3. APPROACH AND METHODOLOGY

3.1 General

3.1.1 The findings, conclusion and recommendation of the Scoping Study on Existing Flyovers will form a basis for further assessment particularly in terms of maintenance consideration, structural impact, public and traffic disruption, etc.

3.2 Noise Assessment

3.2.1 Noise Standards and Regulations

At present, the current policy does not require protection of NSRs to redress the traffic noise problem arising from existing roads. Whilst road traffic noise problem is more amenable through planning process, for the purpose of analysing noise from existing roads, it is considered appropriate to adopt similar criteria for planning new roads or designating new NSRs. These criteria according to the Hong Kong Planning Standards and Guidelines (HKPSG) require that the noise level L10(1hr) at the external facade due to road traffic should not exceed 70 dB(A) for domestic premises.

3.2.2 Identification of Noise Sensitive Receivers (NSRs)

3.2.2.1 In the Study, the existing NSRs in the vicinity of the flyovers have been identified based on the recommendations of the Scoping Study and the most updated survey maps.

3.2.2.2 Site visits have been made subsequently to verify the information and to determine the heights of the affected buildings and the approximate number of dwellings presently exposed to traffic noises from the flyovers.

3.2.2.3 Relevant Government departments such as Highways Department, Housing Department, Lands Department, etc. as well as the Mass Transit Railway Corporation (MTRC) and the Kowloon Canton Railway Corporation (KCRC) have been consulted for the latest information on both existing and planned development.

3.2.2.4 Assessment points representing NSRs of different floor levels and angles of view of the flyovers have been determined based on the information gathered from survey maps and site visits.

3.2.3 Identification of Barrier Extent and Locations

3.2.3.1 In general, the location of noise barriers should be established as close to the noise source on the flyover as possible to achieve higher protection subject to the presence of footpath and roadside equipment and furniture (i.e. emergency telephones, lighting columns, fire hydrants, gantry signs, safety barriers etc.).

3.2.3.2 The extent of barriers should be maximised as far as possible to ensure that the NSRs are protected and shielded from the traffic noises.

3.2.3.3 The likely location and extent for the installation of noise barriers would be established based upon the above considerations as well as all physical constraints identified on site.

3.2.3.4 Where the physical erection of noise barriers on the existing flyovers were not considered as feasible, the use of independent support structures on ground would be examined.

3.2.4 Identification of Barrier Forms

3.2.4.1 The alignment and profile of the flyover and associated slip roads in relation to the configuration of the NSRs would likely dictate the forms of noise mitigation measures to be used.

3.2.4.2 Vertical barriers of various height are generally used to achieve specific noise attenuation in the existing flyovers. However, for those barriers taller than 5 metres above carriageway, it would be more effective to use cantilevered barriers with curved or inclined canopy to provide a less intrusive appearance and higher mitigation effectiveness.

3.2.4.3 Partial/Full enclosures would be required at location where traffic noises cannot be effectively attenuated by using the vertical or cantilevered barriers. Special consideration should be given to the impacts on illumination, air quality, sightline, fire fighting and other site constraints if enclosures are used.

3.2.5 Development of Noise Model

3.2.5.1 ENPAC's in-house model which was developed on the basis on the UK's Department of the Transport procedure described in "Calculation of Road Traffic Noise", HMSO, Welsh Office 1988, has been used to calculate the L_{10}(1-hr) noise levels at the representative NSRs. The model used traffic figures obtained from actual traffic counts in 1998 as input data.

3.2.5.2 Actual traffic counts were adopted where census information was not obtained from the Annual Traffic Census. The flyovers being investigated in the Study are subject to a limit of 50 kph. This speed limit also formed part of the basis in the noise model.

3.2.6 Development of Mitigation Measures and Options

Ap Lei Chau Bridge & Tsing Tsuen Bridge

3.2.6.1 For each or clusters of representative NSRs, a number of noise mitigation scenarios have been considered and tested individually for acoustical effectiveness by iterative calculations using the noise model. The noise barriers tested include all practical forms (i.e. vertical barrier, cantilevered barrier, semi-enclosure, or full enclosure).

3.2.6.2 The noise model is run iteratively for various heights and lengths of a hypothetical barrier system positioned at the edge of the flyover. Alternative configurations are examined and the mitigation option that can achieve higher noise protection is identified for further evaluation.

3.2.6.3 Noise mitigation scenarios will only be established when practical locations for erection of mitigation have been identified within the site boundaries as the site constraints imposed by the limit of structural capacity of the flyovers, adjacent roads and developments, underground utilities and safety aspects would be critical in urban area.

Kwai Chung Road Flyover

3.2.6.4 Since the site constraints imposed by the limit of structural capacity of the flyover, underground utilities alongside the edge of slip roads, development of future infrastructure, etc. were so serious, noise mitigation scenarios could only be established when practical locations for the erection of mitigation measures have been identified within the site boundary.

3.3 Engineering Consideration

3.3.1 As the flyovers are close to the residential area, engineering considerations, particularly on the identification of site constraints, would be most important for the establishment of feasible mitigation measures. These considerations included buildability, traffic engineering, traffic management during construction and safety which would be discussed in the following sections.

3.3.2 Buildability

3.3.2.1 Buildability is a term given to the degree of difficulty that a proposed noise barrier would be implemented. Space limitation and maintenance requirements are crucial factors in the assessment. Maintenance considerations include the needs to minimise types of noise barriers/enclosures and to allow proper access for inspection/repairing/ maintenance.

3.3.2.2 In Hong Kong, wind pressure is the governing factor in the design of noise barriers. The design wind pressures as specified in the Structures Design Manual (SDM) published by the Highways Department are generally high by international standards. Noise barriers are therefore subject to high bending moments and shear forces on their bases. The size of bases for supporting these barriers may not be able to fit into the edges of the flyover structure.

3.3.2.3 In addition, wind loads acting on these barriers will finally transfer to the flyover structure including bearings. Any strengthening works or replacement of bearings may require road closure for months and cause significant disruption to traffic flow. Thus, detailed structural assessment of the flyovers shall only be carried out when other constraints on site do not constitute a major problem to the barrier installation on the flyovers.

3.3.2.4 Underground utilities including drainage and sewerage works are usually very congested especially at urban area, the foundation for independent structures to support barriers or enclosures, if found necessary, will inevitably lead to serious conflicts with them.

3.3.2.5 Consideration should be given to any necessitated diversion or reprovision of these existing utilities, if necessary, for the implementation of the proposed barrier. Further consultation with relevant utilities undertaker would be necessary for their requirements.

3.3.2.6 Utilities and services records were obtained from a number of utility companies and Government departments in early July 1998. They included the following:

- China Light & Power Company Limited
- The Hong Kong Electric Company Limited
- Hong Kong Telecommunication Limited
- The Hong Kong and China Gas Company Limited
- Wharf Cable Limited
- Hutchison Communication Limited
- New T&T Hong Kong
- New World Telephone Company Limited
- Rediffusion (HK) Limited
- Drainage Services Department
- Highways Department
- Transport Department
- Water Supplies Department

3.3.2.7 Whenever possible, noise mitigation measures to protect NSRs adjacent to the flyover will be proposed alongside its parapet. However, when necessary, elevated barriers or enclosures supported by independent structure, i.e. with relatively high columns erected on ground level, will also be considered. Under such circumstance, piled foundation will be considered necessary.

3.3.2.8 The foundation of the proposed barriers shall be engineering feasible, structurally sound and with minimum disturbance to the existing utilities inside the bridge structure and/or underground and road/bridge furniture. Reprovision works shall be designed to cope with the proposed foundation, if necessary.

3.3.2.9 The proposed barriers shall not have adverse impact on the road illumination during any time of the day in order to ensure the safety of drivers and pedestrians.

3.3.3 Traffic Engineering

3.3.3.1 The sitting of the proposed mitigation measures on the flyover or at-grade shall maintain sufficient highway clearance to ensure that the compliance of requirements as stated in Transport Planning and Design Manual (TPDM).

These requirements include visibility of road users for signing, at bend and road junctions during and after the installation of the barriers.

3.3.4 Traffic Management During Construction

3.3.4.1 Besides the effect on traffic after the implementation of the proposed mitigation measures, the impact on the existing traffic at the sites in question during construction stage shall also be carefully assessed if found necessary.

3.3.4.2 Consideration will also be given to the extent of traffic/pedestrian diversion and the feasibility for carrying out such diversion. Consultation exercise with relevant Government departments such as Transport Department, Police etc. shall be carried out, if necessary. Such information assists the preparation of realistic construction programme for the proposed mitigation measures.

3.3.5 Safety

3.3.5.1 In addition to all technical/engineering considerations, safety and disruption to the public are one of the major concerns in the Study. The erection of any noise barriers shall not impose potential hazard or reduce the degree of safety in any aspect.

3.3.5.2 Consideration has been given to the impacts on pedestrian safety, accessibility for emergency vehicles, fire fighting and rescue operations, loading/unloading activities, bus stopping operation, etc.

3.3.5.3 Consultation has been made with Fire Services Department for the emergency access and fire fighting requirements on the flyovers and adjacent buildings. The requirements would have a direct impact on whether the proposed barrier locations are acceptable. Location of existing fire hydrants should be identified and the installation of barriers and enclosures should not affect the fire fighting operation. In the case of noise enclosure, the risk/hazard to road users in case of vehicle explosion/fire occurred inside the enclosure should also be considered.

3.3.5.4 Rectification works should be addressed in the preliminary design of noise barriers, if necessary, to ensure the safety of road users and residents in the area in question.

3.4 Landscape and Visual Assessment

3.4.1 The introduction of noise mitigation measures to specific study locations will generate landscape impacts.

3.4.2 The assessment would be based upon the direct technical mitigation measures identified within the study area. Any potential impacts upon existing landscape and impacts to existing views from residential/public properties, or from footpaths and roads, would be classified as slight, moderate or severe according to the significance of the impact within the existing environment.

3.5 Air Quality Assessment

3.5.1 As agreed with Air Policy Group of Environmental Protection Department on 4th March 1997 in the Feasibility Study of Agreement No. CE 8/96 and on 2nd September 1998 in this Study, air quality analysis model has been established to carry out air quality assessment for identified mitigation measures.

3.6 Environmental Gains and Losses Account

3.6.1 The identified noise mitigation measures may generate positive or negative effects on the environment in the vicinity of the studied flyovers. Environmental gains and losses account for the mitigation measures will be elaborated.

3.7 Cost Estimation

3.7.1 Preliminary estimation of direct and indirect construction costs for the identified mitigation measures would be carried out and based on the rates at December 1998 prices obtained from recently returned tenders of other projects. Contingencies and price fluctuation beyond December 98 would not be included.

3.7.2 Apart from the construction cost estimation, the recurrent consequence in terms of annual maintenance cost and annual staff cost based on the rates obtained from Highways Department would be provided for reference.