4. DESCRIPTION OF ASSESSMENT METHODOLOGIES

This section details the assessment methodologies for noise, air quality, landscape and visual impact assessments. As the assumptions for the respective assessments have been agreed with relevant government departments, the level of uncertainty has been minimized.

4.1 Construction Noise Impact Assessment Methodology

4.1.1 Based on the construction activities and programme described in Section 2, construction noise has been assessed in accordance with the procedures stipulated in *the Technical Memorandum on Noise from Construction Work other than Percussive Piling, BS 5228:Part 1:1997.* Adjustments for equipment on-time have been made according to Figure 4 of *BS 5228:Part I:1997.* The sound power levels (SWL) for the equipment were obtained from the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and are summarised in the Table 4.1.

4.1.2 For the purpose of this EIA study, the construction noise impact arising from single construction activities as well as multiple or concurrent activities have been assessed based on the following assumptions at any given NSR:

- Combinations of powered mechanical equipment (PME) required for a particular construction activity are located at a notional source position or a probable position of the segment where such activity is performed.
- A +3 dB(A) facade correction is added to the predicted noise levels in order to account for the facade effect at each NSR.
- The most affected and representative sensitive facades of the residential buildings to the notional or probable source positions are examined.

4.1.3 A sample calculation for construction noise is included in Appendix B.

4.2 Construction Dust Impact Assessment Methodology

4.2.1 Dust concentrations at the sensitive receivers arising from the construction of the proposed improvement works have been predicted using the Fugitive Dust Model (FDM). The improvement works are represented in the model as a series of links and the link that contributes the maximum concentration is assumed to be the worst-affected scenario. Emission factors have been determined in accordance with the US EPA's AP-42 publication. Receivers are assumed to be at breathing level (1.5m above ground level) and first-floor receivers level. In addition, one year's sequential meteorological data for the year 1993 from the Hong Kong Observatory's Junk Bay Station has been used to predict the 1-hr and 24-hr TSP concentrations in the proximity of the construction corridor.

4.2.2 According to AP-42, an approximate emission factor for heavy construction operation is:

1.2 tons per acre of construction per month of activity

4.2.3 This emission factor is considered to be the most appropriate emission factor available, since it deals with operations such as land clearance, ground excavation and the construction of the facilities, which are typical of the construction activities for the proposed Project.

4.2.4 The annual average TSP concentration for the year 1993 as measured at EPD's Junk Bay monitoring station was 77 μg/m^3. For the purpose of this assessment, this value has been used as an indication of the future TSP background concentration.

4.2.5 A sample output file for construction dust is included in Appendix C.

Table 4.1 Sound Power Levels (SWL) for Each Single Construction Activity

Activity Construction	Equipment, CNP Code & Quantity			Assessment Input		Total
				Assumed on-time[i]	SWL[ii] per piece dB(A)	
Roadworks - Stage I	Backhoe Dump Truck	081 067	1 1	80% 50%	112 117	116
Roadworks - Stage II	Concrete Lorry Mixer Vibratory Compactor Air Compressor, silenced	044 050 002	1 1 1	80% 75% 100%	109 105 100	110
Roadworks - Stage III	Backhoe Concrete Pump	081 047	1 1	80% 100%	112 109	113
Roadworks - Stage IV	Road Roller Asphalt Paver	185 004	1 1	100% 100%	108 109	112
Bridge Works - Stage I	Large Diameter Bored Piling Rig (Oscillator or Grab-&-Chisel) Dump Truck	164/ 165 067	1 1	100% 50%	115 117	118
Bridge Works - Stage II	Backhoe Dump Truck	081 067	1 1	80% 50%	112 117	116
Bridge Works - Stage III	Concrete Lorry Mixer Vibratory Compactor Air Compressor, silenced	044 050 002	1 1 1	80% 75% 100%	109 105 100	110
Bridge Works - Stage IV	Concrete Lorry Mixer Vibratory Compactor Concrete Pump Crane, Mobile Diesel	044 050 047 048	1 1 1 1	80% 75% 100% 80%	109 105 109 112	115
Subway & Retaining Walls Works - Stage I	Excavator Dump Truck	081 067	1 1	80% 50%	112 117	116
Subway & Retaining Walls Works - Stage II	Concrete Lorry Mixer Vibratory Compactor Concrete Pump Air Compressor, silenced	044 050 047 002	1 1 1 1	80% 75% 100% 100%	109 105 109 100	112

Notes:
i. "On-time" estimates are generally obtained from BS 5228:Part I:1984, using estimates shown in Appendix C of that Standard. Estimates for breakers, air compressors and dumptrucks have been assumed.
ii. SWL values are from Table 3 of the Technical Memorandum on Noise from Construction Work other than Percussive Piling, assuming silenced equipment have been used.

4.3 Road Traffic Noise Impact Assessment Methodology

4.3.1 Noise Model

Road traffic noise levels have been predicted using Enpac's in-house noise model which is a computerised model developed on the basis of the UK's Department of the Transport procedures described in "Calculation of Road Traffic Noise" published by the Welsh Office, HMSO 1988 (CRTN).

4.3.2 Traffic Figures

In order to establish the baseline conditions prior to the proposed improvement works, morning peak traffic flows for year 2000, being the commencement year of the construction works, have been used to calculate the prevailing road traffic noise levels. As for the worst noise impact within 15 years after the completion of the proposed improvement works in 2003, the projected traffic flows for the morning peak hours in 2006 and 2016[1] have been compared for the worst-case traffic scenario. According to the short-term development plan in Tseung Kwan O, local traffic is expected to build up to a maximum in year 2006. With the progressive development of the road network in Tseung Kwan O, e.g. coastal road, some of the local traffic is expected to be diverted from the local network. A comparison of these two scenarios reveal that year 2006 is the worst of the two in terms of the overall traffic noise levels. Therefore, the traffic flows in 2006 have been adopted for this noise impact assessment. Transport Department, in principle, has no objection on the adopted traffic forecast. Figures 5-1 and 5-2 show the traffic flows for 2000 and 2006, respectively. A sample input/output file for one of the NSRs is Appendix E.

4.4 Vehicle Emissions Impact Assessment Methodology

4.4.1 Line Source Dispersion Model

The US EPA CALINE4 model which is based on the Gaussian diffusion equation to characterise pollutant dispersion over the roadway has been used to model the air quality at the Air Sensitive Receivers. The model uses as input the vehicle emissions from the traffic forecasts for 2006. As the air pollutants of prime concern from vehicle emissions are Respirable Suspended Particulate (RSP) and Nitrogen Dioxide (NO_2), the model has been employed to predict 1-hour and 24-hour concentrations of these parameters. In the model, RSP has been modelled as a particulate, and the average 24-hour concentration has been calculated.

The NO_2 option was used to simulate the transformation of NO to NO_2 from the roadway to the receivers. The improved road is represented in the model as a series of short links, each emitting NOx at a rate that is proportional jointly to a composite emission factor of the air pollutant and the vehicle flow on the road link. A sample output file has been included in Appendix F.

[1] The traffic flow diagram and the associated noise levels for the representative NSRs are shown in Appendix D.

In order to account for the side effects of noise screening structure on the dispersion of air pollutants, the proposed locations of inverted L-shaped barrier, partial enclosure and full enclosures have been taken into account in the model. For plain barriers or cantilevered barriers, the source lines were shifted vertically by the height of the barriers. For partial enclosure, the source lines were shifted horizontally by the width of the extended panel and vertically by the height of the enclosures. The vertically shifted road links were modelled as 'fill' in the CALINE4 model. It was assumed that the air flow streamlines followed the artificial terrain in an undisturbed manner in accordance with the CALINE4 User's Guide issued by the US Department of Transportation, Federal Highway Administration.

Tunnel Air Quality Model

The air quality inside a noise enclosure will be modelled as a tunnel since it confines air pollutants in the space underneath the enclosure with longitudinal transport of pollutants promoted by the statistical fluctuation of the traffic density, the meteorological condition, and the turbulence generated by the passing vehicles. This effect is, to some extent, similar to that of a two-way naturally ventilated tunnel with a balanced east- and west-bound traffic.

According to Ohashi & Koso's theory presented in "Longitudinal Diffusion of Exhaust Pollutants in Two-way Automobile Tunnels" (Ref. 1) presented to International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels, 1985, the maximum concentration in a tunnel of a given length is given by :

$$C_{MAX} = wL_e^2 / 8DA_T$$

where

C_{max} = maximum volumetric concentration of pollutant, ppm
w = emission of the pollutant per unit length, g/s-m
L_e = effective length of tunnel = L + L_a, m
D = longitudinal diffusion coefficient, m^2/s
A_T = cross-sectional area of tunnel, m^2
L = the physical length of tunnel, m
L_a = additional tunnel length, m

The additional length is a measure of the diffusive transport of pollutants at the portal and is given by:

$L_a = 2 \times 3 \times d_T$

where d_T = equivalent diameter of the tunnel, m^2

The calculations have assumed an average vehicle speed of 25 kph and an average head-to-head distance of 30.5m in order to determine the worst-case air pollutant concentrations.

4.4.2 Meteorological Conditions

The following meteorological conditions have been assumed in the air quality modelling using the CALINE4 model :

Mixing height:	500m
Surface Roughness:	1.0 m
Wind speed:	1m/s
Stability Class:	D and F
Wind Direction:	worst case
Directional Variability:	18 degrees

4.4.3 Emission Factors

The EPD's Fleet Average Emission Factors contain emission factors for various types of vehicles in different years of operation. Since there are indications that the traffic flows may peak for a short period around 2006, the Fleet Average Emission Factors applicable to the morning peak hours in 2006 have been calculated as a worst-case scenario.

4.4.4 Background Pollutant Concentrations

The background pollutant concentrations for NO_2 , O_3 and RSP have been advised by the EPD to adopt the annual average of daily hourly maximum values in 1996 for rural/new development areas for assessment. The background pollutant concentrations for the above-mentioned are as follows:

RSP = 51 $\mu g/m^3$
NO_2 = 39 $\mu g/m^3$
O_3 = 57 $\mu g/m^3$

In the absence of in-situ monitoring data, the above figures have been used as the background concentration for the impact assessment.

4.5 Landscape and Visual Impact Assessment Methodology

4.5.1 Landscape Impact

The assessment of the potential impacts of a proposed scheme on the existing landscape comprises two distinct sections:

- baseline survey, and;
- potential landscape impacts assessment.

Baseline Survey

A baseline survey of the existing landscape character and quality will be undertaken from site and desk-top surveys. Landscape elements considered include:

- local topography,
- woodland extent and type,
- other vegetation types,
- built form,
- patterns of settlement,
- land use,
- details of local materials, styles, streetscapes, etc.,
- prominent watercourses, and;
- cultural and religious identity.

Proposed developments either within the study area or adjacent to it are also considered. The baseline survey will form the basis of the landscape context by describing broadly homogenous units of character. The landscape is rated into **low**, **medium, good** or **high** depending not only on the quality of elements present but also their sensitivity to change and local or regional importance.

Landscape Impact Assessment

The assessment of the potential landscape impacts of the proposals will result from:

- identification of the sources of impact, and their magnitude, that would be generated during construction and operation of the scheme, and;
- identification of the principal landscape impacts, primarily in consideration of the degree of change to the baseline conditions. The impacts are considered systematically in terms of the landscape or elements, the site and the its context.

The overall impact is a product of the following factors:

- the landscape character and its quality,
- source, nature and magnitude of potential impacts,
- the degree of change caused by each of the impacts to the existing landscape,
- tolerance of the landscape to absorb the change,
- significance of this change in consideration of the local and regional areas and other developments,
- the degree of conflict of the scheme on proposed developments, and;
- cumulative effects on the landscape of this and neighbouring proposals.

The magnitude of landscape / townscape impact is rated into **high**, **medium**, **low** or **no change**. The impact can be adverse or beneficial. Combining the assessment of sensitivity and magnitude of impact, the significance of adverse landscape impacts arising from this project can be classified as **slight impact**, **moderate impact** or **significant impact** as shown below:

Magnitude of Impact				
	High	*Moderate Impact*	*Moderate / Significant Impact*	*Significant Impact*
	Medium	*Slight / Moderate Impact*	*Moderate Impact*	*Moderate / Significant Impact*
	Low	*Slight Impact*	*Slight / Moderate Impact*	*Moderate Impact*
		Low	Medium	High
			Sensitivity / Quality	

The degree of landscape impact is rated as outlined in Annex 10 Criteria for Evaluating Visual and Landscape Impact, and Impact on Sites of Cultural Heritage and are classified into five levels as follow: **beneficial, acceptable, acceptable with mitigation measures, unacceptable and undetermined.**

4.5.2 Visual Impact

The assessment of the potential visual impact of the scheme comprises two distinct parts:
- baseline survey, and;
- visual impact assessment.

Baseline Survey

The baseline survey of all views towards the proposals is undertaken by identifying:

- the visual envelope or visual zone within which the proposed development may be contained either wholly or partially with in views. This must also include indirect effects such as offsite construction activities, and;
- the visually sensitive receivers within the visual envelope whose views will be affected by the scheme. The potential receivers are considered as three groups:

  - views from residences - the most sensitive of receivers due to the high potential of intrusion on the visual amenity and quality of life,
  - view from workplaces - less sensitive than above due to visual amenity being less important within the work environment, and;
  - views from public areas - including all areas apart from the above, e.g., public parks, recreation grounds, footpaths, roads, etc. Sensitivity of this group depends on the transitory nature of the receiver, e.g. sitting in a park or travelling on a highway. Also considered is the degree of view or glimpsed views.

The sensitivity of each group is also influenced by its location and direction of view relative to the scheme. Both present and future visually sensitive receivers will be considered. The existing visual quality, in consideration of the VSRs sensitivity, is rated as **low**, **medium**, **good** or **high**.

Visual Impact Assessment

The baseline survey will form of the basis of the visual character and quality of the site. The assessment of the potential visual impacts will result from:

- identification of the sources of visual impacts, and their magnitude, that would be generated during construction and operation of the scheme, and;
- identification of the principal visual impacts primarily in consideration of the degree of change to the baseline conditions.

The impact assessment will relate to the visual receiver group and their existing and potential views subsequent to the scheme development. The visual impact will result from consideration of the following:

- character of existing view,
- quality of existing view,
- context and location of the visually sensitive receiver,
- sensitivity of the visual group,
- degree of change to existing views,
- other views available to receiver group, and;
- the cumulative effects on views of this and other neighbouring developments.

Magnitude of Impact

High	*Moderate Impact*	*Moderate / Significant Impact*	*Significant Impact*
Medium	*Slight / Moderate Impact*	*Moderate Impact*	*Moderate / Significant Impact*
Low	*Slight Impact*	*Slight / Moderate Impact*	*Moderate Impact*
	Low	Medium	High

Sensitivity / Quality

The degree of visual impact is rated as outlined in Annex 10 Criteria for Evaluating Visual and Landscape Impact, and Impact on Sites of Cultural Heritage and are classified in to five levels as follows: **benefits, acceptable, acceptable with mitigation measures, unacceptable and undetermined.**

4.5.3 Mitigation Measures

The identification of the visual and landscape impacts will highlight those sources of conflict requiring landscape design solutions to reduce the impacts, and, if possible, blend the development, and associated activities, in with the surrounding landscape. These mitigation measures should take into account factors including:

- retention of all existing roadside planting, where possible;
- dense tree and shrub planting on any new cut slopes to create a landscape buffer zone and visual screen.

- re-instatement of street tree planting where it is required to be removed;
- transplantation of street tree planting, where it is regard to be removed, where possible;
- dense screen tree and shrub planting in the planned Open Space;
- dense tree and shrub planting in all roadside amenity areas within the interchange;
- dense tree and shrub planting to screen all retaining wall and noise barriers/enclosure where possible;
- consideration of the design of, and hard materials finishes to. All elevated sections of road together with their piers, in conjunction with advice from Advisory Committee on the Appearance of Bridges and Associates Structures (ACABAS);
- consideration of the materials used to enhance the existing streetscape while maintaining consistency;
- consideration of the materials used to enhance the existing streetscape while maintaining consistency;
- consideration of the design of subway tubes and portals for consistency with the existing subways on or adjacent to the site and in conjunction with advice from ACABAS; and
- consideration of noise barrier design to create elements that are integrated within the scheme and the surrounding landscape, and in conjunction with advise from ACABAS.

This will result in the formation of landscape mitigation measure proposals which will alleviate the previously identified landscape and visual impacts as far as possible.

4.6 Land Use Impact Assessment Methodology

4.6.1 Land Use Impact Study

The land use impact study is to access the impacts of the proposed Grade Separated Interchange on the existing and planned land uses and to propose mitigation measures to reduce likely impacts.

The land use impact assessment will begin with a broad land use survey of baseline conditions within 300m (including works areas), and identify the land uses that might be affected by the proposed road alignment. It will also assemble planned land uses and assess the impacts of the project on the planned land uses..

4.6.2 Mitigation Measures

Mitigation measures will be proposed for the road alignment.