5 AIR QUALITY

5.1 INTRODUCTION

In this subsection the air quality impact of reclamation of CT10 and CT11 incorporating marine fill is discussed. The reclamation activities have a high potential to produce adverse impact on sensitive receivers within Pennys Bay and on the eastern side of the TCT peninsula in addition to the major residential population concentrations at Discovery Bay and Peng Chau. This subsection sets out the environmental context, identifies the relevant legislation and discusses the construction phase impacts and mitigation.

Air quality impacts of reclamation activities are primarily concerned with dust emissions arising from: haulage truck movements on unpaved roads, tipping of fill material from trucks to reclamation, surcharge handling and wind erosion of open site area. In this case, dust is used as a generic term for total suspended particulates (TSP) and respirable suspended particulates (RSP).

Given the levels of activity and the isolated and open nature of the site, vehicle exhaust emissions are not considered to offer significant air quality impact.

5.2 ENVIRONMENTAL LEGISLATION AND GUIDELINES

The Air Pollution Control Ordinance (APCO) (Cap. 311, 1983) provides authority for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites, and encompasses a number of Air Quality Objectives (AQO). Currently AQOs stipulate concentrations for sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and total and respirable suspended particulates (TSP/RSP) in ambient air over the Territory, listed in Table 5.1.

Table 5.1 Hong Kong Air Quality Objectives (AQOs)

Parameter	Maximum Average Concentration $\mu g/m^3$			
	1-Hour*	8-Hour	24-Hour**	Annual
SO_2	800	--	350	80
CO	30000	10000	--	--
NO_2	300	--	150	80
TSP	500***	--	260	80
RSP	--	--	180	55

* Not to be exceeded more than three times per year

** Not to be exceeded more than once per year

*** In addition to the above established legislative controls, it is generally accepted that an hourly average TSP concentration of 500 $\mu g/m^3$ should not be exceeded. Such a control limit is particularly relevant to construction work and has been imposed on a number of construction projects in Hong Kong in the form of contract clauses.

5.3 BACKGROUND MONITORING

The LAPH studies has conducted baseline air quality monitoring between 14 November 1991 and 18 December 1991. During this period ambient concentrations of sulphur dioxide (SO_2), oxides of nitrogen (NO/NO_2), total suspended particulates (TSP) and respirable suspended particulates (RSP) were measured at 2 strategic sites in Cheung Chau and Discovery Bay. No monitoring of CO was carried out. It was considered the parameters monitored were reflective of the traffic, industrial and construction activities at the monitoring sites. The monitoring results are reproduced in Tables 5.2 and 5.3. It was noted that all the measured pollutant concentrations met the pertinent Hong Kong Air Quality Objectives (AQO).

Table 5.2 Mean Measured Pollutant Concentrations at Cheung Chau Site

Pollutant	Arithmetic Mean ($\mu g/m^3$)	Geometric Mean ($\mu g/m^3$)	Standard Deviation
SO_2	8.3	--	12.0
NO	2.4	--	6.9
NO_2	28.4	--	20.9
TSP	--	73.0	--
RSP	--	57.6	--

Table 5.3 Mean Measured Pollutant Concentrations at Discovery Bay

Pollutant	Arithmetic Mean ($\mu g/m^3$)	Geometric Mean ($\mu g/m^3$)	Standard Deviation
SO_2	10	--	12.9
NO	3	--	10.5
NO_2	41	--	28.9
TSP	--	90.6	--
RSP	--	75	--

Table 5.4 Air Pollutant Concentrations Compared to Air Quality Objectives

Pollutant	Averaging Time	Air Quality Objective ($\mu g/m^3$)	Maximum ($\mu g/m^3$) at Cheung Chau	Maximum ($\mu g/m^3$) at Discovery Bay
SO_2	1 hr 24 hr	800 350	90 28	129 19
NO	1 hr 24 hr	-- --	69 12	98 13
NO_2	1 hr 24 hr	300 150	127 51	134 45
TSP	24 hr	260	119	134
RSP	24 hr	180	99	104

5.4 SENSITIVE RECEIVERS

The sensitive receivers of dust impacts are identified in Table 5.5 which follows:

Table 5.5 Locations of Sensitive Receivers

Sensitive Receivers	Locations
1	CLP Station
2	Penny's Bay Shipyard
3	Fa Peng
4	Tso Wan
5	Tsing Chau Tsai
6	Ma Wan
7	Peng Chau
8	Discovery Bay

Predicted air quality at the SR locations of Pennys Bay Shipyard and the CLP Station are considered indicative of likely impacts experienced by planned developments in Pennys Bay area. The sensitive receivers are identified in Figure 5.1

5.5 ASSESSMENT METHODOLOGY

Air quality computer simulation modelling was undertaken using USEPA approved Fugitive Dust Model (FDM) dispersion model to assess potential dust impacts from the reclamation activities. This model was used in preference to the originally proposed Industrial Source Complex (ISCST) model as it is specifically designed for estimation of impacts from fugitive dust sources using wind-dependent emission and advanced gradient-transfer deposition algorithms. This model was recommended by EPD for this type of study.

Concurrent construction of both container terminals 10 and 11 (CT10 & 11) was assumed in this assessment. Modelling was undertaken to establish TSP concentrations at sensitive receivers for 1-hour, 24-hour and annual average time periods, based on wind speed and direction data from the Shell Tsing Yi Installation weather station (Jan 1990 to Dec 1992) which represented the closest weather station to the study site. These were combined with surface observations recorded at the Royal Observatory to obtain the best available data set.

Dust Emissions

The major pollutant emission of concern from reclamation activities is particulate matter. Vehicle and plant exhaust emissions from the site are not considered to constitute a significant source of air pollutants.

The CT10 and CT11 reclamations, including the terminals and the backup areas, will be filled strip by strip according to the sand-fill summary programmes. Placing of material will be done by rainbowing of sand-fill material (approximately 50 percent water). Surcharging and removal of surcharge material will be done by land-based machinery and haulage trucks.

In the assessment, rainbowing of "semi-liquid" material was not considered to be a dust generating activity. Emission points for dust release from reclamation activities included the following:

- Loading of trucks from excavators
- End-tipping of surcharge material from trucks
- Bulldozing surcharge material
- Truck travel on dusty roads
- Wind erosion of stockpiles and open site

The estimation of dust emissions was based on typical values and emission factors from USEPA *AP-42*. Marine sand silt content was taken as 3.5 percent, which is the average of the marine fill in ten reclamation sites in Hong Kong. Unpaved site road surface material silt content was taken as 5 percent; this was based on the results of a particle size analysis of samples of typical site road surface material.

In this assessment, dust suppression measures and the estimated mitigation efficiencies have been incorporated into the dust emission calculations. The mean vehicle speed of the haulage trucks within the site area would be reduced to 15 $kmhr^{-1}$ by speed control. A 50 percent reduction of the dust generated from wind erosion and vehicle movements on dusty roads would result from twice daily watering with complete coverage of all site roads and open site area as from *AP-42*.

Assessment was done by considering the emissions due to surcharging, removal of surcharge and site erosion from each strip and the entrustment area of each terminal at different stages of the project according to the programmes. Emission from site erosion was only considered for the active operating unpaved site area.

Dispersion Modelling

Air dispersion modelling was undertaken using USEPA approved Fugitive Dust Model (FDM) to assess potential impacts from the reclamation activities. Wind-dependent emission from fugitive dust sources and advanced gradient-transfer deposition algorithm

have been incorporated in the model. Modelling was undertaken to establish TSP concentrations at sensitive receivers for 1-hour, 24-hour and annual average time periods.

Particle size distributions assumed in the modelling composed of 10% RSP fraction and consisted of five separate particle size classes : 0-2.5, 2.5-5, 5-10, 10-20, 20-30 micrometers which contributed to fractions of 0.0198, 0.0289, 0.0513, 0.1609 and 0.7392 respectively. Wind speed and direction data for the year 1991 from the Shell Tsing Yi Installation meteorological station, which represents the closest meteorological station to the study site, were combined with surface observations recorded at the Royal Observatory to obtain the best available data set. Wind speed used in the modelling was adjusted to the level of the reclamations.

Screening calculations were undertaken to determine the impacts at the sensitive receivers by adding the maximum impacts due to different strips/area of the reclamations at different stages of the project. For annual and 24-hour average time periods, results of screening calculations were effective to represent the situation at the sensitive receivers.

For 1-hour average time period, detailed assessment was undertaken by modelling all the possible emissions on the reclamations at once. By considering the results of screening calculations, period of 12 months (from January 1998 to December 1998) of maximum reclamation activities was chosen for detailed assessment. Detailed modelling of the months February 1998, April 1998, June 1998, August 1998, October 1998 and December 1998 were undertaken and maximum 1-hour average TSP concentrations at the sensitive receivers were predicted.

No specific assessment was undertaken to calculate RSP concentrations. It is normally assumed that RSP generation is approximately 10 percent of the TSP, and this is acceptable to EPD.

5.6 IMPACT ON RECEIVERS

The maximum 1-hour, 24-hour and annual average TSP levels at the sensitive receivers during the period of reclamation are tabulated in Table 5.6. No background dust concentration was incorporated in the calculations as background information for Pennys Bay was not available. All the predicted TSP levels are solely due to the activities of CT10 & 11 reclamations, including the terminals and the backup areas.

Modelling results indicate that there would not be exceedance of the 1-hour average TSP guideline level and the 24-hour and annual average TSP AQOs at all the sensitive receivers. Nevertheless, cumulative dust impacts at the sensitive receivers could only be predicted by incorporating the background dust concentration and other dust generating activities within Penny's Bay in the models.

RSP concentrations in the area are unlikely to be high in view of the fact that particulate matter produced in reclamation activities with sand-fill material is usually of relatively large particle size.

Table 5.6 Predicted Maximum TSP Concentration at Sensitive Receivers During Period of Reclamation (μgm^{-3})

Receiver	1-hour Average	24-hour Average	Annual Average
Air Quality Objective	500	260	80
CLP	218	157	28
Pennys Bay	94	70	13
Fa Peng	220	127	18
Tso Wan	143	70	9
Tsing Chau Tsai	92	42	5
Ma Wan	73	23	3
Peng Chau	84	26	1
Discovery Bay	126	19	2

Control and Mitigation

The modelling shows that the reclamation activities will cause elevated dust levels at closest sensitive receivers, mitigation should therefore be adopted by the contractor to minimise dust generation.

A commitment to adopt good operational practices for dust minimisation by the contractor will minimise the dust nuisance. A number of practical measures are listed below:

- Areas of reclamation should be completed, including final compaction, as quickly as possible consistent with good practice to limit the creation of wind blown dust.
- All exposed site area and haul roads should be watered and cleaned regularly, at least twice daily with complete coverage, particularly during dry weather.
- Frequently used site roads should be watered on a regular basis.
- Vehicles should use wheel wash facilities or should be hosed before leaving the site.
- Wind shield and dust extractor should be provided at the loading point.
- Water sprinkler should be used at the loading area.
- Open stockpiles should be avoided or covered.
- Speed controls for on-site vehicles should be applied and enforced. Average vehicle speed of 15 $kmhr^{-1}$ is recommended.

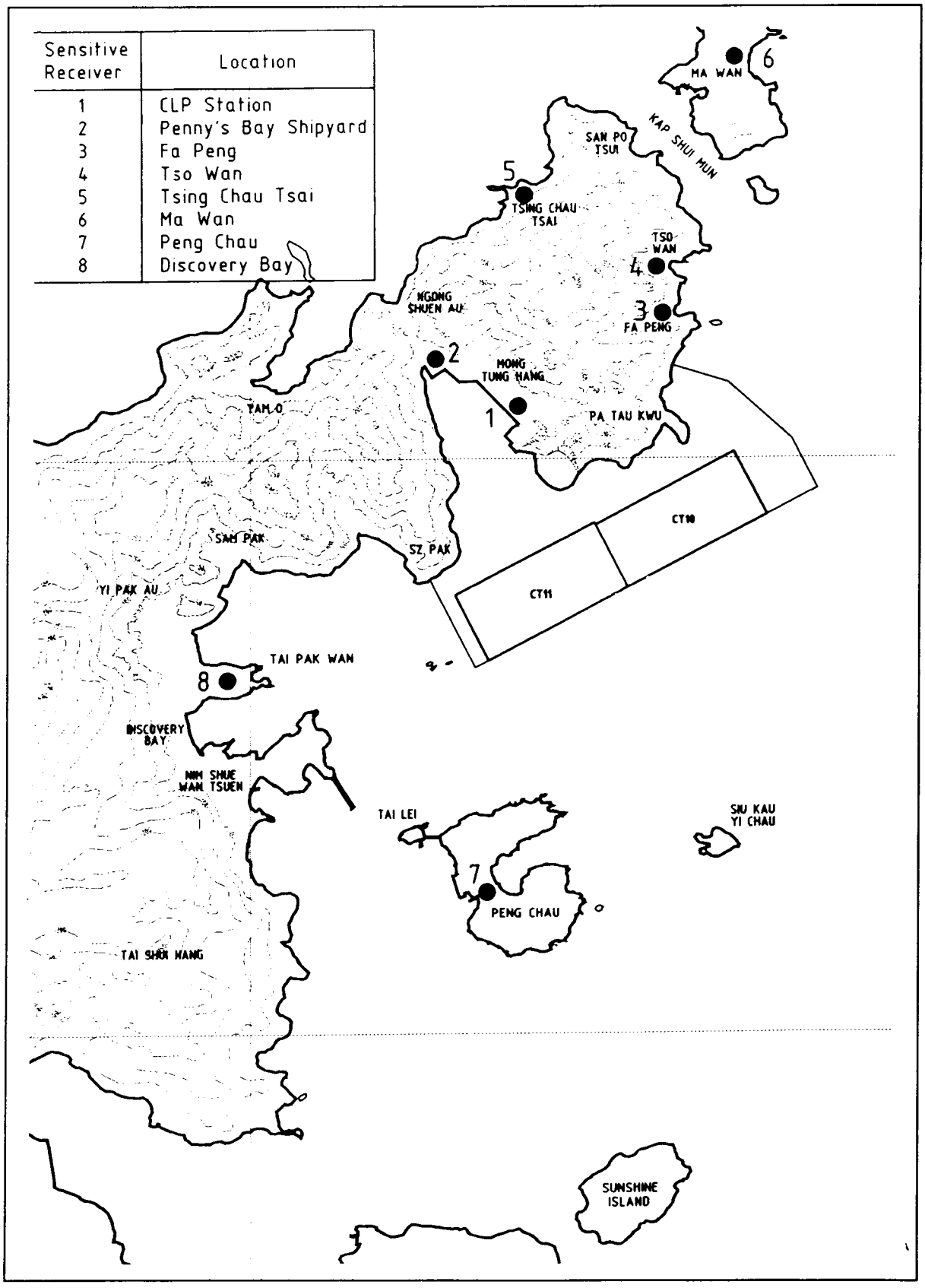

Figure 5.1 Air Quality Sensitive Receivers