4. AIR QUALITY IMPACT ASSESSMENT

4.1 Introduction

4.1.1 This section presents an assessment of air quality impacts associated with the construction (qualitative) and operation (quantitative) of the recreational and residential development proposed at Whitehead and Lee On area (the Project). Worst-case impacts (i.e. based on the preliminary Preferred Development Option) on the representative Air Sensitive Receivers (ASRs) have been assessed. Three major sources of air pollution have been identified namely construction dust emission, road traffic emissions and industrial emissions. The sources of air pollutants at the different phases of the development are categorized as follows:

i) Construction Phase: Construction works include site clearance, site formation, building works, infrastructure provision and any other infrastructure activities. The major temporary air pollution is dust generated as a result of these construction works.

ii) Operational Phase: The major permanent sources of air pollutants are the vehicle emission from traffic on major roads and the air pollutants emitted from the vicinity of the industrial stationary sources. Vehicular emissions from the roads surrounding the Project, including the future Road T7, widened Sai Sha Road and all internal roads are considered. Chimneys emissions associated with nearby industrial premises are the stationary air pollutant sources.

4.2 Air Quality Assessment Criteria

4.2.1 The principal legislation regulating air emissions in Hong Kong is the *Air Pollution Control Ordinance* (APCO) [Cap 311] of 1983 and its subsidiary regulations, and Technical Memorandum on Environmental Impact Assessment Process (TMEIA). The whole Hong Kong has been covered by Air Control Zones. The Hong Kong Air Quality Objectives (AQOs) stipulate maximum acceptable concentrations of four major air pollutants: nitrogen dioxide (NO_2); sulphur dioxide (SO_2), total and respirable suspended particulates (TSP and RSP). The ambient standard for hourly, daily and annual concentrations of these pollutants are shown in Table 4.1

Table 4.1
Hong Kong Air Quality Objectives (AQOs)

Pollutants	Concentration in Micrograms per Cubic Metre ($\mu g/m^3$)[A]		
	Averaging Time		
	1 hour[B]	24 hour[C]	1 year[D]
Nitrogen Dioxide (NO_2)	300	150	80
Sulphur Dioxide (SO_2)	800	350	80
Total Suspended Particulates (TSP)	500[E]	260	80
Respirable Suspended Particulates (RSP)[F]	-	180	55

Notes:
A Measured at 298k (25°C) and 101.325 kPa (one atmosphere).
B One hour criteria not to be exceeded more than three times per year.
C 24 hour criteria not to be exceeded more than once per year.
D Arithmetic means
E This control limit has no statutory basis but is used as a target level for limiting fugitive dust emissions generated by construction activities.
F Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometer (μm) or smaller.

4.2.2 There are no statutory criteria for maximum levels of odours in Hong Kong. EPD's recommended an odour nuisance criterion is 5 odour units (OUs) based on averaging time of 5 seconds at the sensitive receiver.

4.3 Study Area

4.3.1 The Project is located in the Shatin – Sai Kung Corridor about midway between Sha Tin Town and Sai Kung Town and to the east of Ma On Shan area.

4.3.2 Majority of land in this area is used for residential development (public estate and private residential development), car park, small farm and scattered villages. No major industrial activities are found within the Study Area. Sai Sha Road is the major road passing the centre part of the Study Area. Thus, the major air pollutant source is vehicular emissions from the roads.

4.4 Baseline Conditions

Meteorology and Topography

4.4.1 The Study Area is located in a meteorological confined area, the Tolo Airshed where only gaseous fuel is permitted under the *Air Pollution Control (Fuel Restriction) Regulation*. Therefore, the majority of the air pollutants are emitted from the moving vehicles, particularly the diesel trucks and heavy vehicles.

4.4.2 Figure 4.1 illustrates the wind conditions at Shatin station. The dominant wind direction is northeasterly due to the channelling effect associated with the Sha Tin Valley.

Existing Air Quality

4.4.3 The baseline air quality data within the Study Area has been based on the EPD's monitoring station in Shatin. According to "*Air Quality in Hong Kong (2000)*", the concentration levels of NO_2, SO_2, TSP, RSP and O_3 at Shatin are shown in Table 4.2:

Table 4.2
Measured Concentrations at Shatin EPD Station (2000)

Pollutant	Hourly		Daily		Annual	
	Maximum	AQO	Maximum	AQO	Average	AQO
TSP	N/A	500	223	260	58	80
RSP	N/A	N/A	164	180	46	55
NO_2	254	300	146	150	46	80
SO_2	185	800	72	350	18	80
O_3	265	240	N/A	N/A	N/A	N/A

Notes: N/A means Not Applicable
Concentration in micrograms per cubic metre ($\mu g/m^3$)

4.4.4 The table indicates that the concentration of SO_2 is well below the AQO. The short-term and long-term maximum concentration of NO_2, TSP and RSP are below the AQOs.

4.4.5 The fairly high concentration of NO_2, TSP and RSP was mainly contributed by heavy traffic in the Shatin area. The construction of the Ma On Shan (MOS) Rail also increase the particulates concentration in the regional area.

Future Air Quality

4.4.6 From the latest findings of the Third Comprehensive Transport Study (CTS3), the projection of future baseline air quality data at Shatin Station is used. According to CTS3 Study, the annual average concentrations of nitrogen dioxide (NO_2) and Respirable Suspended Particulates (RSP) are predicted to be 52.4 $\mu g/m^3$ and 55.0 $\mu g/m^3$ respectively for the high growth scenario in 2016. This worst case scenario gives rise to an increase of around 6.4 $\mu g/m^3$ for NO_2 and 9 $\mu g/m^3$ for RSP in comparison with EPD's monitoring data at Shatin in 2000. As the predicted future concentration of sulphur dioxide (SO_2) is not available in CTS3, the data from EPD's Shatin Station (18 $\mu g/m^3$) is assumed for this assessment.

4.5 Representative Air Sensitive Receivers

4.5.1 The representative air sensitive receivers (ASRs) within the Study Areas will represent the future and existing sensitive receivers likely to be affected by the Project. They are described in detail under the noise chapter.

4.6 Construction Impact

Introduction

4.6.1 The principal potential source of air quality impact arising from the construction of the Project will be fugitive dust. The temporary dust nuisance, measurable as Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP), would be generated as a result of construction activities during the construction phase of the Project.

4.6.2 The construction programme of the Project is yet to be finalized. Tentatively, the construction programme is likely to commence in 2003 and completed in 2008. Thus the construction period is expected to last for about six years. It is noted that the site formation for the Wu Kai Sha (WKS) station development is not part of this Project. The station development will be constructed on the platform of the MOS Rail – Wu Kai Sha Station, which is currently under construction by KCRC.

4.6.3 The potential dust sources associated with construction activities is likely to be generated from loading and unloading, top soil removal, travel over dirt roads and wind erosion. Concrete batching plants and rock crushing plant with a processing capacity exceeds 5,000 tonnes per annum[1] are not necessary for this Project. Blasting is not required. However, stockpiling areas and working areas may be required.

1 EPD - A Guidance Note on The Best Practicable Means for Mineral Works (Stone Crushing Plants) – BPM 11/1 February 1995

Construction Programme

4.6.4 The construction works associated with the development are broadly divided into three categories:

(i) Wu Kai Sha Station residential development – (2002-2006);

(ii) Site formation and infrastructure works – (2003-2008); and

(iii) Residential development at Lok Wo Sha and Whitehead and Recreation development – (2004 – 2008).

4.6.5 Among all construction activities, site formation has the highest potential of causing dust nuisance to the nearby ASRs. In brief, the site formation works will commence in 2003 and likely to be finished by 2004.

Representative Air Sensitive Receivers

4.6.6 During the construction of the Project, some existing residence may be subject to the potential construction dust impacts. Table 4.3 shows these air sensitive receivers and the shortest distance between the ASRs and the construction areas. The location of the sensitive receivers is shown in Figure 3.4.1 of Chapter 3 (Noise Impact Assessment).

Table 4.3
Representative ASR around the Project during Construction Phase

ASR	Status *	General Description	No. of Storey	Shortest Distance to the boundary of Construction area (m)
1	E	Village house in To Tau	1	45
2	E	Village house in Wu Kai Sha	3	65
3	E	Li Po Chung United World College	3	65
4	E	Block 1, Symphony Bay	5	50
5	E	Village house at Cheung Muk Tau	3	150
6	E	Block 15, Monte Vista	30	20
7	F	Wu Kai Sha Station development	50	55

Note:
* E – Existing ASR; F – Future ASR.

Assessment Results

4.6.7 The residential buildings of the Wu Kai Sha Station development will be build on the platform of the Wu Kai Sha station. The platform is currently being constructed during the construction of MOS Rail. Thus, no further site formation works will be required for Wu Kai Sha station development.

4.6.8 For the Lok Wo Sha development, the site formation work will be conducted by the private developer. As the existing ground level of the Study Area is averaging at 6 mPD, the proposed site formation level will likely to be ranging from 7 to 9 mPD based on a balanced out and fill approach, resulting in relatively less quantity of excavation. In addition, currently majority area of the existing Lok Wo Sha have been leveled for purpose of carpark use and thus no extensive site formation is expected to be required.

4.6.9 Under this Project, site formation work will be conducted by Government at the Whitehead Sites 1, 2 and 3, the school sites at Whitehead, and all the proposed roads. As the existing landuses for the Whitehead Sites 1 to 3 and proposed schools are golf course and previous detention camp, extensive site formation work is unlikely required. According to the engineering assessment, most of the excavated material can be reused within the Project. The movement of the cut and fill materials within the Project is summarized in Table 4.4. With the reuse of excavated material, there will be limited fill material required to be imported for site formation. Broad estimation shows that there would likely be no more than 50 to 70 trucks moving out or in materials from the construction site within a day.

Table 4.4
Movement of Cut and Fill Material within Project

Site	Cut (cu.m)	Fill (cu.m)	Net (cu.m)
Whitehead Site 1	85,822	92,173	(6,352)
Whitehead Site 2	73,380	46,309	27,071
Whitehead Site 3	35,282	83,554	(48,273)
Central Spine	12,780	7,797	4,983
Schools at Whitehead Site 3	12,030	12,893	(863)
Road L1	23,443	15,615	7,828
Road D1	1,090	94,134	(93,044)
Total	243,826	352,475	(108,649)

Note : number in bracket means import material quantity

4.6.10 Most of the construction dust will be generated from the movement of construction vehicles on dirt roads. Uploading and removal of spoil material will also be the potential source for dust nuisance. According to the preliminary site investigation, the moisture content of the material to be excavated will be relatively low. Thus the most direct and effective dust suppression measures are regular watering or the pavement of main haul roads within each individual site formation area. With the help of regular watering over all the exposed area, at least twice a day, a 50% reduction[2] on the dust contribution from the exposed surface can be reduced. However, it is our experience from other similar sites in Hong Kong when undertaking the Environmental Monitoring and Audit Phase[3] that a much more acceptable degree of dust suppression can be achieved. For example, the pavement of haulage can further reduce the potential dust nuisance. With the aid of regular watering and haulage pavement, the construction dust levels at representative ASRs, hence all nearby ASRs, will likely to be complied with the requirement of AQOs.

4.6.11 Construction of drains, sewers and water mains will require excavation of trenches. Laying these new infrastructures are likely to be conducted section by section, thus the quantity of the excavated material is unlikely to be large enough to cause dust nuisance. It is anticipated that excavated material will only be stockpiled on each local works area. The duration of stockpiling will be as short as possible as most of the material will be used as backfill material for the open cut trenches. Given the limited scale of construction works and with the implementation of proper standard dust suppression measures, no adverse impact is expected and compliance with the AQOs is achieved at ASRs at all time.

4.6.12 Construction of building blocks and recreation facilities should not generate excessive dust, as the construction works are mainly associated with framework and concrete pouring. Leveling, compacting and resurfacing new areas within these developments will not involve significant material movement. Hence dust impacts will be insignificant. Proper watering of exposed dirt will be undertaken throughout the construction phase and dust generation will be minimized. It is expected that compliance with the AQOs can be achieved at ASRs at all time.

2 Jutze, G.A., K. Actell Jr. and W. Parker, 1974: *Investigation of Fugitive Dust – Sources, Emissions and Control*, Pub. No. EPA – 45013-74-046a, United States Environmental Protection Agency.

3 Binnie Consultants Limited, 1995-1997: Environmental Project Office (ENPO), West Kowloon Project Office, Hong Kong Environmental Protection Department, Hong Kong Government.

Dust Mitigation Measures

4.6.13 In order to comply with *Air Pollution Control Ordinance* (APCO), the Contractor should at all times prevent dust nuisance as a result of his activities. The Contractors are required to follow all the requirements for dust control stipulated in the *Air Pollution Control (Construction Dust) Regulation.* Site formation works are likely to cause short-term unacceptable dust impacts on all of the representative ASRs close to the Project development. Therefore, dust suppression measures, such as regular watering the exposed area and haulage pavement, should be installed as part of good construction practice, and they should be incorporated in the Contract Specification and implemented to minimize dust nuisance to within acceptable levels arising from the works. Measures which are employed to minimize impacts on sensitive receivers in the Study Area are also relevant for the protection of ecologically sensitive areas. Other dust suppression measures are highlighted below:

(i) The Contractor shall observe and comply with the *Air Pollution Control Ordinance* and its subsidiary regulations, particularly the *Air Pollution Control (Construction Dust) Regulation.*

(ii) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. Effective dust suppression measures shall be employed to ensure that the air quality, at the boundary of his site and at any ASRs, complies with the Hong Kong Air Quality Objectives.

(iii) The Contractor shall ensure that there will be adequate water supply / storage for dust suppression purposes.

(iv) The Contractor shall frequently clean and water the site to minimize fugitive dust emissions.

(v) Effective water sprays shall be used during the delivery and handling of aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(vi) Watering of exposed surfaces shall be exercised as often as possible depending on the circumstance.

(vii) Areas within the site where there is a regular movement of vehicles shall be regularly watered.

(viii) Where dusty materials are being discharged to vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhausted fans shall be provided for

this enclosure and vented to a suitable fabric filter system.

(ix) The Contractor shall restricted all motorized vehicles within the site, excluding those on public roads, to a maximum speed of 15 km per hour and confine haulage and delivery vehicles to designated roadways inside the site.

(x) Wheel washing facilities shall be installed and used by all vehicles leaving the site (Figure 4.2). No earth, mud, debris, dust and the like shall be deposited on public roads. Water in wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit detailed proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel washing facilities shall be usable prior to any earthworks excavating activity on the site. The Contractor shall also provide a hard-surfaced road between any washing facility and the public road.

(xi) The Contractor shall devise, arrange methods of working and carrying out the works in such a manner so as to minimize dust impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(xii) All site vehicles' exhausts shall be directed vertically upwards or directed away from the ground.

(xiii) Any stockpile of dusty material shall be either: (a) covered entirely by impervious sheeting; (b) placed in area sheltered on the top and the three sides; or (c) sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

Cumulative Impacts

4.6.14 Projects that have potential cumulative construction dust impacts would be works due to MOS Rail and Road T7. The construction of these two projects is currently being undertaken. It is anticipated that most of the site formation works of the two projects should have been completed in 2004. Therefore, potential cumulative dust impact from these projects is minor.

Monitoring and Audit Requirement

4.6.15 Air quality monitoring should be carried out at selected ASRs during the construction period to monitor compliance with AQOs for the construction activities being undertaken for the proposed development. Monitoring is also required to check the effectiveness of the recommended mitigation measures. Ad-hoc monitoring and audit

should also be carried out at other ASRs in case of complaints, and measures taken to ensure acceptable dust levels are met as far as possible.

4.6.16 It is recommended that the following representative ASRs be monitored during construction stage of the Project development. These ASRs are selected to represent a particular area likely to be worst affected by the construction works.

- ASR 1 (To Tau Village)
- ASR 3 (Li Po Chun United World College)

4.6.17 Details of the monitoring and audit for construction dust are presented in the separate EM&A Manual.

4.7 Operational Impact

Operational Impact Assessment

Introduction

4.7.1 During the operational phase of the Project, two major sources of air pollution have been identified in the neighbourhood of the site. The first source is vehicular exhaust from the road traffic in and around the Study Area. The second source is emission from chimneys in the immediate area.

Vehicular Emission

4.7.2 One of the major sources of potential air pollution is the vehicular emission from traffic. In this assessment, the predicted traffic flow in the year 2023 has been used. Traffic emission impacts has been undertaken using CALINE4. The emissions from the predicted traffic flows on the following major roads have been modelled, namely future Road T7, Sai Sha Road and nearby internal roads.

4.7.3 The traffic air pollution is mainly from NO_2 and RSP. Only maximum hourly concentrations of NO_2 and the maximum daily concentration of NO_2 and RSP need assessment to check the compliance with the AQOs. These are predicted using CALINE4.

Assessment Methodology

(a) The assessment has been based on the 2023 traffic flow data provided by traffic consultant. A detailed breakdown of the types of vehicles is given in Table D1 of Annex D in terms of the percentage of passenger cars (%P.Car), taxi (%taxi), public bus (%PuBus), private bus (%PrBus), public light bus

(%PuLB), light goods vehicle (%LGV), medium goods vehicles (%MGV) and heavy goods vehicles (%HGV) plus the emission rates of RSP and NO_2.

(b) Gases have been assumed to be inert, and concentrations of NO_2 have been taken as 20 percent of the total NOx concentration.

(c) The assumed vehicular emissions factor for pollutants such as particulates and NO_2 in the year 2011 have been supplied by the Vehicle Emission Control Section of EPD. These factors originated from the USEPA MOBILE IV program. The emission factors in 2023 are extrapolated from these data and are assumed to be same as the emission factor of heavy vehicle is predicted to be levelling off after 2008.

(d) The following worst-case meteorological conditions have been assumed:

Wind speed	: 1 m/s at 10m height
Wind direction	: (worst case for individual receiver)
Stability class	: D
Mixing height	: 500m

(e) The associated noise barriers of the future widened Sai Sha Road and that of Road T7, which is currently being constructed, have been taken into account in the assessment. This assessment assumes that the source of the air pollutants will be evaluated from the road surface to be on top of the proposed barriers.

(f) The background concentrations of pollutants have been based on the modelling results of CTS-3 Report under the high growth scenario, i.e. the background concentration of NO_2 and RSP are 52.4 and 55.0 $\mu g/m^3$ respectively.

(g) As a conservative approach, a conversion factor 0.6 is used to calculate the daily air pollutant concentration from hourly value.

Vehicular Emission (NO_2 and RSP) Impacts

4.7.4 The traffic impact assessment shows that the majority of traffic and the heavy vehicle (HV) within the Study Area will flow along the major highways namely Road T7 (5610 veh/hr and about 11.2% of HV) and Sai Sha road (2060 veh/hr and 11.2% of HV). In comparison, the traffic predictions of the internal local roads within the Project are relatively less, ranging from 140 to 1010 veh/hr with about 10-20 % Heavy Vehicle. Therefore, it is expected that Sai Sha Road and Road T7 would constitute the most air quality impact associated with the traffic emission.

4.7.5 Figures 4.3 to 4.5 show the predicted concentration of NO_2 and RSP in the Study Area at pedestrian level. The contour plots show that buffer distance between the major highways and the surrounding residential areas is adequate to alleviate the vehicular emission impacts. The predicted NO_2 and RSP concentration levels at the representative ASRs are shown in Table D2 (including background NO_2 and RSP concentrations) of Annex D. It is expected that the hourly and daily NO_2 concentrations and daily RSP concentrations of the ASRs in the Study Area will comply with the AQOs.

Vehicle Exhaust Emission from proposed Underpass

4.7.6 In this Project, a section of Road L1 of about 80m in length will be depressed to create a pedestrianized area near the proposed recreational site (Figure D1 of Annex D). As it is less than 230m in length, no mechanical ventilation system would be provided for the underpass and thus the underpass air pollutants will be dispersed via the underpass portal.

4.7.7 For the worst-case scenario of air quality within the underpass, a congested condition is considered i.e. traffic moving slowly and the separation between vehicles is assumed to be 1m. For the worst-case scenario of air quality due to the openings of the depressed road, traffic pollutants are assumed to be emitted from both ends of the underpass (portal).

Representative Air Sensitive Receivers

4.7.8 The major landuses around the depressed Road L1 are the pedestrianised area and low-rise residential developments. The details of the representative air sensitive receivers (rASRs) are shown in Table 4.5 and on Figure D1 of Annex D.

Table 4.5
Description of the Representative Sensitive Receivers (rASRs)

rASRs	Landuse	Floor
1	Low-rise Residential Development	Pedestrian Level
2	Visitor Centre	Pedestrian Level

Methodology

4.7.9 In the absence of mechanical ventilation, the exhaust gases emitted from the portal of the depressed road will be dragged out by cars leaving the portal. The ISCST3 air dispersion model has been used to assess the impact due to the portal emission on the surrounding area.

4.7.10 In the air quality model, it was assumed that the open road emission would behave as line sources in accordance with the procedure stated in the Section III of *the Permanent International Association of Road Congresses (PIARC)*, 1991. The sources of the portal emission have been modelled as a line source represented by adjacent area sources. The length of the line source was taken as 100m at each opening of the depressed road. As there is no force ventilation, it is assumed that half of the air pollutants' concentration inside the decking will be emitted out from each opening. It is also assumed that 1st half of 100m consists of 2/3 of the emitted mass and 2nd half of 100m consists of 1/3 of the emitted mass. Annex D1 shows a calculation. Similar to road emission, it is assumed that 20% of NOx will be converted to NO_2.

4.7.11 In addition to the portal emission, the sensitive receivers near Road L1 will also be impacted by the traffic emission from the nearby roads. This assessment has calculated the cumulative NO_2 concentration at the rASR from portal emission and road emission. The methodology used for the traffic emission calculation is based on the CALINE4 model. It is assumed that 20% of NOx will be converted to NO_2.

4.7.12 The associated NO_2 emission rate are thus calculated and shown in Table 4.6 together with the physical parameters of each decking section.

Table 4.6
NO_2 Emission Rates

Decking Section I.D.	Composite Emission Factor	Decking Length (m)	Traffic Flow (veh/hr)	NOx Emission Rate (g/s)
Road L1	1.394 (NOx)	80	180	0.0028
	0.118 (RSP)	80	180	0.0004

Assessment Results

4.7.13 The modelling results are shown in Table 4.7. The findings indicate that the predicted pollutants' concentration at the air sensitive receivers due to the portal emission from the sunken road will be well below the AQOs.

Table 4.7
Predicted Traffic Emission from Portal Emission at the rASR

rASR	Floor	NO_2[(a)]		RSP[(b)]	
		1hr	24hr	1hr	24hr
1	1	55.4	52.9	56.3	55.2
1	3	53.1	52.4	55.3	55.0
2	1	56.8	53.8	56.8	55.6

Note:
(a) Background concentration 52.4 μg/m³ is included. 1hr AQO of NO_2 is 300 μg/m³; 24hr AQO of NO_2 is 150 μg/m³
(b) Background concentration 55.0 μg/m³ is included. There is no 1hr AQO of RSP; 24hr AQO of RSP is 180 μg/m³

Carparks

4.7.14 Carparks are proposed under the podium of the high-rise residential developments (1 storey podium at Whitehead Development and 2 storeys podium at Lok Wo Sha Development). The integrated carparks are all above the ground levels. This layout will enhance the natural air movements across the carparks. Therefore, the air quality associated with most of the carparks is expected to be acceptable.

4.7.15 It is expected that for those carparks whose parking spaces exceeding 500 units, their air qualities may exceed the air quality guidelines listed in ProPECC PN 2/96 (Table 4.8). Mitigation measures such as installation of ventilation systems may be required in order to minimize the emissions from vehicles inside the carparks. With these measures and design consideration, the air quality associated with the proposed carparks is expected to meet the air quality guidelines as given in Table 4.8.

Table 4.8
Air Quality Guidelines of Carparks

Air Pollutants	Maximum Concentration Not to be exceeded*
	5 Minutes Average (μg/m³)
Carbon monoxide	115,000
Nitrogen dioxide	1,800

* Expressed at the reference condition of 25°C and 101.325 kPa (one atmosphere)
Source: ProPECC PN 2/96 – *Control of Air Pollution in Car Parks*

4.7.16 In addition, a public carpark with maximum capacity of 600 capacity for private car is proposed under the cycle park / visitor information centre located in Whitehead Site 1 (Recreational Site). At this stage, there is no layout for the underground carpark. When designing this car park layout, the E&M designer (the Developer) should refer to Table 4.8 and ProPECC PN 2/96 for guidelines on ventilation system and air monitoring system so as to ensure good air quality within the carpark. The outlet of the ventilation system should be properly located so as to avoid imposing nuisance, if any, to the nearby air sensitive receivers, taking into account the prevailing condition of the area (namely northeasterly wind) and flat coastal area. The coastal wind will provide a natural dispersion of the air pollutants. With these measures, it is expected that the potential air quality impact associated with the underground carpark to the nearby environment is minimal.

4.7.17 An open coach parking with maximum capacity of 20 nos. is proposed adjacent to the Visitor Information Centre. Given the peak projection of only 10 coach per hour along the road leading to the visitor centre, air quality impact due to vehicle emission from parking areas is expected to be insignificant.

Industrial Emission Impact Assessment

Chimneys Information

4.7.18 According to EPD's inventory of chimneys information, there are 65 chimneys within the vicinity of the Project. Majority of these chimneys are located at the Tai Po Industrial Estate which is about 5km from the Study Area. EPD's data set are given in Table D3 of Annex D. Figure 4.6 shows the locations of these chimneys. Of these chimneys, 37 chimneys consume light diesel fuel or boiler diesel oil, and 9 chimneys has no fuel consumption information. In addition, 19 chimneys which use naphtha fuel and emit NO_2 gas are in the Tai Po Industrial Estate. One chimney uses other fuels such as kerosene, charcoal, coke and wood.

4.7.19 The measurable environmental parameters due to the industrial chimneys are mainly related to sulphur dioxide and nitrogen dioxide. Screening model (ISC3) has been used to assess their operational impacts on the representative air sensitive receivers at the potential development areas at Whitehead. Local meteorological variations due to the topographical influence have been taken into account by using the local meteorological data from Shatin station.

Assessment Methodology

4.7.20 The measurable environmental parameters due to the industrial chimney emissions have been evaluated for SO_2 and NO_2 impacts by using ISC3 Model. For this air quality assessment of the chimney emission impact, the following assumptions have been made:

(i) As the industrial emissions are mainly due to the combustion of diesel fuels, the impacts due to the light diesel fuel and the boiler diesel oil have been modelled. Also, the LPG gas chimneys consuming naphtha fuel (19 chimneys) have been included in the assessment. The other minor fuels have not been considered for this assessment. Also excluded from this assessment are those chimneys whose technical information are not available and chimneys that no longer exist. For SO_2, there are 37 chimneys modelled in this assessment, while there are 56 chimneys are modelled for NO_2 emission in this assessment.

(ii) The maximum fuel consumption has been assumed during the entire emission period. A 24 hour emission period and 140°C exit temperature have been assumed for chimneys whose emission period and exit temperature are not available. However, in order to prevent over prediction, a general fuel consumption factor, 41 percentage and 23 percentage has been applied for daily and night operation respectively.

(iii) The emission rate, efflux velocity and volumetric flow rate are calculated based on the UK's memorandum on *Method of Calculating Chimney Heights*. A diesel fuel oil with 0.5 % sulphur content has been assumed[4]. The emission factor of nitrogen dioxide is based on AP42[5]. As the diesel fuel contains low nitrogen content, the emission factor of 0.0024 kg/litre has been used. It is assumed that 30% of nitrogen oxides emitted are NO_2. For the boiler diesel oil, the emission factor of SO_2 is based on AP42.

(iv) The pollutants do not react chemically. There is instantaneous and perfect mixing of the air within the Study Area.

(v) Based on the USEPA's guidelines published in Section 8.2.8 of the Guideline on Air Quality Models (Revised), the rural dispersion mode has been used for modelling the chimney emissions.

(vi) No building downwash analysis has been made. Gradual plume rise mode has been applied.

(vii) The Study Area has been covered by twelve domains. The domain is divided into a 15 x-grids and 16 y-grids with equal grid spacing of 100 m.

4 Hong Kong Government, 1990: *Hong Kong Planning Standard and Guidelines, Chapter 9.*

5 United States Environmental Protection Agency, 1995: *Compilation of Air Pollution Emission Factors, Volume 1, Stationary Point and Area Sources* (AP/42). (Table 1.3-1 Criteria Pollutant Emission Factors for Uncontrolled Fuel Oil Combustion)

(viii) The assessment has been based on 1998 sequential meteorological data from the stations at Shatin. The station contains the hourly wind direction, wind speed, stability and temperature.

(ix) The background value of NO_2 is based on the modelling results of CTS-3 report under the high growth scenario and that of SO_2 is based on the concentrations at Shatin EPD station (2000). The average concentrations of NO_2 and SO_2 are 52.4 and 18.0 $\mu g/m^3$ respectively.

(x) The emission rates of SO_2 and NO_2 calculated based on the above assumptions are constant over time.

4.7.21 The emission rates of SO_2 and NO_2 calculated based on the above assumptions are listed in Table D5 and D6 of Annex D.

Industrial Emission (SO_2 and NO_2)

4.7.22 Figures 4.7 to 4.9 show the maximum hourly concentration levels of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) at pedestrian level. There are no black spots where there is likelihood of exceeding Air Quality Objectives of SO_2 and NO_2 found within the Study Area. It is expected that concentration levels of SO_2 and NO_2 at the pedestrian level will be within the AQO limit.

4.7.23 Representative air sensitive receivers at the Study Area have been evaluated and shown in Table D7 of Annex D. For future high-rise residential developments within the Project, different heights of the ASRs have been selected, namely pedestrian level, 1st floor, 5th floor and every 10th floor up to the each proposed top floor. The modelling results show that all the predicted air pollutant concentrations at the ASRs are below the AQOs. Therefore, the buffer distances among the chimneys and the Project are sufficient to protect the proposed residential developments from industrial emission of surrounding chimneys.

Cumulative Impact Assessment

4.7.24 The cumulative impact for SO_2 is mainly generated from the chimneys and has been assessed to be below the AQOs. The cumulative impact for RSP is mainly generated from the traffic and has been assessed to be below the AQOs.

4.7.25 The cumulative impact for NO_2 is generated from the chimneys and the traffic. The major contribution to the cumulative NO_2 level is from the traffic. The predicted cumulative NO_2 levels are shown in Table D8 of Annex D. Generally, the predicted cumulative NO_2 concentration at pedestrian level is higher than that of upper evaluation. Therefore, pedestrian level is expected to be the worst affected level from

vehicular and industrial emission pollution in terms of NO_2 concentration. Figures 4.10 and 4.11 show the predicted cumulative hourly and daily NO_2 concentration at the pedestrian level (worst level). It is expected that there will be no exceedance of the AQOs found within the residential development areas of Project.

4.8 Conclusion

Construction Dust - Impacts

4.8.1 The construction dust impact assessment has identified Air Sensitive Receivers (ASRs) within the Study Area and the works with the potential to generate substantial dust have been identified.

4.8.2 Site formation and haul road traffic would potentially be the main causes of construction dust impact. With adequate dust suppression measures, dust levels from the Project will not exceed the Air Quality Objectives (AQOs) at nearby ASRs.

4.8.3 Mitigation measures such as watering of exposed areas or pavement of haulage route have been proposed to suppress dust generation. With the implementation of the recommended mitigation backed up by an EM&A programme, the Project should comply with the AQOs.

Operational Air Quality - Impacts

4.8.4 Assessment of the vehicular emission due to the major roads shows that the proposed buffer areas adjacent to the major traffic corridors such as Road T7, Sai Sha Road and proposed local roads are adequate. The predicted air pollutant concentrations at all the air sensitive receivers due to vehicular emission will comply with the AQOs. No mitigation measure will be required.

4.8.5 The air quality due to the chimney emissions within the vicinity of the Study Area will comply with the AQOs. Tai Po Industrial Estate will have minor impact on the Project. The predicted air pollutant concentrations at all the air sensitive receivers from industrial emission will comply with the AQOs.

4.8.6 Assessment of cumulative effect from traffic emission and industrial emission shows that the air quality within Study Area is acceptable and below the AQOs.

4.8.7 The air quality associated with the proposed carparks is expected to be acceptable provided the design considerations stipulated in ProPECC PN2/96 – Control of Air Pollution in Car Parks are adhered to.