive rooms of St. Joseph's Primary College. Window-typed air conditioning units were also noted at this NSR.

In view of the magnitude of adverse noise impacts, a comprehensive package of effective mitigation measures combined with strict implementation and environmental management practises will be necessary to reduce impacts during the construction phase of the EAR. Recommended noise mitigation measures to address the construction noise impacts and an assessment of their effectiveness are presented in the following section.

Table 15.2a - Kam Tin Eastern Access Road, Predicted Construction Noise Levels (dB(A))

NSR	Description	Drainage Works	Road Construction	Barrier Construction	Max. Cumulative Noise Level
71	School Area near Kam Tin By-pass Roundabout, facing Kam Tin River (Kam Kwong Kindergarten)	74 (4)	76 (6)	80 (10)	83 (13)
72	Village House, North of Tsz Tong Tsuen, near North Bank of Kam Tin River	73	75	74	78 (3)
73	Village House, East of St. Joseph's Primary School	69	71	71	74
74	Village House of Tsz Tong Tsuen East, South Bank of Kam Tin River	73	75	76 (1)	79 (4)
75	Village, House of Tsz Tong Tsuen South, North of Kam Sheung Road	73	74	86 (11)	89 (14)
75a	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	74	75	86 (11)	89 (14)
75b	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	71	72	87 (12)	90 (15)
76	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	76 (1)	77 (2)	92 (17)	95 (20)
76a	Village House of Tsz Tong Tsuen South, South of Kam Sheung Road	71	73	92 (17)	95 (20)
77	Village House of Yee Hong Garden East, South of Kam Sheung Road	72	74	98 (23)	101 (26)
77a	Village House of Yee Hong Garden East, South of Kam Sheung Road	68	70	85 (10)	88 (13)
78	St. Joseph's Primary School	67	69	71 (1)	74 (4)
79	Village House, East of Yee Hong Garden	71	73	75	78 (3)
80	Village House, East of Yee Hong Garden	70	71	71	74
82	Village House at south of Yee Hong Garden	75	77 (2)	74	80 (5)
83	Village House, South of Ball Kee Factory	71	72	73	76 (1)
84	Village House, South of Ball Kee Factory	70	71	72	75
85	Village House, South of Ball Kee Factory	69	70	70	73
86	Village House, South of Ball Kee Factory	76 (1)	77 (2)	79 (4)	82 (7)
87	Village House, East of Ball Kee Factory	75	76 (1)	78 (3)	81 (6)
89	Lutheran Kam Sheung Church	76 (6)	77 (7)	89 (19)	92 (22)
90	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	76 (1)	77 (2)	82 (7)	85 (10)
91	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	80 (5)	82 (7)	82 (7)	85 (10)
92	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road (near the Proposed Subway)	90 (15)	91 (16)	95 (20)	98 (23)
93	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	79 (4)	80 (5)	81 (6)	84 (9)

NSR	Description	Drainage Works	Road Construction	Barrier Construction	Max. Cumulative Noise Level
94	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	80 (5)	82 (7)	83 (8)	86 (11)
95	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	79 (4)	80 (5)	83 (8)	86 (11)
96	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	77 (2)	79 (4)	81 (6)	84 (9)
97	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	75	77 (2)	78 (3)	81 (6)

Note: Figure in brackets indicates the level of predicted noise exceedance.

15.2.4 Environmental Mitigation Measures During Construction Phase

Noise emissions from construction sites can be reduced through employing good site practices, selecting quiet plant, adopting quieter working methods and restricting the number and use of noisy equipment deployed on site. The control philosophies detailed in this section are recommended to be incorporated into the Contract Specifications to ensure the achievement of acceptable environmental performance of the proposed construction works.

The contractor is free to develop a different package of mitigation measures to achieve the required noise criterion, but the following illustrates one method to mitigate the predicted noise impacts during the construction phase. Should the Contractor propose alternative arrangements, these need to be demonstrated to achieve or better the performances given below to the Proponent. All the mitigation measures must be practicable and feasible in completing the proposed works.

15.2.4.1 Good Site Practices

Good site practices and noise management can considerably reduce the noise impact from construction activities at nearby NSRs. The following 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 nearby NSRs;
- silencers or mufflers on construction equipment should be utilised and be properly maintained during the construction works;
- 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.

Although it is difficult to quantify the noise reduction achieved, the environmental performance of the works would be improved through employment of these control measures.

15.2.4.2 Selecting Quieter Plant and Working Methods

The use of quiet plant is a feasible method of tackling the adverse noise impacts associated with the construction works. The contractor may obtain particular models of plant that are quieter than standard types as given in GW-TM. As the benefits achievable in this way will depend on the details of the contractors' chosen methods of working which is not known at the time of writing, it is considered too restrictive to specify the use of specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance in terms of the total SWL of all PME on site so that the Contractor is allowed some flexibility to select plant to suit his own requirements.

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 British Standard *BS5228: Part 1: 1997; Noise Control on Construction and Open Sites*, which are known to be used are given in *Table 15.2b*. The total SWLs for each construction activity with the recommended silenced PMEs are detailed in *Annex B*. The information detailed in *Table 15.2b* and *Annex B* is for reference only. However, it is the Contractor's responsibility to source construction plant with a similar power rating and noise source level as recommended in this EIA Study for undertaking the works and meeting the required construction programme.

Table 15.2b Sound Power Levels for Specific Silenced PME

PME	BS5228 Table no.	Ref no.	SWL dB(A)	Relative size or power rating (where applicable)
Bulldozer	C3	65	111	46 kW
Mobile Crane	C7	110	106	56 kW
Air Compressor	C7	25	98	7 m³/min
Concrete Pump	C6	36	106	100 kW
Dump Truck	C9	29	109	35 t
Excavator	C3			
- for trenching		97	105	52 kW
- for ground excavation		35	106	45 kW
Generator	C7	62	100	-
Lorry	C9	27	105	35 t
Loader	C3	97	105	52 kW
Concrete Lorry Mixer	C6	35	100	5 m³

PME	BS5228 Table no.	Ref no.	SWL dB(A)	Relative size or power rating (where applicable)
Vibratory Roller	C3	115	102	9 kW
Grader	C3	76	111	-
Breaker	C2	10	110	35 kg
Road Roller	C8	27	104	10 t
Poker Vibrator	C6	32	100	-

Some of the noisiest construction activities include excavation works, placement of road base and road paving in which dump trucks have been proposed to be used. In order to reduce the level of noise emissions from these activities, lorries has been recommended as a suitable replacement. It is believed that this plant substitution can satisfy the functional and operational requirements of these activities and, at the same time, reduce the level of noise impact nearby NSRs.

It should be noted that while various types of silenced equipment can be found in Hong Kong the Noise Control Authority, when processing a CNP application, will apply the SWLs specified in the GW-TM unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration. The onus is therefore placed with the Contractor to prove that his proposed plant deployment meets with the quiet plant noise levels should he choose this method of noise mitigation. With the use of quiet plant on site the overall noise reduction in the worst case predicted unmitigated noise levels would be 3 to 12 dB(A) depending on the type of quiet plant selected.

15.2.4.3 Use of Temporary Noise Barriers

In general, noise barriers of 3 m to 5 m in height located between noisy construction activities and blocking the line of sight to low-rise type NSRs can provide an effective form of acoustical screening resulting in noise level reductions of up to 5 dB(A) (estimated in accordance with the GW-TM). Such noise barriers should be purpose designed and built and need to be located as close as possible to plant to be most effective. Previous experience has indicated that a number of portable noise barriers with a surface material of a minimum superficial density of 15 kg/m^2, a skid-type footing to aid portability and a small cantilevered upper portion maintained in close proximity to the plant and overlapping each other at all times is a minimum standard required to be effective. Certain types of fixed plant such as generators and compressors, can be more effectively screened providing noise emission reductions of 10 dB(A) or more.

The noise screening benefit for general plant types considered in this Study are listed as follows:

- stationary plant - 10 dB(A) screening for PME such as air compressor; and
- mobile plant - 5 dB(A) screening for PME such as excavator, breaker, concrete lorry mixer, mobile crane, poker vibrator, roller, loader and asphalt paver.

Any barriers designed by the contractor should satisfy this noise performance in order to control the emission of noise from PME. The Contractor should pay particular attention to ensure barriers are close fitting and well lapped around plant items to achieve maximum benefit.

15.2.4.4 Restriction of Plant Usage On-site During Critical Construction Stages

From a contractual point of view, it is preferable to allow the Contractor to determine the usage of construction plant according to the construction programme or work schedule. However, in locations where adverse noise impacts are predicted, it may be appropriate in environmental terms, to restrict the usage of particularly noisy equipment operating within certain parts of the site that are very close to the NSRs. Where this is not possible, or where particularly substantial adverse noise impacts remain, it may further be appropriate to limit the percentage of time that the noisy equipment is in operation.

By restricting the percentage of operation (in terms of time usage) of PME to 50% within a 30-minute period (ie 15 minutes of operation within any 30 minute time period), a noise reduction of 3 dB(A) can be achieved. In this instance, with the substantial adverse noise impacts predicted, particularly noisy plant including excavator, grader, concrete pump, asphalt paver, lorry, loader and breaker should be used with caution to ensure the engines are switched off or only idling at a low power setting when not in use. Additionally, the actual operating time will need to be carefully controlled to ensure that they are only operating only for 15 minutes in every consecutive 30-minute period.

This measure is particularly useful in mitigating the noise from barrier construction activities where the work sites are extremely close to the NSRs and also during drainage and road construction at work sites close to NSR 92. This method of control should be monitored by the Contractor and supervised by the Resident Engineer during implementation as the implementation of this measure will have adverse impact on the construction programme.

15.2.4.5 Noise Assessment with the Recommended Mitigation Packages

Without mitigation measures, construction activities associated with the works of EAR will cause exceedances of the daytime construction noise standards. Three mitigation packages, as outlined below, have been reviewed and considered in this Study to develop the required control measures for tackling the predicted noise impacts:

- **M1 - Use of Quiet/Silenced PMEs;**
- **M2 - M1 with the use of temporary noise barriers; and**
- **M3 - M2 plus limiting the operating time of PMEs by 50%.**

The predicted noise levels with the mitigation measures outlined above are shown in *Table 15.2c*. The noise reductions which can be achieved through the use of silenced equipment (mitigation package M1) ranges from 3 to 12 dB(A) for individual construction activities, depending on the type of silenced equipment chosen. For

mitigation package M2 (use of quiet plant and barriers), a further noise reduction of 4 to 5 dB(A) could be achieved. Further limiting the operating time of PME on site could offer an extra 3 dB(A) noise reduction.

As it is considered too restrictive and contracturally inappropriate to insist that the Contractor use specific items of plant, recommendations for mitigation to achieve the applicable noise standards have been based on a combination of noise barriers and a plant noise performance specification. This performance specification requires the Contractor to incorporate silenced construction equipment not exceeding the SWL as given above or reduced plant inventories for the construction activities so that noise levels at nearby NSRs are kept below the relevant noise standards.

Table 15.2c - Kam Tin Eastern Access Road, Mitigated Construction Noise Levels (dB(A))

NSR	Description	Drainage Works	Road Construction	Barrier Construction	Max. Cumulative Noise Level
71	School Area near Kam Tin By-pass Roundabout, facing Kam Tin River (Kam Kwong Kindergarten)	67/ 62/ -	68/ 67/ -	72 (2)/ 67/ -	75 (5)/ 70/ -
72	Village House, North of Tsz Tong Tsuen, near North Bank of Kam Tin River	66/ -/ -	67/ -/ -	66/ -/ -	70/ -/ -
73	Village House, East of St. Joseph's Primary School	62/ -/ -	63/ -/ -	63/ -/ -	66/ -/ -
74	Village House of Tsz Tong Tsuen East, South Bank of Kam Tin River	66/ -/ -	67/ -/ -	68 / -/ -	71/ -/ -
75	Village, House of Tsz Tong Tsuen South, North of Kam Sheung Road	65/ 60/ 57	67/ 66/ 63	78 (3)/ 73/ 70	81 (6)/ 76 (1)/ 73
75a	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	66/ 61/ 58	68/ 67/ 64	79 (4)/ 74/ 71	82 (7)/ 77 (2)/ 74
75b	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	63/ 58/ 55	65/ 64/ 61	79 (4)/ 74/ 71	82 (7)/ 77 (2)/ 74
76	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	68/ 63/ 60	70/ 69/ 66	85 (10)/ 80 (5)/ 77 (2)	88 (13)/ 83 (8)/ 80 (5)
76a	Village House of Tsz Tong Tsuen South, South of Kam Sheung Road	64/ 58/ 55	65/ 64/ 61	84 (9)/ 79 (4)/ 76 (1)	87 (12)/ 82 (7)/ 79 (4)
77	Village House of Yee Hong Garden East, South of Kam Sheung Road	65/ 60/ 57	66/ 65/ 62	90 (15)/ 85 (10)/ 82 (7)	93 (18)/ 88 (13)/ 85 (10)
77a	Village House of Yee Hong Garden East, South of Kam Sheung Road	61/ 56/ -	62/ 61/ -	77 (2)/ 72/ -	80 (5)/ 75/ -
78	St. Joseph's Primary School	60/ -/ -	61/ -/ -	63/ -/ -	66/ -/ -
79	Village House, East of Yee Hong Garden	64/ -/ -	65/ -/ -	67/ -/ -	70/ -/ -
80	Village House, East of Yee Hong Garden	62/ -/ -	64/ -/ -	63/ -/ -	67/ -/ -
82	Village House at south of Yee Hong Garden	68/ -/ -	69/ -/ -	66/ -/ -	72/ -/ -
83	Village House, South of Ball Kee Factory	64/ -/ -	65/ -/ -	65/ -/ -	68/ -/ -
84	Village House, South of Ball Kee Factory	62/ -/ -	63/ -/ -	64/ -/ -	67/ -/ -
85	Village House, South of Ball Kee Factory	61/ -/ -	63/ -/ -	62/ -/ -	66/ - /-
86	Village House, South of Ball Kee Factory	68/ -/ -	69/ - / -	71/ - / -	74/ -/ -

NSR	Description	Drainage Works	Road Construction	Barrier Construction	Max. Cumulative Noise Level
87	Village House, East of Ball Kee Factory	67/ -/ -	68/ -/ -	70/ -/ -	73/ -/ -
89	Lutheran Kam Sheung Church	68/ 63/ 60	69/ 68/ 65	81 (11)/ 76 (6)/ 73 (3)	84 (14)/ 79 (9)/ 76 (6)
90	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	68/ 63/ -	69/ 68/ -	74/ 70/ -	77 (2)/ 73/ -
91	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	73/ 68/ 65	74/ 73/ 70	75/ 70/ 67	78 (3)/ 76 (1)/ 73
92	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road (near the Proposed Subway)	82 (7)/ 77 (2)/ 74	83 (8)/ 82 (7)/ 79 (4)	87 (12)/ 83 (8)/ 80 (5)	90 (15)/ 86 (11)/ 83 (8)
93	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	71/ 66/ -	72/ 72/ -	73/ 68/ -	76 (1)/ 75/ -
94	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	73/ 67/ 64	74/ 73/ 70	75/ 70/ 67	78 (3)/ 76 (1)/ 73
95	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	71/ 66/ -	73/ 72/ -	75/ 70/ -	78 (3)/ 75/ -
96	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	70/ 65/ -	71/ 70/ -	73/ 68/ -	76 (1)/ 73/ -
97	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	68/ -/ -	69/ -/ -	70/ -/ -	73/ -/ -

Note:

1. Figure in bracket indicates the level of noise exceedance.
2. Predicted Noise Levels with mitigation package M1/ M2/ M3.

Potential adverse noise impacts associated with drainage works and road construction can be controlled through the use of quiet plant (mitigation package M1) in most cases, except NSR 92. In view of the small buffer distance between NSRs and work sites for barrier construction, mitigation package M3 (use of quiet plant and noise barriers, with restriction on the operating time of PMEs on site) would be necessary as indicated in *Table 15.2c*. These measures are required for drainage and road construction works next to NSR 92 and at all work sites involving construction of the proposed barriers.

Residual noise exceedances as well as residual cumulative noise impacts are still predicted however at NSRs 76, 76a, 77 (residential premises along Kam Sheung Road), 89 (Lutheran Kam Sheung Church) and 92 (village house closest to the pedestrian subway) after implementing the proposed mitigation measures. These residual impacts could be further reduced by use of the following measures, although it is difficult to quantify their acoustic effectiveness in this study prior to site specific insitu application:

- limiting the number of noisy equipment operating at work sites close to these NSRs;

- avoiding simultaneous construction activities to be undertaken at work sites close to these NSRs through appropriate planning and scheduling of construction works; and
- construction equipment used for material delivery such as lorry or mobile crane should be shut down or switched to a low power setting when idling or not in use. (These additional measures have not been taken into account in the computation of residual noise impacts.)

15.2.5 Residual Impacts and Constraints

In the preceding section, mitigation measures to tackle the noise issues associated with the works for EAR were discussed. The suggested environmental control measures include:

- good site practices;
- selecting quieter plant and working methods;
- use of temporary noise barriers;
- restriction of plant usage on-site during critical construction stages; and
- avoidance of simultaneous noisy activities to eliminate cumulative noise impact.

With the implementation of the recommended mitigation measures, predicted noise impacts can be mostly brought under control. However, residual noise impacts in the range of 1 to 7 dB(A) are still predicted at NSRs 76, 76a, 77 (residential premises along Kam Sheung Road), 89 (Lutheran Kam Sheung Church) and 92 (village house closest to the pedestrian subway) (The additional measures recommended in *Section* 15.2.4.5 have not been taken into account in the computation of residual noise impacts). These residual impacts arise because of the small buffer distance between the proposed works and these NSRs and the need to use heavy construction equipment. The estimated indicative number of residential dwellings with predicted residual construction noise impacts would be about five.

The range of predicted residual noise impacts in association with barrier construction predicted at NSRs 76, 76a, 77, 89 and 92 was 1 to 7 dB(A) during excavation for foundation and erection of noise barrier. The expected time period of noise impact on these NSRs was estimated to be three weeks to one month, dependent on the actual construction programme developed in the detailed design stage. Residual noise impact of up to 4 dB(A) was also predicted at NSR 92 due to road construction, especially during excavation activities and levelling of new road pavement. The expected impact period would be about one to two months time depending on the actual construction programme developed during the detailed design stage.

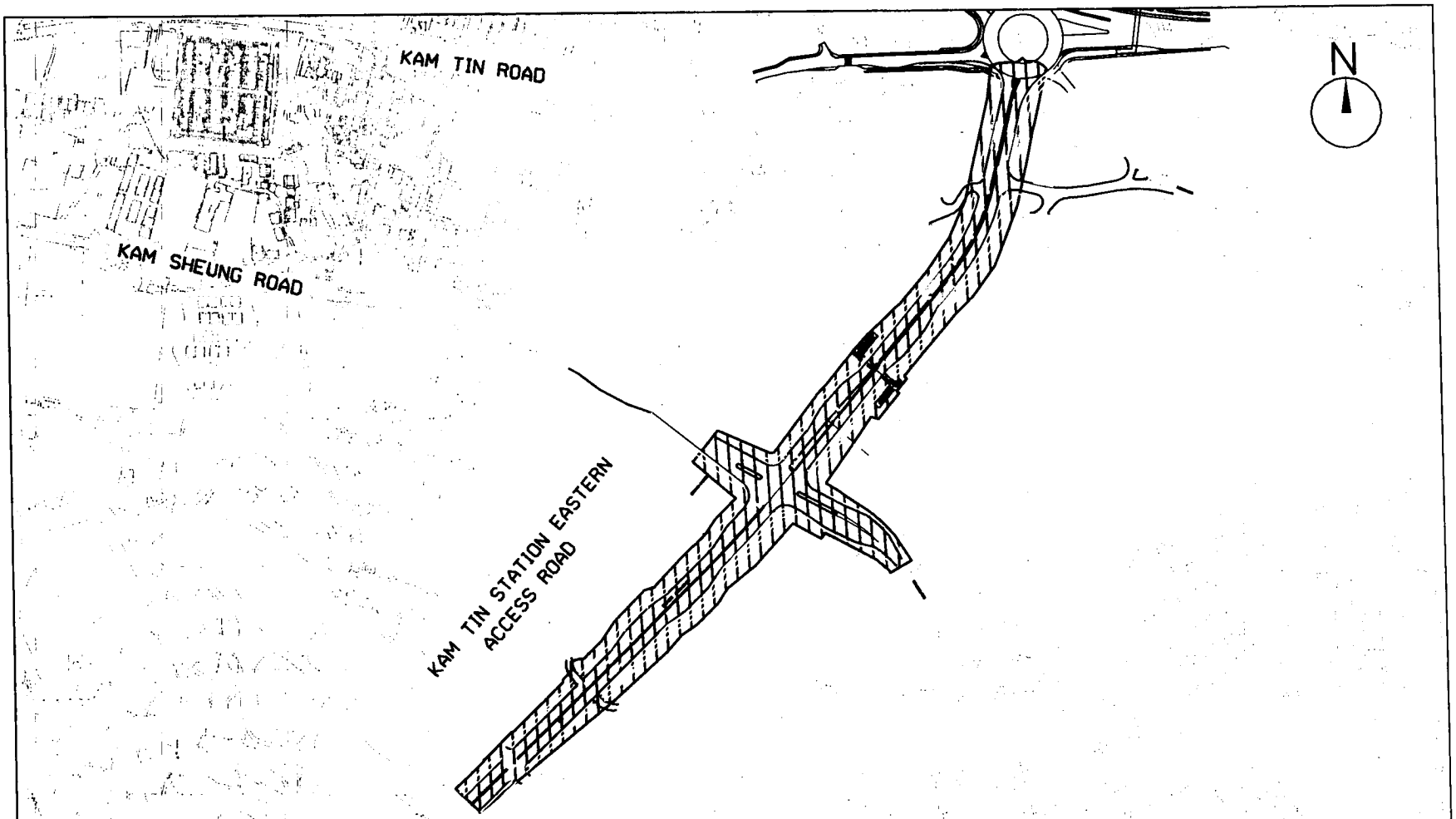
There has been considerable discussion on the practicality of introducing controls on the operational time of plant as has been proposed in the previous section as a mitigation measures. The two sides of the argument are: the need to exhaust all forms of mitigation to reduce the generation of construction noise to the lowest level possible if the noise

control standard cannot be achieved; and, the additionally prolonged duration of those affected construction activities if a reduction in plant on-time were introduced. By way of illustration, a 50% reduction in on-time, if strictly enforced, will have the effect of prolonging the construction activity duration by more than 50% when the inefficiencies of stopping and starting operational plant are taken into account.

Given that in this instance, regardless of the implementation or otherwise of this measure, substantial adverse residual noise impacts at NSRs will still be recorded, it is considered inappropriate and impractical to recommend this measure in the knowledge that these impacts will be additionally prolonged from that originally proposed by the Proponent. It is considered the "least worst" option to expose these NSRs to a slightly higher level of residual noise impact (by approximately +3 dB(A)) than to adopt a more environmentally stringent approach. Taking a broader view of these impacts, the high level of residual noise impacts will be sustained only for a short period of the total construction period and the opportunity to adopt and implement additional control measures, potentially providing mitigation to levels of impact lower than have been predicted, may be identified by the Contractor and/or an on-site EM&A team during construction.

The EIA has, within the realms of the currently assumed construction scenario, considered all practicable means of mitigating the construction noise. However, during the detailed design stage, precise details of the proposed plant team, construction methodology and construction programme will be developed. As a potential means of eliminating the residual noise impacts, the Contractor responsible for the construction works should undertake a thorough review of his proposed plant team, construction methodology and construction programme, and, if possible, develop further mitigation measures. The Contractor should also develop an Environmental Management Plan (as detailed in *Section 23.5*), which clearly defines how the Contractor will implement the mitigation measures defined in this EIA Report, and all the specific remedial measures developed by the Contractor to further mitigate the predicted residual noise impacts. The measures in the EMP shall, as appropriate, be implemented by the Contractor throughout the construction period of Eastern Access Road to ensure there no unacceptable noise impacts to the nearby sensitive uses.

As residual construction noise impacts are identified and a high degree of noise control is required to avoid adverse impacts through this EIA Study, regular monitoring at the NSRs will be required during the construction phases. The purpose of the monitoring will be to examine the effectiveness of all the on-site measures, to enable the Contractor to be aware of his environmental performance and provide necessary action if the assessment criteria are exceeded. Monitoring will also provide a direct response mechanism for the Project Proponent to manage the Contractors' action in effecting reductions in noise emissions at specific areas. The monitoring requirements are described in *Section 23* of this report.



ROAD CLASSIFIED AS "NEW" IN TRAFFIC NOISE ASSESSMENT FOR KAM TIN

SCALE: 1/5,000

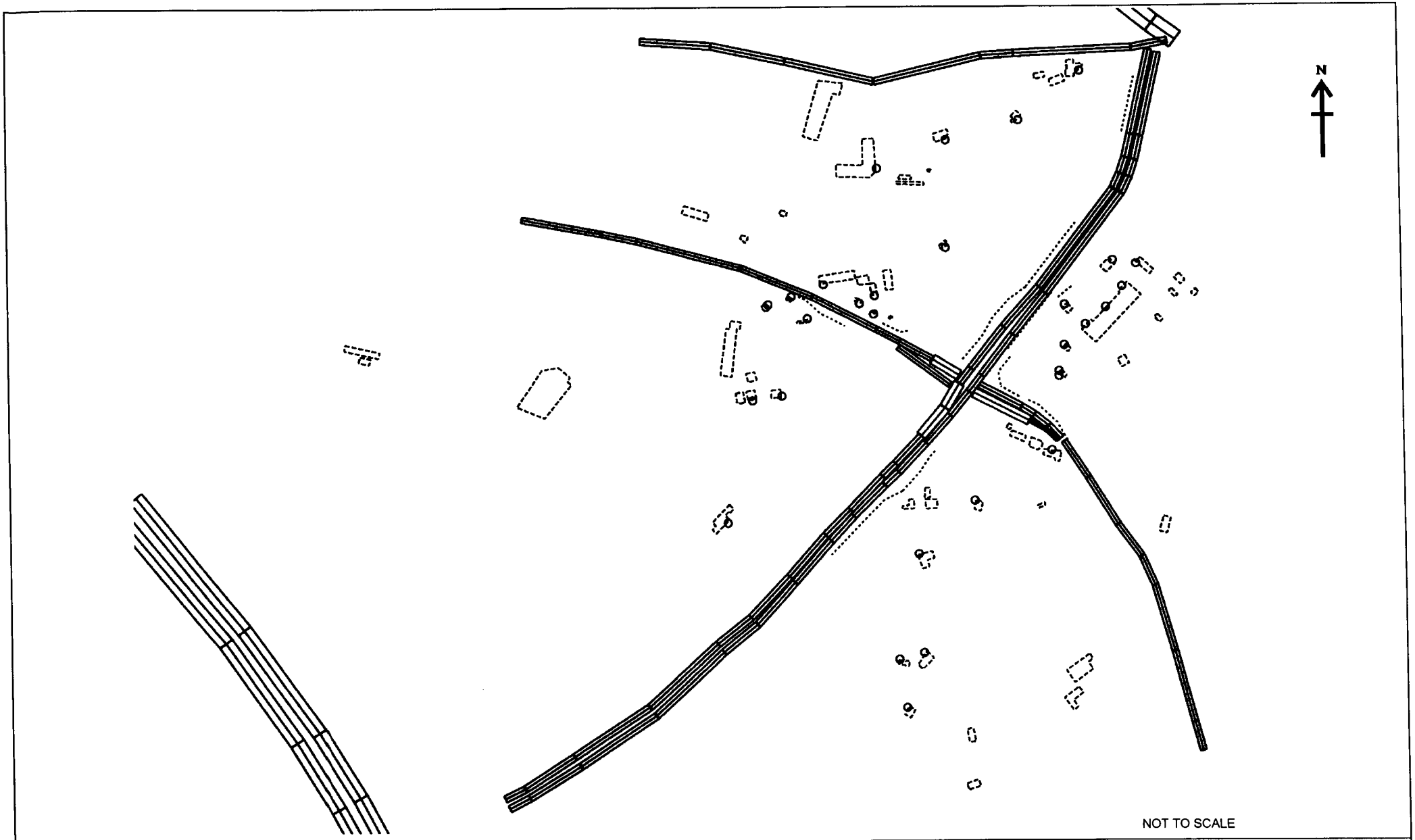
FIGURE 15.3a

C1088/kam.3

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: DD-981 ENVIRONMENTAL SUPPORT SERVICES



DIGITISED ROAD SCHEME FOR KAM TIN

FIGURE 15.3b

Contract/C1800P9

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: DD-901 ENVIRONMENTAL SUPPORT SERVICES

15.3 Operational Phase

15.3.1 Potential Sources of Impact

As described in *Section 14.1*, road traffic noise is the dominant noise source affecting the existing NSRs in the vicinity of the EAR. In view of the traffic flows on existing highway network and the future EAR, and the minimal extent of land available to act as a noise buffer during the past and present planning of noise sensitive developments, noise impacts during the operational phase of EAR would be likely.

The prevailing road traffic noise and future levels expected from natural growth and West Rail associated traffic growth, and the traffic carried by the EAR are addressed in the following sections. All traffic data used in this Study have been approved by Transport Department (see *Annex A*).

15.3.2 Assessment Methodology

15.3.2.1 Calculation of Prevailing Noise Levels

The road traffic noise calculations presented in this Study follow the methodology described by *Calculation of Road Traffic Noise* (CRTN), published by the UK Department of Transport in 1988, and as required by the Study Brief. The computer software "*HFANoise*", developed by Halcrow Fox to implement CRTN on a wide scale basis using a links and nodes representation of the road network and receiving environment, was used for the implementation of this methodology.

The modelling scheme for the determination of prevailing noise levels is based upon a digitised representation of the existing unaltered roads within the spatial scope of the Project. Each of the existing unaltered highway networks were divided into discrete road segments of homogeneous traffic and road layout characterisation. The segment parameters define the key elements of a road link with respect to traffic noise emissions such as traffic volume, composition, vehicle speed, road layout, and vertical and horizontal alignment. Road surfaces were taken to be standard wearing course based on existing conditions.

For the propagation of noise, a worst-case hard ground attenuation was assumed throughout the study area. All other features that could potentially provide noise screening or reflection were defined in the *HFANoise* models. Peak hour traffic flows for the year 1999, the year immediately prior to the commencement of construction of the Project, were used for the determination of prevailing noise levels. All road traffic noise levels presented in this report are expressed in the $L_{A10,peak\ hour}$ dB index and have been predicted at representative receivers and worst affected floor heights.

15.3.2.2 Prediction of Future Noise Levels

The prediction of future road traffic noise levels was based on a modelling methodology similar to the prevailing situation with road layouts and alignment derived from the Proponent's engineering design.

All roads that would be subject to significant variation and those which remain unaltered or subject to minor changes were classified in the *HFANoise* model as "new " and "unaltered" respectively with reference to the Study Brief. This has enabled the model to calculate noise levels classified by road link description according to the Study Brief and the *ExCo Directive*. The roads classified as "new" in this Study are shown in *Figure 15.3a.*

As with the prevailing road network, the Project was divided into discrete road segments and examples of the *HFANoise* digitised representation of these segments and the receiving environment are shown by *Figure 15.3b*. An example of the *HFANoise* results file is presented in *Annex D.*

15.3.3 Prediction and Evaluation of Impacts

The predicted road traffic noise levels at identified NSRs for the model years of 1999 and 2018 are discussed below. Assessment has been undertaken at three different receiver heights (low, mid and high) representing the NSRs and the unmitigated predicted noise levels are given in *Table 15.3a*. In addition, during the assessment and design of mitigation, intervening receiver heights have been tested to ensure a worst case review of all NSRs. Assessment of impacts associated with the Project during the worst prediction year (i.e. Year 2018) are based on the prediction results and compared with the road traffic noise criteria stipulated in EIAO TM. For NSR 89 (Lutheran Kam Sheung Church), the assessment criterion adopted was $L_{A10,\ peak\ hour}$ 65 dB as stipulated in EIAO TM.

According to *Table 15.3a*, adverse impacts in the range of 2 to 8 dB(A) were predicted in the prevailing situation. NSRs located close to Kam Sheung Road and Kam Tin Road would be impacted by road traffic noise. In the future case, noise exceedances in the range of 1 to 13 dB(A) were predicted. NSRs experiencing new adverse noise impacts include NSR 75 (village house to the immediate north of Kam Sheung Road and west of EAR), NSR 87 (village house south of Kam Sheung Road and east of EAR) and NSRs 90, 91, 92 and 94 (village houses within Ng Ka Tsuen). In general, the noise level changes in the future year at NSRs experiencing adverse impacts will be in the range of +1 to +9 dB(A). This is attributed to the traffic on the new EAR, the growth in road traffic on Kam Sheung Road and Kam Tin Road and due to the widened sections of Kam Sheung Road which will bring the noise source closer to the NSRs.

The estimated number of dwellings affected by the Project (noise from new roads defined according to the Study Brief) based on the predictions made at the worst representative NSRs would be about 14. Kam Kwong Kindergarten, St. Joseph's Primary School and the Lutheran Kam Sheung Church would also be impacted as the overall noise level

predicted at these NSRs would be increased by at least 1 dB(A) due to the Project. The estimated number of classrooms being affected by the Project would be about 24 at St. Joseph's Primary School and six at Kam Kwong Kindergarten. Direct mitigation measures should be considered for these highways to reduce the predicted future adverse impacts.

Table 15.3a Kam Tin EAR - Predicted Noise Levels $L_{10, 1\ hour\ (dB(A))}$ for the Prevailing Year and Future Year (1999 & 2018)

NSR	Description	Low Level	Year 1999	Year 2018	Mid Level	Year 1999	Year 2018	High Level	Year 1999	Year 2018
		mPD	dB(A)	dB(A)	mPD	dB(A)	dB(A)	mPD	dB(A)	dB(A)
71	School Area near Kam Tin By-pass Roundabout, facing Kam Tin River (Kam Kwong Kindergarten)	8.8	68 (3)	70 (5)	-	-	-	-	-	-
72	Village House, North of Tsz Tong Tsuen, near North Bank of Kam Tin River	8.5	62	66	-	-	-	-	-	-
73	Village House, East of St. Joseph's Primary School	8.5	60	66	11.8	60	66	15.2	61	67
74	Village House of Tsz Tong Tsuen East, South Bank of Kam Tin River	8.5	64	70	-	-	-	11.5	64	70
75	Village, House of Tsz Tong Tsuen South, North of Kam Sheung Road	7.2	69	75 (5)	10.5	69	75 (5)	13.9	70	75 (5)
75a	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	7.0	74 (4)	80 (10)	-	-	-	9.5	74 (4)	80 (10)
75b	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	7.9	73 (3)	79 (9)	11.2	73 (3)	79 (9)	14.6	73 (3)	78 (8)
76	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	6.5	75 (5)	80 (10)	-	-	-	-		-
76a	Village House of Tsz Tong Tsuen South, South of Kam Sheung Road	6.5	72 (2)	78 (8)	-	-	-	-	-	-
77	Village House of Yee Hong Garden East, South of Kam Sheung Road	8.0	76 (6)	82 (12)	-	-	-	-	-	-
77a	Village House of Yee Hong Garden East, South of Kam Sheung Road	7.7	72 (2)	77 (7)	-	-	-	-	-	-
78	St. Joseph's Primary School	8.8	67 (2)	68 (3)	16.3	67 (2)	69 (4)	20.1	67 (2)	69 (4)
79	Village House, East of Yee Hong Garden	8.1	64	70	11.4	64	70	14.8	64	70
80	Village House, East of Yee Hong Garden	8.2	64	69	11.5	64	69	14.9	64	69
82	Village House at south of Yee Hong Garden	7.2	62	69	-	-	-	9.7	62	69
83	Village House, South of Ball Kee Factory	7.4	60	66	-	-	-	-	-	-
84	Village House, South of Ball Kee Factory	7.4	62	66	-	-	-	-	-	-
85	Village House, South of Ball Kee Factory	8.2	65	69	-	-	-	11.2	65	69
86	Village House, South of Ball Kee Factory	8.5	62	69	-	-	-	-	-	-
87	Village House, East of Ball Kee Factory	8.5	65	70	11.3	65	71 (1)	14.2	65	71 (1)
89	Lutheran Kam Sheung Church	8.5	73 (8)	78 (13)	11.3	73 (8)	78 (13)	14.2	72 (7)	78 (13)
90	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	9.0	67	72 (2)	-	-	-	11.5	67	72 (2)

NSR	Description	Low Level	Year 1999	Year 2018	Mid Level	Year 1999	Year 2018	High Level	Year 1999	Year 2018
		mPD	dB(A)	dB(A)	mPD	dB(A)	dB(A)	mPD	dB(A)	dB(A)
91	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	8.5	65	71 (1)	-	-	-	11.0	66	72 (2)
92	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road (near the Proposed Subway)	8.0	64	73 (3)	-	-	-	10.5	64	73 (3)
93	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	61	68	-	-	-	-	-	-
94	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	64	70	-	-	-	11.0	65	71 (1)
95	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	62	68	-	-	-	11.0	63	69
96	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	62	69	-	-	-	11.0	63	70
97	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	60	66	-	-	-	10.5	61	67

Note: Figure in brackets indicates the level of predicted noise exceedance.

15.3.4 Environmental Mitigation Measures During Operational Phase

The results of the assessment show that NSRs identified within the spatial scope of the Project will be adversely impacted with exceedances in the range of 1 to 13 dB(A). In accordance with the Study Brief, the Proponent is required to provide direct mitigation to new highways that contribute to noise exceedances or, where direct mitigation is not feasible or wholly ineffective, to provide indirect mitigation. The application of these assessment procedures and implementation of technical remedies is seen by HyD to be an opportunity to provide environmental improvements for noise sensitive properties within the vicinity of West Rail and in the wider context through the spatial scope of the Project.

For the design of barriers, reference has been made to Transport Department's *Transport Planning & Design Manual (TPDM)* which outlines the need to design barrier installations so as to preserve the driver's visibility of approaching traffic at road junctions. Reference and guidance were taken from the design recommendations for priority junctions which are given as a function of design speed of the road. Although the speed limit of the EAR and Kam Sheung Road is 50 kph, a design speed of 70 kph has been used in the design of the highway alignment. With a design speed of 70 kph, barrier installations (barriers located at the kerb side) on new roads should not encroach within 95 m of any adjoining major road at signalised junctions. From the advice of KCRC's traffic consultant, a visibility splay of at least 95 m should also be maintained at curved road section and bus-bay areas.

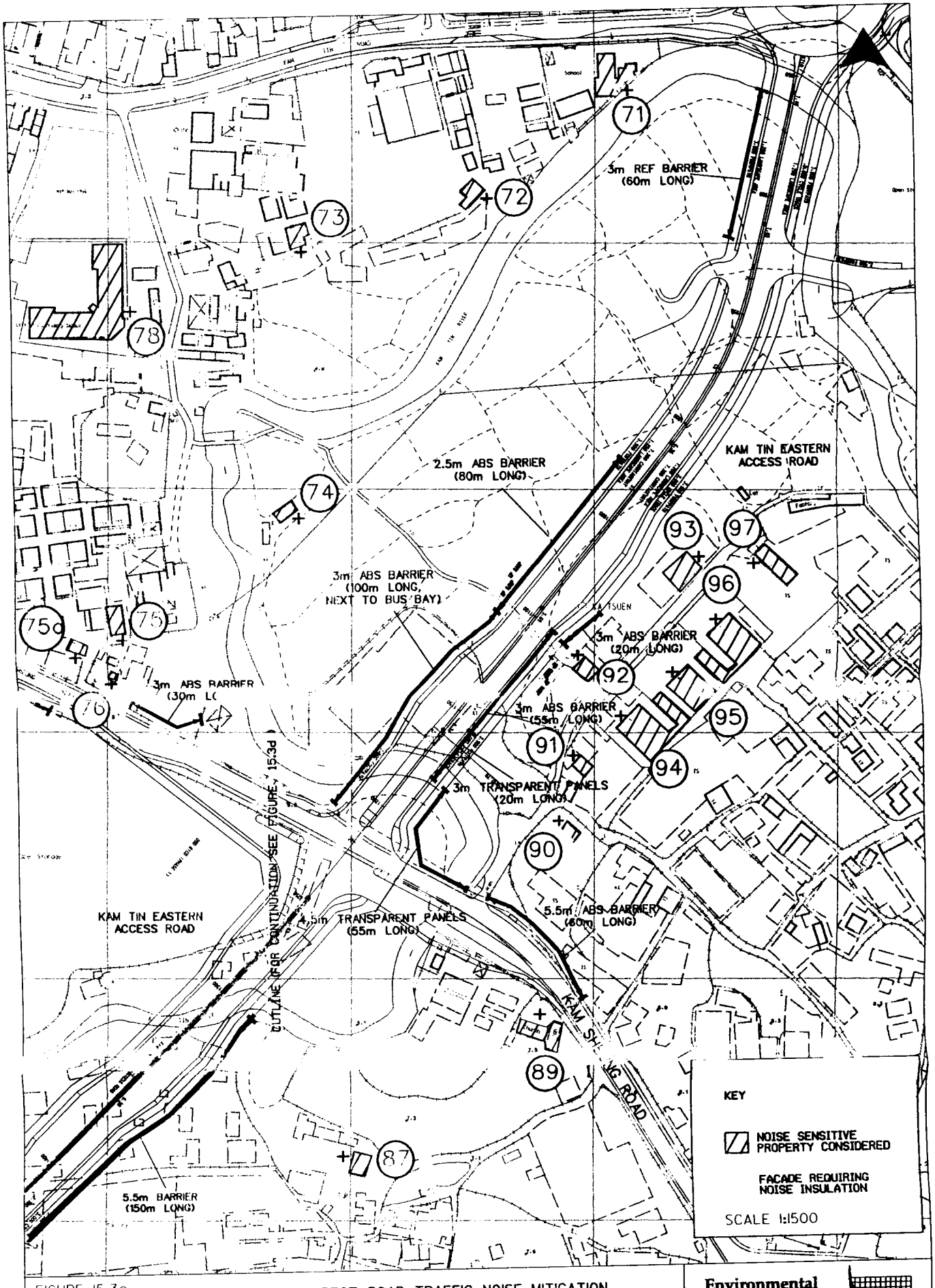


FIGURE 15.3c

PROPOSED DIRECT ROAD TRAFFIC NOISE MITIGATION MEASURES FOR KAM TIN EASTERN ACCESS ROAD

USTN FILE: /cl800/figures/kam_ll.dgn

DATE: 09/99

Environmental Resources Management

ERM

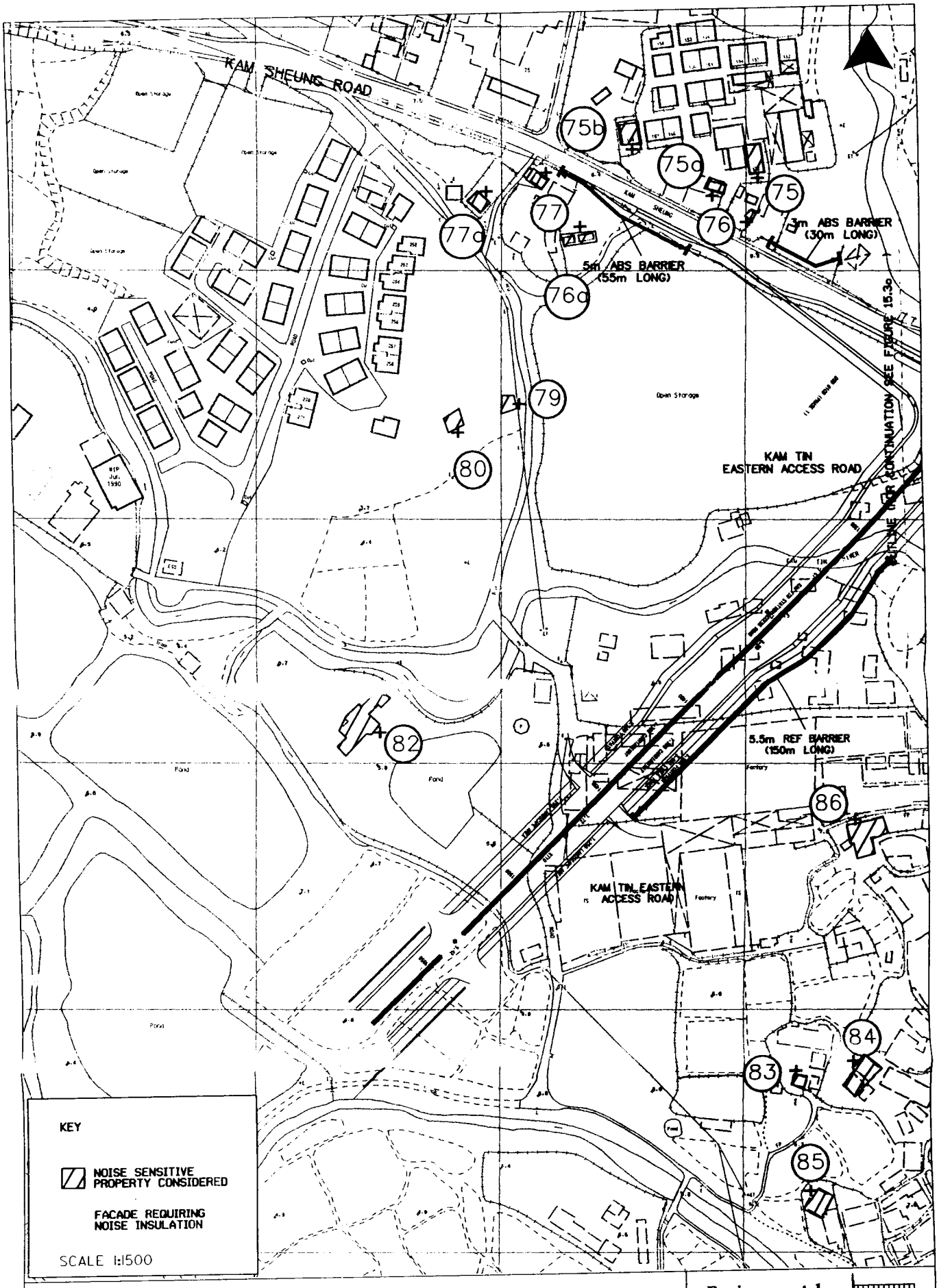


FIGURE 15.3d

PROPOSED DIRECT ROAD TRAFFIC NOISE MITIGATION MEASURES FOR KAM TIN EASTERN ACCESS ROAD

Environmental Resources Management

ERM

USTN FILE: c1800/figures/kam_12.dgn

DATE: 09/99

The design of roadside barriers also considered potential constraints of the site including local frontage access, the new/relocated ingress/egress points for residential dwellings, the presence of box culverts and drainage reserves and the spatial requirements of the proposed bus-bays. Based on the predictions of future road traffic noise and the identified adverse impacts, direct noise mitigation measures are required and have been reviewed in detail.

It is the objective of this EIA Study to recommend mitigation measures and to assess any potential side-effects in conjunction with the proposed noise mitigation measures. The length as well as the height of the proposed measures have been optimised according to the acoustic effectiveness of barrier and the physical and engineering constraints of the site.

Figures 15.3c-d indicate the locations of proposed noise barriers along the EAR and Kam Sheung Road. Details of noise barriers proposed under this Study are summarised in *Table 15.3b* below. All the reflective barriers made of transparent panels, plexi-glass or concrete shall have a transmission loss of not less than 20 dB(A) (for road traffic noise spectrum). Absorptive barriers proposed under this Study shall be made of absorptive panels with a transmission loss of not less than 20 dB(A) (for road traffic noise spectrum) and sound absorption coefficient of not less than 0.9 in the 125 Hz to 2k Hz frequency range. All the proposed measures shall be maintained by HyD to ensure their acoustic performance during the operational phase of EAR. The mitigated future noise levels are presented in *Table 15.3c*.

Table 15.3b - Details of Proposed Direct Mitigation Measures on Eastern Access Road

Barrier	Location	Reference	NSR Protected
3 m Reflective Barrier (60 m long)	NB carriageway of EAR and behind the footpath, immediate south of Kam Tin Road/Kam Tin By-pass roundabout (Approx. Chainage 860-920 m) (1)	Figure 15.3c	NSRs 71 and 78
2.5 m Absorptive Barrier (80 m long)	NB carriageway of EAR and behind the footpath, north-east of the proposed pedestrian subway (Approx. Chainage 1029-1109 m)	Figure 15.3c	NSR 78
3 m Absorptive Barrier (100 m long)	NB carriageway of EAR, next to the bus-bay and behind the footpath, south-west of the proposed pedestrian subway, (Approx. Chainage 1109-1209 m)	Figure 15.3c	NSRs 75, 75a, 76 and 78
3 m Absorptive Barrier (20 m long)	SB carriageway of EAR and in front of Ng Ka Tsuen, next to bus-bay and behind the footpath, north-east of the proposed pedestrian subway, (Approx. Chainage 1080-1100 m)	Figure 15.3c	NSRs 90, 91, 92 and 94
3 m Absorptive Barrier (55 m long)	SB carriageway of EAR and in front of Ng Ka Tsuen, 1 m from kerbside, south-west of the proposed pedestrian subway, (Approx. Chainage 1100-1155 m)	Figure 15.3c	NSRs 90, 91, 92 and 94
3 m Reflective Barrier (made of transparent panels) (20 m long) (2)	SB carriageway of EAR and in front of Ng Ka Tsuen, 1 m from kerbside, south-west of the proposed pedestrian subway, (Approx. Chainage 1155-1175 m)	Figure 15.3c	NSRs 90, 91, 92 and 94
4.5 m Reflective Barrier (made of transparent panels) (55 m long) (2)	SB carriageway of EAR and EB of Kam Sheung Road, north-east of the junction (Approx. 7 m setback from EAR and 2 m from Kam Sheung Road)	Figure 15.3c	NSRs 90, 91, 92 and 94
5.5 m Absorptive Barrier (60 m long)	EB of Kam Sheung Road and east of EAR, approx. 2 m from kerbside and next to bus-bay	Figure 15.3c	NSRs 90 and 91
3 m Absorptive Barrier	EB of Kam Sheung Road and west of EAR, approx. 5 m from kerbside	Figure 15.3d	NSRs 75, 75a

Barrier	Location	Reference	NSR Protected
(30 m long)			and 76
5 m Absorptive Barrier (55 m long)	WB of Kam Sheung Road and west of EAR, behind the footpath of the proposed bus-bay	Figure 15.3d	NSRs 76a, 77 and 77a
5.5 m Reflective Barrier (150 m long)	SB carriageway of EAR, south of EAR/Kam Sheung Road junction, next to the bus-bay and behind the footpath (Approx. Chainage 1300-1450 m)	Figure 15.3d	NSR 87

Note:

(1) Chainage reference derived from Drawing DD600/SCHEM/01, revision C dated 28 Jan 1999.

(2) The proposed barrier has potential to cause sight-line problem at the EAR/Kam Sheung Road junction.

Table 15.3c Kam Tin EAR - Mitigated Noise Levels $L_{10, 1hour (dB(A))}$ for the Future Year 2018

NSR	Description	Low Level	Year 2018	Mid Level	Year 2018	High Level	Year 2018
		mPD	dB(A)	mPD	dB(A)	mPD	dB(A)
71	School Area near Kam Tin By-pass Roundabout, facing Kam Tin River (Kam Kwong Kindergarten)	8.8	69 (4) [a]	-	-	-	-
72	Village House, North of Tsz Tong Tsuen, near North Bank of Kam Tin River	8.5	65	-	-	-	-
73	Village House, East of St. Joseph's Primary School	8.5	63	11.8	64	15.2	65
74	Village House of Tsz Tong Tsuen East, South Bank of Kam Tin River	8.5	67	-	-	11.5	68
75	Village, House of Tsz Tong Tsuen South, North of Kam Sheung Road	7.2	74 (4)	10.5	75 (5)	13.9	75 (5)
75a	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	7.0	80 (10)	-	-	9.5	80 (10)
75b	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	7.9	79 (9)	11.2	79 (9)	14.6	78 (8)
76	Village House of Tsz Tong Tsuen South, North of Kam Sheung Road	6.5	80 (10)	-	-	-	-
76a	Village House of Tsz Tong Tsuen South, South of Kam Sheung Road	6.5	71 (1)	-	-	-	-
77	Village House of Yee Hong Garden East, South of Kam Sheung Road	8.0	81 (11)	-	-	-	-
77a	Village House of Yee Hong Garden East, South of Kam Sheung Road	7.7	76 (6)	-	-	-	-
78	St. Joseph's Primary School	8.8	67 (2)	16.3	68 (3)	20.1	68 (3)
79	Village House, East of Yee Hong Garden	8.1	68	11.4	69	14.8	69
80	Village House, East of Yee Hong Garden	8.2	69	11.5	69	14.9	69
82	Village House at south of Yee Hong Garden	7.2	69	-	-	9.7	69
83	Village House, South of Ball Kee Factory	7.4	65	-	-	-	-
84	Village House, South of Ball Kee Factory	7.4	64	-	-	-	-
85	Village House, South of Ball Kee Factory	8.2	69	-	-	11.2	69
86	Village House, South of Ball Kee Factory	8.5	66	-	-	-	-

NSR	Description	Low Level	Year 2018	Mid Level	Year 2018	High Level	Year 2018
		mPD	dB(A)	mPD	dB(A)	mPD	dB(A)
87	Village House, East of Ball Kee Factory	8.5	69	11.3	70	14.2	70
89	Lutheran Kam Sheung Church	8.5	78 (13)	11.3	78 (13)	14.2	78 (13)
90	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	9.0	67[b]/ 71[c] (1)	-	-	11.5	68/71 (1)
91	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road	8.5	66/70	-	-	11.0	68/70
92	Village House, South of Ng Ka Tsuen, North of Kam Sheung Road (near the Proposed Subway)	8.0	66	-	-	10.5	70
93	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	68	-	-	-	-
94	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	67	-	-	11.0	68
95	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	67	-	-	11.0	68
96	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	68	-	-	11.0	69
97	Village House, West of Ng Ka Tsuen, North of Kam Sheung Road, Next to Eastern Access Road	8.0	65	-	-	10.5	66

Note:

a) Figure in brackets indicates that level of predicted noise exceedance.

b) Predicted noise level with the two proposed transparent reflective barriers at the corner of EAR/Kam Sheung Road junction.

c) Predicted noise level without the two proposed transparent reflective barriers at the corner of EAR/Kam Sheung Road junction.

With the proposed direct noise mitigation measures, noise reductions of up to 7 dB(A) will be achieved depending on the geometry of the source-barrier-NSR considered. NSRs 87 (village house south of Kam Sheung Road and east of EAR), 91, 92 and 94 (village houses of Ng Ka Tsuen) will be protected and the noise levels will comply with the road traffic noise standards of EIA O TM. The estimated number of residential dwellings protected by the proposed measures was about 12. The proposed measures also reduced the noise level at St. Joseph's Primary School by reducing the noise contribution from new roads. The overall increase in noise level, in comparison with the level due to existing roadways, was less than 1 dB(A) at this NSR.

NSRs with predicted noise impacts due to the traffic on existing roads include NSRs 75, 75a, 75b, 76, 76a, 77, 77a (village houses west of EAR and close to Kam Sheung Road) and 78 (St. Joseph's Primary School). However, the direct mitigation measures proposed within the spatial scope of EAR offered limited benefit in reducing the noise impacts at these NSRs. Furthermore, these NSRs will not be eligible for noise insulation as the Project itself creates limited impacts on these NSRs.

As advised by the Transport Department, the two transparent reflective barriers proposed at the corner of the EAR/Kam Sheung Road junction will affect the line of sight of the ingress/egress of Ng Ka Tsuen. Without these barriers, noise exceedances of 1 dB(A)

will be likely at NSR 90. There may be an opportunity to relocate this ingress/egress point so that the erection of the proposed barriers would not create a visibility issue. In view of the current design of EAR, the chance for this relocation is limited taking account of land take requirements for the run-ins and the provision of bus-bays along EAR. The use of low noise road surfacing for the new sections of Kam Sheung Road and EAR is not feasible as the percentage of heavy vehicles of these roadways exceed 35%.

Apart from NSR 90, residual noise impacts caused by the Project were also predicted at NSRs 71 (Kam Kwong Kindergarten) and 89 (Lutheran Kam Sheung Church). NSR 71 is located close to the roundabout junction of Kam Tin Road and Kam Tin By-pass. Although a 60 m long, 3 m high roadside barrier is proposed, further increasing the length of the barrier is not feasible due to the sight-line requirement. A residual noise impact of 4 dB(A) was predicted at this NSR (An overall noise level of 69 dB(A) was predicted and noise contribution from the Project was more than 1 dB(A).)

Assessment of the use of road side barriers to protect NSR 89 has been made. Site restrictions including sight-line requirements for the nearby bus-bay, maintenance of ingress/egress for the church, access for the new refuse collection point, visibility issues for left-turning traffic and road safety reasons have all limited the application of direct technical remedies. Given the above constraints, only short barriers of limited length could be used in the vicinity of this NSR which is acoustically insufficient to tackle the predicted 13 dB(A) noise exceedance. The use of low noise road surfacing for the new sections of Kam Sheung Road and the EAR to protect these NSRs 71 and 89 is again not feasible as the percentage of heavy vehicles exceed 35%. Installation of noise enclosures or any form of noise cover to fully screen the noise from the highways and junction is also impractical, given the requirement to maintain visibility and general road safety requirements. Therefore, as a last resort, the requirement for indirect technical remedies to protect the affected NSRs will be considered and addressed in the subsequent section.

15.3.5 Residual Impacts and Noise Insulation Eligibility

In the preceding section, direct technical remedies in the form of roadside barriers are proposed in order to mitigate adverse impacts. Recommended direct road traffic noise mitigation measures are presented in *Figures 15.3e-f* for ease of reference. Given the potential traffic constraints such as visibility splay, road safety aspects, the boundary limits of the Project, presence of bus-bays and DSD culverts, the use of direct technical remedies will not fully mitigate adverse impacts at some of the identified NSRs as discussed in the preceding section.

Since the use of direct technical remedies were seen to be exhausted, the residual noise impacts at NSRs 71 (school close to Kam Tin Road/Kam Tin By-pass roundabout), 89 (Lutheran Kam Sheung Church) and 90 (village house of Ng Ka Tsuen) were assessed against the noise insulation criteria embodied in the *ExCo Directive, Equitable Redress for Persons Exposed to Increased Noise Resulting From The Use of New Roads*. The assessment results are detailed in *Annex F* and *Table 15.3d* identifies the NSRs which are thus considered eligible for noise insulation. The type of noise insulation for the affected

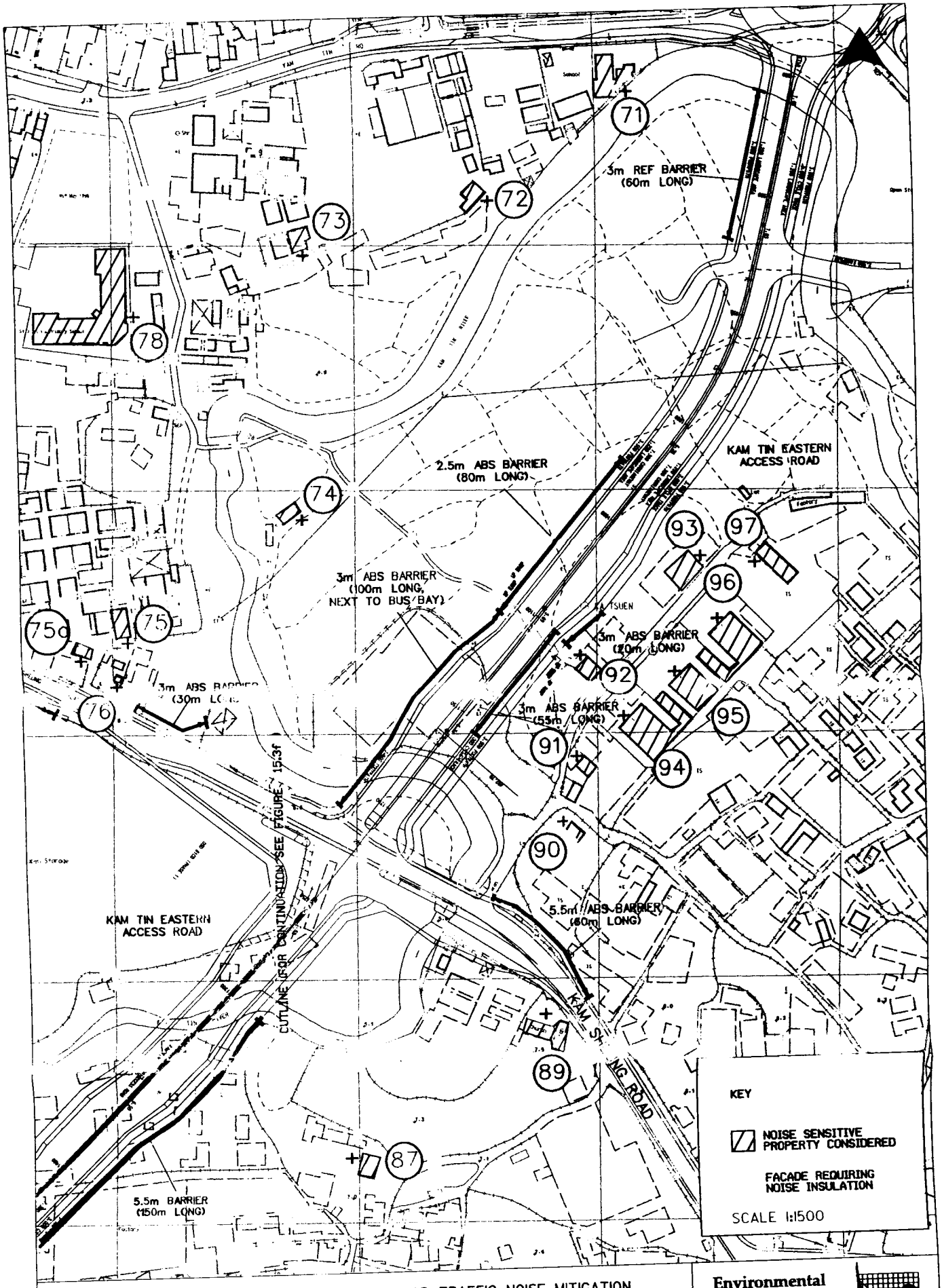


FIGURE 15.3e

RECOMMENDED DIRECT ROAD TRAFFIC NOISE MITIGATION MEASURES FOR KAM TIN EASTERN ACCESS ROAD

Environmental Resources Management

ERM

USTN FILE: /c800/figures/kam_ita.dgn

DATE: 09/99

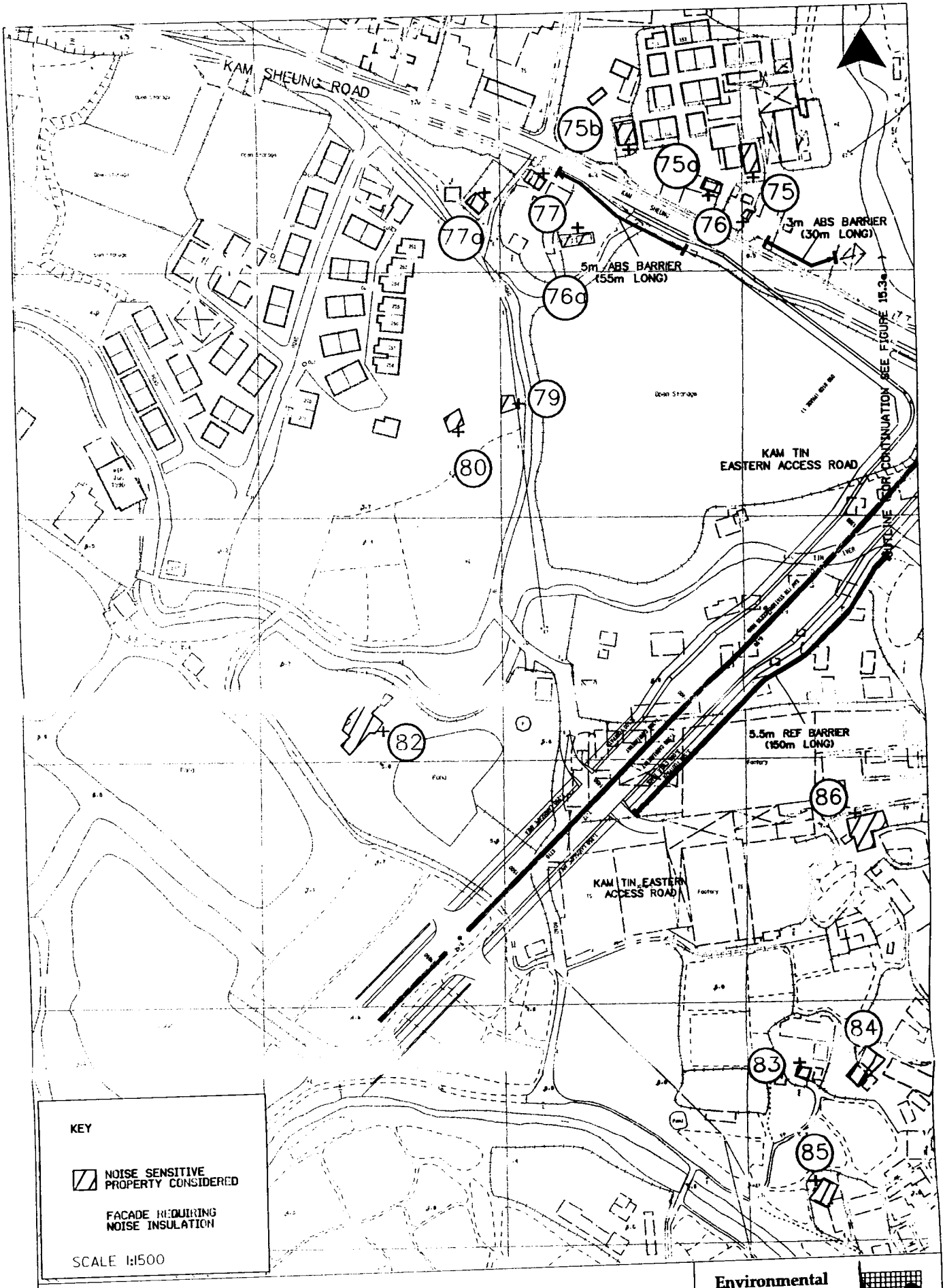


FIGURE 15.3f

RECOMMENDED DIRECT ROAD TRAFFIC NOISE MITIGATION MEASURES FOR KAM TIN EASTERN ACCESS ROAD

Environmental Resources Management

ERM

USTN FILE: c1800/figures/kam_t2a.dgn

DATE: 09/99

NSRs is also defined in this Study to provide an initial indication for the Project Proponent.

According to EIAO-TM, the type of noise insulation, if proved to be eligible for existing NSRs, depends on the level of noise exceedance over the standard limit (ie 70 dB(A) for residential uses and 65 dB(A) for schools and places of public worship). For adverse impacts less than 10 dB(A), Type I noise insulation would be required. This specifies existing openable well-gasketted window, 6 mm pane, or transmission loss (TL) of 28 dB or above in the 250 Hz octave band and sound transmission class (STC) 31 or above. For predicted noise exceedances equal to 10 dB(A) or below 15 dB(A), Type II insulation would be required: openable well-gasketted window, 8 mm pane, or transmission loss (TL) of 32 dB or above in the 250 Hz octave band and STC 34 or above.

For habitable rooms, classrooms or other noise sensitive rooms with adverse impacts, provided the transmission loss of the existing glazing systems meets with these requirements and air conditioners are already installed, no further work would be required. However, thorough site inspection and sample sound transmission loss testing will be required to confirm the extent of works necessary. This would be undertaken by the Project Proponent between the EIA approval and the commissioning of the Project. The glazing system for the affected NSRs should be upgraded by the Project Proponent in accordance with the recommendations made in this EIA Study if the existing systems are found to be inadequate. All the installation works or upgrading of existing glazing systems must be implemented before the commissioning of the EAR.

Table 15.3d Noise Sensitive Receivers Eligible for Noise Insulation

NSR	Description	Type of Insulation Proposed
71	School near Kam Tin By-pass Roundabout (Kam Kwong Kindergarten) (classrooms on the ground floor with a sensitive facade facing EAR, estimated number of classroom requiring noise insulation is about six and is subjected to further investigation by KCRC/HyD during the detailed design of EAR)	Type I
89	Lutheran Kam Sheung Church (noise sensitive rooms from ground floor to top floor having a line of sight to the new road section of Kam Sheung Road, estimated number of rooms requiring noise insulation is about 10 and is subjected to further investigation by KCRC/HyD during the detailed design of EAR)	Type II
90	Village House of Ng Ka Tsuen, immediate north of Kam Sheung Road and close to the junction (residential units from ground floor to top floor facing EAR and the new road section of Kam Sheung Road, estimated number of dwellings requiring noise insulation is about two and is subjected to further investigation by KCRC/HyD during the detailed design of EAR)	Type I

15.4 Conclusions

Unmitigated construction activities associated with the Project will cause exceedances of daytime construction noise standards stipulated in EIA O TM at most of the nearby NSRs. Noise exceedances in the range of between 1 to 16 dB(A) have been predicted during drainage and road construction works. The construction of proposed noise barriers along the EAR would also cause adverse noise impacts by up to 23 dB(A). The critical noisy

construction activities identified were excavation works during various construction stages, placement of road base and road paving in road construction.

A comprehensive package of effective mitigation measures will be required to reduce the predicted noise impacts. Mitigation measures including the adoption of good site practices, use of quiet plant, installation of temporary noise barriers, control of the number and location and reduction in the percentage of operational time of noisy equipment, avoidance of simultaneous construction activities and substitution of particular noisy equipment have been assessed to investigate their effectiveness in reducing adverse noise levels. However, even with the implementation of all these measures, residual noise impacts in the range of 1 to 7 dB(A) were still predicted at some of the NSRs along Kam Sheung Road, village house close to the proposed pedestrian subway and at the Lutheran Kam Sheung Church.

The practicality of the adoption of reductions in plant on-time is under debate, although in this case, given that large residual impacts will still result even with the implementation of this measure, it is considered inappropriate to proceed on this basis knowing that adoption of this principle with multiply the duration of these impacts by a factor of two or more. Under these circumstances, adoption of a least worst alternative is to allow construction to proceed as planned without the recommendation of this approach which will ensure the noisy activity is completed in as short a time as possible. Further, it is possible that EM&A monitoring to accompany the works implementation together with the Contractor's Environmental Management Plan based upon more solid information regarding the construction plant team and construction programme will enable the level of adverse noise to be reduced.

The impacts of operational road traffic noise is a key issue raised in this Study. Based upon the worst case traffic forecasts of year 2018, unmitigated noise impacts are likely at some of the identified NSRs within the locality of the Project, although the majority of these are already adversely affected by Kam Tin Road and Kam Sheung Road prior to the opening of the EAR. The use of direct technical remedies in the form of roadside barriers for the proposed scheme has been considered, taking account of existing and potential engineering constraints of the site, and other controlling factors including visibility splay at junctions, presence of drainage reserve and bus-bay areas.

With an exhaustive research of direct measures being completed, the residual noise impacts predicted at Kam Kwong Kindergarten, Lutheran Kam Sheung Church and village house of Ng Ka Tsuen (immediately north of Kam Sheung Road and close to the junction) have been assessed against the noise insulation criteria. The Study concludes that these NSRs will be eligible for noise insulation. Type I and II noise insulation are required for EAR in order to satisfy the EIA O TM road traffic noise standards.

The recommended mitigation measures for EAR are given in *Table 15.4a*.

Table 15.4a - Summary of Recommended Mitigation Measures During Construction and Operation of the Project

Development Phase	Recommended Mitigation Measures
• Construction Phase	◊ Good site practices;
	◊ Use of quiet construction plant on all work sites, adopt quieter construction method and use only lorries on site;
	◊ Install temporary noise barriers next to all operating construction equipment at work sites involving barrier construction (within a separation distance of 20 m), and at work sites next to the proposed pedestrian subway and close to the village house of Ng Ka Tsuen;
	◊ Avoidance of simultaneous noisy activities on construction worksites near all NSRs.
• Operational Phase	◊ 3 m Reflective Barrier (60 m long), NB carriageway of EAR and behind the footpath, immediate south of Kam Tin Road/Kam Tin By-pass roundabout (Approx. Chainage 860-920 m);
	◊ 2.5 m Absorptive Barrier (80 m long), NB carriageway of EAR and behind the footpath, north-east of the proposed pedestrian subway (Approx. Chainage 1029-1109 m);
	◊ 3 m Absorptive Barrier (100 m long), NB carriageway of EAR, next to the bus-bay and behind the footpath, south-west of the proposed pedestrian subway, (Approx. Chainage 1109-1209 m);
	◊ 3 m Absorptive Barrier (20 m long), SB carriageway of EAR and in front of Ng Ka Tsuen, next to bus-bay and behind the footpath, north-east of the proposed pedestrian subway, (Approx. Chainage 1080-1100 m);
	◊ 3 m Absorptive Barrier (55 m long), SB carriageway of EAR and in front of Ng Ka Tsuen, 1 m from kerbside, south-west of the proposed pedestrian subway, (Approx. Chainage 1100-1155 m);
	◊ 5.5 m Absorptive Barrier (60 m long), EB of Kam Sheung Road and east of EAR, approx. 2 m from kerbside and next to bus-bay;
	◊ 3 m Absorptive Barrier (30 m long), EB of Kam Sheung Road and west of EAR, approx. 5 m from kerbside;
	◊ 5 m Absorptive Barrier (55 m long), WB of Kam Sheung Road and west of EAR, behind the footpath of the proposed bus-bay; and
	◊ 5.5 m Reflective Barrier (150 m long), SB carriageway of EAR, south of EAR/Kam Sheung Road junction, next to the bus-bay and behind the footpath (Approx. Chainage 1300-1450 m).
	◊ Use of indirect technical remedies, in the form of suitable window glazing and air-conditioning to protect the affected NSRs (Kam Kwong Kindergarten, Lutheran Kam Sheung Church and village house of Ng Ka Tsuen).