6 AIR QUALITY IMPACT

6.1 Introduction

6.1.1 This section presents an air quality impact assessment for the construction and operational phases of the Kai Tak Development. Existing and planned air sensitive receivers in the vicinity of the study area are determined. Potential air quality impacts associated with the Project have been identified together with the proposed methodology for the respective impact assessments.

6.2 Environmental Legislation, Policies, Plans, Standards and Criteria

6.2.1 The criteria for evaluating air quality impacts and the guidelines for air quality impact assessment are set out in Annex 4 and Annex 12 of the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM).

Air Quality Objectives and EIAO-TM

6.2.2 The Air Pollution Control Ordinance (APCO) provides the statutory authority for controlling air pollutants from a variety of sources. The Hong Kong Air Quality Objectives (AQOs), which must be satisfied, stipulate the maximum allowable concentrations over specific periods for typical pollutants. The relevant AQOs are listed in **Table 6.1**.

Table 6.1 Hong Kong Air Quality Objectives

Pollutant	Maximum Concentration (µg m^{-3}) (1)			
	Averaging Time			
	1 hour (2)	8 hour (3)	24 hour (3)	Annual (4)
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates (RSP) (5)	-	-	180	55
Sulphur Dioxide (SO_2)	800	-	350	80
Nitrogen Dioxide (NO_2)	300	-	150	80
Carbon Monoxide (CO)	30,000	10,000	-	-
Photochemical Oxidants (as Ozone, O_3) (6)	240	-	-	-

Notes:
(1) Measured at 298 K and 101.325 kPa.
(2) Not to be exceeded more than three times per year.
(3) Not to be exceeded more than once per year.
(4) Arithmetic mean.
(5) Suspended particulates in air with a nominal aerodynamic diameter of 10 µm or smaller.
(6) Photochemical oxidants are determined by measurement of ozone only.

6.2.3 The EIAO-TM stipulates that the hourly TSP level should not exceed 500 µgm^{-3} (measured at 25°C and one atmosphere) for construction dust impact assessment. Standard mitigation measures for construction sites are specified in the Air Pollution Control (Construction Dust) Regulation.

6.2.4 In accordance with the EIAO-TM, odour level at an air sensitive receiver should meet 5 odour units based on an averaging time of 5 seconds for odour prediction assessment.

Air Pollution Control (Construction Dust) Regulation

6.2.5 Notifiable and regulatory works are under the control of Air Pollution Control (Construction Dust) Regulation. Notifiable works are site formation, reclamation, demolition, foundation and superstructure construction for buildings and road construction. Regulatory works are building renovation, road opening and resurfacing slope stabilisation, and other activities including stockpiling, dusty material handling, excavation, concrete works, stockpiling, dusty material handling etc. This Project is expected to include both notifiable works and regulatory works. Contractors and site agents are required to inform the Environmental Protection Department (EPD) on carrying out construction works and to adopt dust reduction measures to reduce dust emission to the acceptable level.

6.3 Description of the Environment

6.3.1 The Project is located in the southeastern part of Kowloon Peninsula, comprising the apron and runway areas of the former Kai Tak Airport and existing waterfront areas at To Kwa Wan, Ma Tau Kok, Kowloon Bay, Kwun Tong and Cha Kwo Ling. It covers a land area of about 328 hectares. It also covers Kowloon Bay and Kwun Tong Typhoon Shelter and adjacent water bodies. There is no air quality monitoring station located in the study area. EPD's Sham Shui Po and Kwun Tong air quality monitoring stations are the nearest stations to the Project site. **Table 6.2** summarizes the annual average concentrations of the air pollutants recorded at these two monitoring stations in Year 2006.

Table 6.2 Annual Average Concentrations of Pollutants in Year 2006 at EPD's Sham Shui Po and Kwun Tong Air Quality Monitoring Stations

Pollutant	Annual Average AQO (μg m^{-3})	Year 2006 Annual Average Concentration (μg m^{-3})	
		Sham Shui Po station	Kwun Tong station
TSP	80	79	75
RSP	55	55	55
NO_2	80	67	61
SO_2	80	24	19

6.4 Air Quality Sensitive Receivers

6.4.1 In accordance with Annex 12 of the EIAO-TM, any domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping centre, place of public worship, library, court of law, sports stadium or performing arts centre are considered to be an air sensitive receiver (ASR). Any other place with which, in terms of duration or number of people affected, has a similar sensitivity to the air pollutants as the aforelisted places are also considered to be an ASR, for example, playground, sitting area of parks / promenade.

6.4.2 In accordance with Section 3.4.5.3 of the EIA Study Brief No. ESB-152/2006, the air quality impact assessment area is defined by a distance of 500m expanded from the boundary of the Project. The study areas of air quality impact assessment are shown in **Figure 3.1**.

6.4.3 The identified representative ASRs are listed in **Table 6.3** and the corresponding locations are shown in **Figure 3.1**. The assessment height taken for the construction dust impact assessment was 1.5m above ground in view of the fact that the majority of the dust emissions would be emitted from the ground level, 1.5m is the height of normal human breathing zone. For operational phase impact assessment, the assessment heights were taken as 1.5m, 5m, 10m, 15m, 20m above ground and so on up to the maximum building height of the respective ASR.

Table 6.3 Summary of Representative Air Sensitive Receivers

ASRs	District (1)	Location	Existing / Planned Land Use	Max. Building Height, m (2)	Distance to Project Boundary, m
A1	KT	Cha Kwo Ling Tusen	Residential	5	17
A2	KT	Cha Kwo Ling	Residential	15	17
A3	KT	Laguna City IV	Residential	81	26
A4	KT	Laguna Park	Recreation	1.5	40
A5	KT	Hoi Bun Industrial Centre	Industrial	42	9
A6	KT	Seapower Industrial Centre	Industrial	33	19
A7	KT	CAC Tower	Commercial	57	11
A8	KT	Bite Industrial Building	Industrial	30	12
A9	KT	Wharf T&T Square	Commercial	45	15
A10	KT	Hoi Bun Road Park	Recreation	1.5	27
A11	NTK	Kowloon Bay Factory Estate	Industrial	24	8
A12	NTK	Kowloon Bay Motor Vehicle Exam Centre	Industrial	6	45
A13	NTK	New Kowloon Bay Motor Vehicle Exam Centre	Industrial	3	14
A14	NTK	Kai Fok Industrial Centre	Industrial	24	38
A15	KB	Sing Tao Building	Commercial	30	45
A16	KB	WSD Kowloon Bay Pipe Yard	Industrial	1.5	16
A17	KB	Hong Kong International Trade & Exhibition Centre	Commercial	54	146
A18	KB	Hong Kong Bank New Treasury Building	Commercial	12	12
A19	KB	Electrical & Mechanical Services Department Headquarters	G/IC	21	105
A20	KB	Sino Industrial Plaza	Industrial	30	5
A21	KB	Skyline Tower	Commercial	117	11
A22	KB	Football field	Recreation	1.5	100
A23	KB	Kowloon Health Centre	G/IC	30	153
A24	KB	Bicycle Track Near Richland Garden	Recreation	1.5	40
A25	NCW	Richland Gardens Shopping Centre	Shopping Center	30	56
A26	NCW	Richland Gardens	Residential	99	60
A27	NCW	Kam Bik House, Choi Hung Estate	Residential	60	102
A28	NCW	Pik Hoi House, Choi Hung Estate	Residential	60	105
A29	NCW	Rhythm Garden	Residential	87	49
A30	SPK	Cognitio College	Educational	18	35
A31	SPK	Sir Robert Black Health Centre	Clinic	9	67
A32	SPK	Lee Kau Yan Memorial School	Educational	10	77
A33	SPK	Shek Ku Lung Road Playground	Recreation	1.5	50
A34	SPK	Regal Oriental Hotel	Hotel	42	56
A35	SPK	South Mansion	Residential	15	64
A36	SPK	Jenford Building	Residential	12	57
A37	KC	Sung Wong Toi Playground	Recreation	1.5	5
A38	KC	Sung Wong Toi Garden	Recreation	1.5	9
A39	TKW	Parc 22	Residential	33	16
A40	TKW	Sky Tower	Residential	141	5

ASRs	District (1)	Location	Existing / Planned Land Use	Max. Building Height, m (2)	Distance to Project Boundary, m
A41	TKW	Freder Centre	Industrial	153	3
A42	TKW	K K Industrial Building	Industrial	12	5
A43	TKW	HK Society for Blind hostel	Hostel	9	23
A44	TKW	Mok Cheong Street Residential District	Residential	18	22
A45	TKW	China Gas Company	Commercial	15	21
A46	TKW	Ming Lun Street Residential District	Residential	21	136
A47	TKW	Grand Waterfront	Residential	153	115
A48	TKW	Merit Industrial Center	Industrial	36	24
A49	TKW	Wei Chien Court	Residential	39	9
A51	TKW	United Daily	Industrial	48	28
A52	TKW	Holly Carpenter Primary School	Educational	18	41
A53	TKW	Oblate Father's Primary School	Educational	21	7
A54	TKW	Sui Ying Industrial Building	Industrial	33	9
A55	TKW	Fook Shing Industrial Building	Industrial	36	14
A56	TKW	Sunrise Villa	Residential	90	18
A57	TKW	Wing Kwong Street Residential District	Residential	21	17
A58	TKW	CCC Kei To Secondary School	Educational	24	0
A59	TKW	Po Leung Kuk Ngan Po Ling College	Educational	27	70
A60	HH	Sunrise Plaza	Residential	39	101
A61	HH	Peninsula Square	Commercial	69	68
A62	HH	A.P.B Centre	Industrial	1.5	15
A63	HH	DSD To Kwan Wan PTW Workshop	G/IC	27	21
PA1	KTD	Site 1A1 (Planned)	Residential	115	N/A
PA2	KTD	Site 1A1 (Planned)	Residential	115	N/A
PA3	KTD	Site 1A1 (Planned)	Residential	115	N/A
PA4	KTD	Site 1A1 (Planned)	Residential	115	N/A
PA5	KTD	Site 1A1 (Planned)	Residential	115	N/A
PA6	KTD	Site 1A2 (Planned)	Educational	40	N/A
PA7	KTD	Site 1A3 (Planned)	Educational	40	N/A
PA8	KTD	Site 1A4 (Planned)	Educational	40	N/A
PA9	KTD	Site 1B1 (Planned)	Residential	115	N/A
PA10	KTD	Site 1B1 (Planned)	Residential	115	N/A
PA11	KTD	Site 1B1 (Planned)	Residential	115	N/A
PA12	KTD	Site 1B1 (Planned)	Residential	115	N/A
PA13	KTD	Site 1B1 (Planned)	Residential	115	N/A
PA14	KTD	Site 1B1 (Planned)	Residential	115	N/A
PA15	KTD	Site 1B4 (Planned)	Educational	40	N/A
PA16	KTD	Site 1C1 (Planned)	G/IC	85	N/A
PA17	KTD	Site 1D2 (Planned)	Commercial	95	N/A
PA18	KTD	Site 1D3 (Planned)	G/IC	55	N/A
PA19	KTD	Site 1D4 (Planned)	G/IC	95	N/A
PA20	KTD	Site 1E1 (Planned)	G/IC	95	N/A
PA21	KTD	Site 1E1 (Planned)	G/IC	95	N/A
PA22	KTD	Site 1F1 (Planned)	Commercial	145	N/A
PA23	KTD	Site 1F2 (Planned)	Commercial	170	N/A
PA24	KTD	Site 1G2 (Planned)	G/IC	75	N/A
PA25	KTD	Site 1H1 (Planned)	Residential	105	N/A
PA26	KTD	Site 1H2 (Planned)	Residential	105	N/A
PA27	KTD	Site 1H3 (Planned)	Residential	105	N/A

ASRs	District (1)	Location	Existing / Planned Land Use	Max. Building Height, m (2)	Distance to Project Boundary, m
PA28	KTD	Site 1I1 (Planned)	Residential	95	N/A
PA29	KTD	Site 1I2 (Planned)	Residential	95	N/A
PA30	KTD	Site 1I3 (Planned)	Residential	95	N/A
PA31	KTD	Site 1J1 (Planned)	G/IC	55	N/A
PA32	KTD	Site 1J3 (Planned)	G/IC	25	N/A
PA33	KTD	Site 1K1 (Planned)	Residential	105	N/A
PA34	KTD	Site 1K2 (Planned)	Residential	105	N/A
PA35	KTD	Site 1K3 (Planned)	Residential	95	N/A
PA36	KTD	Site 1L1 (Planned)	Residential	95	N/A
PA37	KTD	Site 1L2 (Planned)	Residential	95	N/A
PA38	KTD	Site 1L3 (Planned)	Residential	95	N/A
PA39	KTD	Site 1L4 (Planned)	Residential	25	N/A
PA40	KTD	Site 1M1 (Planned)	Commercial	35	N/A
PA41	KTD	Site 1M1 (Planned)	Commercial	35	N/A
PA42	KTD	Site 1M2 (Planned)	Commercial	35	N/A
PA43	KTD	Site 2A1 (Planned)	G/IC	65	N/A
PA44	KTD	Site 2A2 (Planned)	G/IC	65	N/A
PA45	KTD	Site 2A3 (Planned)	G/IC	65	N/A
PA46	KTD	Site 2A4 (Planned)	G/IC	65	N/A
PA47	KTD	Site 2A5 (Planned)	G/IC	65	N/A
PA48	KTD	Site 2A6 (Planned)	G/IC	40	N/A
PA49	KTD	Site 2B1 (Planned)	Residential	105	N/A
PA50	KTD	Site 2B1 (Planned)	Residential	105	N/A
PA51	KTD	Site 2B2 (Planned)	Residential	95	N/A
PA52	KTD	Site 2B3 (Planned)	Residential	80	N/A
PA53	KTD	Site 2B4 (Planned)	Residential	80	N/A
PA54	KTD	Site 2B5 (Planned)	Residential	80	N/A
PA55	KTD	Site 2B6 (Planned)	Residential	80	N/A
PA56	KTD	Site 2D1 (Planned)	Recreation	40	N/A
PA57	KTD	Site 2D1 (Planned)	Recreation	40	N/A
PA58	KTD	Site 3C1 (Planned)	Hospital	55	N/A
PA59	KTD	Site 3C1 (Planned)	Hospital	55	N/A
PA60	KTD	Site 3C1 (Planned)	G/IC	55	N/A
PA61	KTD	Site 3C1 (Planned)	Hospital	55	N/A
PA62	KTD	Site 3D1 (Planned)	Commercial	95	N/A
PA63	KTD	Site 3D2 (Planned)	Commercial	95	N/A
PA64	KTD	Site 3D3 (Existing)/ Site 3D3 (Planned)	Industrial / Commercial	168/ 95	N/A
PA65	KTD	Site 3D4 (Planned)	Commercial	95	N/A
PA66	KTD	Site 3D4 (Planned)	Commercial	95	N/A
PA67	KTD	Site 4A1 (Planned)	Residential	60	N/A
PA68	KTD	Site 4A1 (Planned)	Residential	60	N/A
PA69	KTD	Site 4A2 (Planned)	Commercial	40	N/A
PA70	KTD	Site 4A3 (Planned)	Commercial	75	N/A
PA71	KTD	Site 4A (Planned)	Recreation	1.5	N/A
PA72	KTD	Site 4A (Planned)	Recreation	1.5	N/A
PA73	KTD	Site 4A (Planned)	Recreation	1.5	N/A
PA74	KTD	Site 4A (Planned)	Recreation	1.5	N/A
PA75	KTD	Site 4A (Planned)	Recreation	1.5	N/A
PA76	KTD	Site 4A (Planned)	Recreation	1.5	N/A
PA77	KTD	Site 4B1 (Planned)	Residential	50	N/A
PA78	KTD	Site 4B1 (Planned)	Residential	50	N/A
PA79	KTD	Site 4B2 (Planned)	Residential	50	N/A
PA80	KTD	Site 4B2 (Planned)	Residential	50	N/A
PA81	KTD	Site 4B3 (Planned)	Residential	60	N/A
PA82	KTD	Site 4B3 (Planned)	Residential	60	N/A
PA83	KTD	Site 4B4 (Planned)	Residential	50	N/A

ASRs	District (1)	Location	Existing / Planned Land Use	Max. Building Height, m (2)	Distance to Project Boundary, m
PA84	KTD	Site 4B4 (Planned)	Residential	50	N/A
PA85	KTD	Site 4B5 (Planned)	Residential	40	N/A
PA86	KTD	Site 4B5 (Planned)	Residential	40	N/A
PA87	KTD	Site 4B5 (Planned)	Residential	40	N/A
PA88	KTD	Site 4B5 (Planned)	Residential	40	N/A
PA89	KTD	Site 4C1 (Planned)	Commercial	40	N/A
PA90	KTD	Site 4C2 (Planned)	Commercial	50	N/A
PA91	KTD	Site 4C3 (Planned)	Commercial	40	N/A
PA92	KTD	Site 4C4 (Planned)	Commercial	40	N/A
PA93	KTD	Site 4C5 (Planned)	Commercial	40	N/A
PA94	KTD	Site 4D2 (Planned)	G/IC	1.5	N/A
PA95	KTD	Site 4D2 (Planned)	G/IC	1.5	N/A
PA96	KTD	Site 4D2 (Planned)	G/IC	1.5	N/A
PA97	KTD	Site 4D2 (Planned)	G/IC	1.5	N/A
PA98	KTD	Site 4D3 (Planned)	Commercial	30	N/A
PA99	KTD	Site 4D3 (Planned)	Commercial	30	N/A
PA100	KTD	Site 4D3 (Planned)	Commercial	30	N/A
PA101	KTD	Site 4D3 (Planned)	Commercial	30	N/A
PA102	KTD	Site 5A4 (Planned)	Residential	60	N/A
PA103	KTD	Site 5A4 (Planned)	Residential	105	N/A
PA104	KTD	Site 3B1 (Planned)	Undesignated	40	N/A
PA105	KTD	Site 3B2 (Planned)	Undesignated	40	N/A
PA106	KTD	Site 3B3 (Planned)	Undesignated	40	N/A
PA107	KTD	Site 3B4 (Planned)	Undesignated	40	N/A
PA108	KTD	Site 4D2 (Planned) Tourism node	Other Specified Uses	95	N/A
PA109	KTD	Site 4D2 (Planned) Tourism node	Other Specified Uses	95	N/A
PA110	KTD	Site 4D2 (Planned) Tourism node	Other Specified Uses	95	N/A
PA111	KTD	Site 4D2 (Planned) Tourism node	Other Specified Uses	95	N/A
PA112	KTD	Site 4D2 (Planned) Tourism node	Other Specified Uses	95	N/A
PA113	KTD	Site 4D2 (Planned) Tourism node	Other Specified Uses	95	N/A

Note: (1) KT – Kwun Tong; NTK – Ngau Tau Kok; KB – Kowloon Bay; NCW – Ngau Chi Wah; SPK – San Po Kong; KC – Kowloon City, TKW – To Kwa Wan; HH – Hung Hom; KTD – Kai Tak Development

(2) The maximum height for Planned ASR was made reference to the RODP.

6.4.4 A number of representative planned and existing ASRs located in close proximity to the Kai Tak Nullah (KTN), Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS) were selected for the purpose of odour impact assessment. The selected ASRs are listed in **Table 6.4** below and shown in **Figure 6.1**. The major odour emission sources of concern in this assessment are KTN, KTAC and KTTS, which are area sources near ground level. Therefore, worst-case odour impacts would also be expected near ground level. The assessment heights at the ASRs were taken as 1.5m above local ground level to represent the height of normal breathing zone of human. In addition, the odour impacts at assessment heights of 10m, 20m and 30m above local ground level at the ASRs were also examined in the odour impact assessment.

Table 6.4 Representative ASRs selected for Odour Impact Assessment

ASR ID	Description	Region
OA1	Planned stadium, site2D	North apron area of Kai Tak Development
OA2	Planned residential site 1L3	
OA3	Existing EMSD Headquarters, site 1N	
OA4	Planned government site 3B1	South apron area of Kai Tak Development
OA5	Planned government site 3B2	
OA6	Planned government site 3B3	
OA7	Planned government site 3B4	
OA8	Planned hospital site	
OA9	Planned hospital site	
OA10	Planned district open space, site 3E2	
OA11	Planned commercial site 3D4	
OA12	Existing World Trade Square	Existing Kwun Tong area
OA13	Existing Kwong Sang Hong Building	
OA14	Existing Seapower Industrial Centre	
OA15	Planned Runway Park, site 4D1	Runway area of Kai Tak Development
OA16	Planned Runway Park, site 4D1	
OA17	Planned Runway Park, site 4D1	
OA18	Planned tourism node, site 4D1	
OA19	Planned cruise terminal building, site 4D3	
OA20	Planned cruise terminal building, site 4D3	
OA21	Planned cruise terminal building, site4D3	
OA22	Planned local open space, site 4B5	Runway area of Kai Tak Development
OA23	Planned residential site 4B5	
OA24	Planned residential site 4B4	
OA25	Planned residential site 4B3	
OA26	Planned residential site 4B2	
OA27	Planned residential site 4B1	
OA28	Planned residential site 4A1	
OA29	Planned commercial site 4A3	
OA30	Planned regional open space, site 4A	
OA31	Planned regional open space, site 4A	
OA32	Planned regional open space, site 4A	
OA33	Planned Site 1L4	North apron area of Kai Tak Development
OA34	Planned government site 1J3	
OA35	Planned Site 1L1	
OA36	Planned Site 1I3	
OA37	Planned Site 1K1	
OA38	Planned Site 1H3	
OA39	Planned Site 1M1	
OA40	Planned Site 1M2	
OA41	Existing Lee Kau Yan Memorial School	Existing Kowloon City Area
OA42	Existing Sir Robert Black Health Centre	

6.5 Assessment Methodology

CONSTRUCTION PHASE (CONSTRUCTION DUST)

6.5.1 Fugitive Dust Model (FDM) was used to assess the potential dust impact from the construction works. Dust emission was predicted based on emission factors from USEPA Compilation of Air Pollution Emission Factors (AP-42), 5th Edition. The major construction activities for the Project, which would be potential sources of construction dust in the Study Area, include soil excavation activities at work site and wind erosion of open site. **Table 6.5** gives the relevant clauses in AP-42 for emission factors adopted in this assessment. The detailed calculations of emission rates are presented in **Appendix 3.1**.

Table 6.5 Emission Factors for Construction Activities

Construction Activities	Emission Rate ($g/m^2/s$)	Remark
All construction work	E = 1.49684E-05	- 50% of works area with active dust emitting construction activities - 87.5% reduction by water suppression (watering eight times a day) - USEPA AP-42 5th ED., S.13.2.3.3
Barging point serving the Development at Anderson Road Project	E = 2.04236E-05	- USEPA AP-42 5th ED., S. 13.2.4 - Information for emission rate calculation was provided by Anderson Road Project Engineer - 75% reduction by water suppression for each unloading
Wind erosion for all construction work (including barging point)	E = 1.34767E-06	- 50% of works area with active construction activities - AP-42 5th ED., S.11.9 Table 11.9.4

6.5.2 The Air Pollution Control (Construction Dust) Regulation specifies that dust suppression measures such as watering should be applied for the construction site. Dust emission from the site would be reduced by 87.5% if watering with complete coverage of active construction area eight times a day. This assumption was adopted in the construction dust impact assessment.

6.5.3 For the purpose of this assessment, 12 working hours per day (08:00-18:00) and 26 working days per month were assumed for the dusty construction works in the assessment. Wind erosion of open work sites would take place over the whole day.

6.5.4 Based on the construction programme (**Appendix 2.2**), the early population intake at Sites1A1 & 1B1 and Phase 1 Berth of the cruise terminal would be around late 2012 and second quarter of 2013 respectively. Two worst-case scenarios namely before and after the early population intake period of late 2012 / mid 2013 have been examined in the construction dust impact assessment. The construction activities under the two scenarios are detailed in **Table 6.6**. The scenarios presented are considered to be representative of the worst case situation. The figures showing locations of dusty construction site areas for each scenario are presented in **Appendix 3.1**. For construction of electricity substation, footbridge and subway enhancement, most of the works would involve superstructure construction and concreting works which are not dusty construction activities. Therefore, construction of electricity substation, footbridge and subway enhancement were not included in the model run. The construction activity for Package C is bioremediation treatment of sediment at Kai Tak Approach Channel which are mostly marine-based with no dusty activities, thus fugitive dust impact is not anticipated.

Table 6.6 Major Dust Generating Activities in the Worst Case Scenarios during Construction Phase

Activities	Period	
	Mid 2009 to Mid 2013	Mid 2013 to Late 2016
	Scenario 1	Scenario 2
Package A - Cruise Terminal Development (Phase 1 Berth), related advance works and Runway Park		
Phase 1 Berth	✓	
Road TD3, TD4, L14 and minor road works in Kowloon Bay	✓	
Modification off Taxiway Bridge	✓	
Pumping Station PS6	✓	
Fireboat Berth	✓	
Runway Park	✓	
Package B - Infrastructure works at North Apron, Phase 1 - Housing Sites and Government Offices		
Construction of Road D1 (part)	✓	
Local Roads L2, L3, L15 and associated footpaths at North Apron	✓	
Local Roads L4 & L5	✓	✓
Construction of Box Culvert (2.5m x 2.5m)	✓	
Construction of Box Culvert (3m x 2.8m)	✓	
Construction of Pumping Station PS1A	✓	✓
Construction of Road D1		✓
Construction of Road D2 (part)		✓
Construction of Road L1	✓	✓
Construction of Road L2 & L11 (part)		✓
Construction of Road L4 (Part) & L5		✓
Construction of Slip Road S7 & S8 of CKR/T2 Interchange		✓
Construction of Box Culvert (5m x 2.5m)	✓	✓
Upgrading of Pumping Station PS1	✓	✓
Package D - Kai Tak Nullah modification works		
Rebuild Kai Tak Nullah	✓	✓
Construction of DSD's Desilting Compounds at Kai Tak Nullah	✓	✓
Package E - Infrastructure works at runway and Metro Park		
600m Wide Opening in Runway	✓	✓
Construction of Road D3 (near at Metro Park)		✓
Construction of Road L12 & L13		✓

Activities	Period	
	Mid 2009 to Mid 2013	Mid 2013 to Late 2016
	Scenario 1	Scenario 2
Conversion of TD3 into D3 with Street Lighting/ Landscaping Works(include Road L14)	✓	✓
Conversion of TD4 into D4		✓
Elevated Landscape Deck above Road D3	✓	✓
Package F - Infrastructure works at North Apron, Phase 2		
Construction of Road D1, L7, L8, L9 & L16		✓
Construction of Drainage Culvert (2.5x2.5m)	✓	✓
Construction of Drainage Culvert (4x3m)	✓	✓
Construction of Drainage Culvert (5x4m)	✓	✓
Construction of Road D2, D3, L6, L17 & L19		✓
Pumping Station PS2		✓
Pumping Station NPS		✓
Upgrading of Pumping Station PS3	✓	✓
Stadium Complex		✓
Package G - Trunk Road T2 and infrastructure works at South Apron		
Construction of Trunk Road T2, Local Roads L10, L18 and associated footpaths at South Apron	✓	✓
Cut and Cover Section of T2	✓	✓
Kwun Tong Transportation Link	✓	✓
Other concurrent projects		
SCL Construction	✓	✓
CKR Construction	✓	✓
Anderson Road Project	✓	✓

6.5.5 The impact of fugitive dust sources on air quality depends upon the quantity as well as the drift potential of the dust particles emitted into the atmosphere. Large dust particles (i.e. over 100 μm in diameter) will settle out near the source and particles that are between 30 and 100 μm in diameter are likely to undergo impeded settling. The main dust impacts are likely to arise from particles less than 30 μm in diameter, which have a greater potential to disperse over greater distances.

6.5.6 According to the Table of Aerodynamic Particle Size Multiplier for Equation 1 stated in S13.2.4.3 of USEPA AP-42, construction dust particles may be grouped into five particle size classes. Their size ranges are 0 – 2.5 μm, 2.5 – 5 μm, 5 – 10 μm, 10 – 15 μm and 15 – 30 μm, and the percentage of particles in each class was estimated to be 7%, 20%, 20%, 18% and 35%, respectively.

6.5.7 One year sequential meteorological data for the year 2006 from the South East Kowloon Weather Station were used to predict the 1-hour and 24-hour average TSP concentrations at representative discrete ASRs close to the construction works. As South East Kowloon Weather Station does not record temperature data, the ambient temperature data at the King's Park Weather Station were adopted. Since the construction activities would be undertaken at ground level, the worst dust impact on the ASRs would be at the ground floor of the ASRs. The height of 1.5m above ground, which is the breathing level of human, was adopted for construction dust impact assessment.

6.5.8 The background pollutant values adopted for this assessment are derived based on EPD's "Guideline on Assessing the 'TOTAL' Air Quality Impacts". The annual average concentrations of the pollutants measured at EPD's Sham Shui Po and Kwun Tong air quality monitoring stations in the latest five years (Year 2002 to 2006) are adopted as the background air quality as their locations are within and adjacent to the Project area. As most of the monitoring data in Year 2002 at Kwun Tong air quality station was missing, therefore the data of Year 2002 recorded at this station has not been taken into account in the calculation of background concentration. The five years TSP average monitoring data recorded at EPD's Kwun Tong and Sham Shui Po air quality monitoring stations are 78$\mu g/m^3$ and 79$\mu g/m^3$ respectively. For this assessment, 79$\mu g/m^3$ was taken as the TSP background concentration.

OPERATIONAL PHASE (GENERAL AIR QUALITY)

6.5.9 Potential air quality impacts during the operational phase of the Project would be associated with the following pollution sources.

- Background pollutant concentrations based on five years averaged monitoring data from EPD monitoring stations at Sham Shui Po and Kwun Tong;
- Vehicle emissions from open sections of existing and proposed road networks in KTD and roads within 500m from the project site boundary;
- Portal emissions from Road T2 Tunnel, proposed Road L1 tunnel, decked Road D2, tunnel section of Tseung Kwan O – Lam Tin Tunnel (near TKO/T2 interface), existing Kai Tak Tunnel and existing Eastern Harbour Crossing Tunnel (EHC) portal;
- Emissions from idling traffic at the toll plaza of EHC near Yau Tong
- Ventilation building emissions from Road T2 Tunnel, planned Central Kowloon Route (CKR), existing Kai Tak Tunnel and existing EHC;
- All industrial chimneys within 500m from the Project boundary;
- Emission from the proposed hospital within KTD;
- Cruise ship emissions from the proposed cruise terminal at Kai Tak;
- Emission from existing Typhoon Shelters;
- Emission from Sai Tso Wan Landfill; and
- Planned heliport emission at the end of runway.

Background Pollutant Concentrations

6.5.10 The background pollutant values adopted for this assessment are derived based on EPD's "Guideline on Assessing the 'TOTAL' Air Quality Impacts". The annual average concentrations of the pollutants measured at EPD's Sham Shui Po and Kwun Tong air quality monitoring stations in the latest five years (Year 2002 to 2006) are adopted as the background air quality as their locations are within and adjacent to the Project area. As most of the monitoring data in Year 2002 at Kwun Tong air quality station was missing, therefore the data of Year 2002 recorded at this station has not been taken into account in the calculation of background concentration. **Table 6.7** summarises the annual average concentrations of the pollutants (NO_2, RSP and SO_2) recorded at the two monitoring stations. For the purpose of this assessment, RSP, NO_2 and SO_2 concentration of 57, 67 and 24 $\mu g/m^3$ respectively are taken as background concentration for the operational phase assessment.

Table 6.7 Annual Average Concentrations of Pollutants in the Latest Five Years at Sham Shui Po and Kwun Tong Air Quality Monitoring Stations

Pollutant	Annual Average Concentration in Latest Five Years (2002-2006) ($\mu g\ m^{-3}$)	
	Sham Shui Po station	Kwun Tong station
RSP	55	57
NO_2	67	63
SO_2	24	19

Vehicle Emissions from Open Road, Portals and Ventilation Shafts

6.5.11 The CALINE4 and the ISCST3 dispersion models were used for the prediction of the 1-hour average NO_2, 24-hour average NO_2, and 24-hour average RSP concentrations. The predicted highest peak hour traffic flows and vehicle mixes for the road network within the next 15 years upon commencement of operation of the proposed road network at Year 2016 were taken to assess the worst-case air quality impacts. For the Kwun Tong Transportation Link (KTTL), the capacity traffic flow was assumed for conservative assessment. It is noted that some of planned land use such as Sites 1A, 1B, 1D4, 1J1 3C2 & 4D3 will be occupied prior to Year 2016 say around 2012. With reference to the Hong Kong Planning Standard and Guideline (HKPSG), the recommended buffer distance are at least 5m for local distributor road and 10m for district distributor road. The minimum buffer distance between the road and the site boundary of above mentioned site is 10m which is fulfil the HKPSG's recommendation. Adverse the vehicular impact for Sites 1A, 1B, 1D4, 1J1 3C2 & 4D3 when occupied prior to Year 2016 is not anticipated. Therefore, the adoption of the traffic forecast within the next 15 years upon commencement of operation of all road networks (i.e. next 15 years upon Year 2016) would be a conservative approach to represent the worst case scenario. Details of the emission calculations and assessment methodology are presented in **Section 3.2** of this report.

Chimney Emissions from Nearby Industrial Areas

6.5.12 The Industrial Source Complex Short Term (ISCST3) dispersion model was used to predict the chimney emissions. Since the inventory of industrial chimneys cannot be obtained from EPD, it is extracted from the previous approved EIA report of SEKDCFS and verified by site survey. For the Ma Tau Kok Gas Works North Plant, the emissions data made reference to the information presented in the latest Specified Process License of the Gas Works. The emission rate for those new chimneys not listed in the SEKDCFS EIA report, the averaged fuel consumption for those valid chimneys was adopted to assess the impacts from the industrial chimney emissions on the ASRs within the Project area. The detailed emission inventory is presented in **Appendix 6.1**.

Emission from Proposed Hospital within KTD

6.5.13 A hospital is proposed at the Area 3C in KTD. The emission impact from the chimney of the hospital was modelled as point source by employing the ISCST3 model.

6.5.14 Based on recent checking with the relevant parties, no detailed information for the proposed hospital is available. The following emission factor and chimney diameter as adopted in the approved EIA report of SEKDCFS were therefore taken in this assessment:

- Height of Chimney : 60m
- Fuel consumption : 600 L/hr
- Exit Velocity : 6m/s
- Temperature : 298K
- Diameter of Chimney : 0.5m

Emission from Proposed Heliport

6.5.15 A heliport is proposed at the end of runway. The emission impact from the heliport was modelled as point source by employing the ISCST3 model.

6.5.16 As there is no detailed information for the proposed heliport at the time of carrying out of this EIA, the following emission factor and parameters as adopted in the approved EIA report of Expansion of Heliport Facilities at Macau Ferry Terminal (HFMFT) (Register No.: AEIAR-095/2006) were taken in this assessment:

- NO_2 Emission Rate : based on the HFMFT EIA Report (Register No.: AEIAR-095/2006)
- SO_2 & RSP Emission Rate : Helicopter Safety Advisory Conference (HSAC) 2001. Helicopter safety advisory conference (HSAC) Gulf of Mexico offshore helicopter operations and safety review
- Flight frequency : Assume 4 flight/hr for both daytime and nighttime as a worst case scenario.

6.5.17 The emission rates adopted in this assessment are presented in **Table 6.8** and the detailed of the emission calculations are presented in **Appendix 6.2**.

Table 6.8 Emission Factor for of Twin Engine T58-GE-8F

Helicopter Mode	NO_x (lb/min)	SO_2 (lb/min)	RSP (lb/min)
Approach (Approach + Hovering to Landing)	0.098	0.011	0.027
Idling	0.006	0.002	0.003
Takeoff (Hovering to Take Off + Take Off)	0.143	0.014	0.027

Cruise Ship Emissions from the Proposed Cruise Terminal at Kai Tak

6.5.18 A two-berth cruise terminal is proposed at the south west tip of the former Kai Tak runway. The major sources of cruise emission would be expected during manoeuvring and hotelling. The cruise emission impact was considered in this assessment.

6.5.19 For the purpose of this assessment, it is assumed that for each of the two berths within a 24 hour period in a day, the cruise vessel will perform the following movements:

(i) Berthing at the cruise terminal (for a period of 1 hour):

For the purpose of this assessment, berthing include all the manoeuvring motions of the cruise vessel from the navigation channel to near the cruise terminal (for a period of 15 minutes), final manoeuvring around the berth (for a period of 15 minutes) and 30 minutes hotelling before connecting to / after disconnecting from the on-shore power supply if required. It is assumed that the berthing of two cruise vessels will not happen concurrently. Based on the vessel track simulation results, the entire manoeuvring motions of cruise vessels between the navigation channel and the berth would be completed within 30 minutes including the necessary turn and berth motions. Besides, with reference to a literature "Going Cold Iron in Alaska, R.Maddison & D.H. Smith", connecting to on-shore power supply for vessels equipped with cold-ironing would normally be completed within 30 minutes.

(ii) Hotelling at the cruise terminal (for a period of 23 hours):

If the cruise vessel is equipped with cold-ironing, it is assumed that the cruise vessel will be connected to the on-shore power supply within 30 minutes (as assumed during the one hour berthing period) and thus no air emissions will be generated during this hotelling period. On the other hand, if the cruise vessel is not equipped with cold-ironing, the cruise vessel will emit during its entire period of hotelling at the cruise terminal.

6.5.20 A sensitivity test to evaluate the dominant emission mode among two operation modes described above has been conducted. The first scenario is to have cruise ships hotelling at both berth 1 and 2 for 24 hours. The second and the third scenarios are to have one cruise ship hotelling at either berth 1 or berth 2, and another cruise ship manoeuvring around the other berth also for 24 hours. The detail results for the sensitivity test are presented in **Appendix 6.3**. The predicted maximum 1-hr average SO_2 concentration for the second and third scenarios were compared with the first scenario. The predicted highest 1-hr average SO_2 concentration among all the assessment points for the first scenario is much higher than the third scenario and is similar to the second scenario. This indicates that hotelling mode is the dominant emission mode for cruise operation near the cruise terminal with regards to the potential air quality on the ASRs on shore. Therefore, the above assumed cruise operation with 24 hours hotelling at the cruise terminal would result in a conservative assessment.

6.5.21 The emission rates of air pollutants from the operation of the propulsion engine, auxiliary engine and boiler of cruise vessels were estimated based on the approach stipulated in *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report, January 2006* prepared by ICF Consulting for USEPA except on the estimation of auxiliary load for cruise ships with very high propulsion engine power. The assumptions made in this assessment in estimating the emission rates are described in the following paragraphs.

6.5.22 The emission rates for Panamax cruise vessel are estimated based on the power rating of the propulsion engine of Queen Elizabeth II (i.e. 2 x 44MW diesel electric engines). Whereas the emission rates for Post-Panamax and Super Post-Panamax cruise vessel are estimated based on the power rating of the propulsion engine of Queen Mary II (i.e. 4 x 21.5MW diesel electric engines). Queen Elizabeth II and Queen Mary II are representative of the large to mega size cruise vessels listed in the Kai Tak Planning Review. Queen Elizabeth II and Queen Mary II have an overall length of 293.5m and 345m respectively which is at or near the maximum length of cruise vessels at the Panamax and Post-Panamax classes; the emission rates of these two cruise vessels are thus taken in this assessment as conservative assumptions.

6.5.23 Apart from these two bigger cruise vessels, emission rates for vessel size smaller than Panamax (say sub-Panamax) and a much smaller vessel compare with sub-Panamax (say super sub-Panamax) are also estimated for completeness of the assessment. Costa Allegra, one of the planned vessels operating in Hong Kong which has an overall length of 187.8m and power rating of the diesel propulsion engine of 19.2MW, is selected to represent the emissions from the sub-Panamax cruise vessel. Wasa Queen, one of the vessels previously operated in Hong Kong which has an overall length of 153m and gross tonnage of 16,546, is selected to represent the emissions from the super sub-Panamax. The engine power rating of Costa Allegro was adopted for Wasa Queen as conservative assumption.

6.5.24 According to the *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report, January 2006*, an auxiliary engine power ratio for cruise ships is estimated at 27.8% based on an average total auxiliary engine power of 11MW to an average propulsion engine power of 39.6MW. Also mentioned in the report is that, prior practice has been to use a fixed power rating for auxiliaries based on ship type and activity mode or to assume auxiliary power is equivalent to 10% of propulsion power.

6.5.25 Further research of the available information on auxiliary load for cruise ships or marine vessels had been conducted. With reference to the *Controlling Air Emissions from Marine Vessels: Problems and Opportunities, Anthony Fournier, University of California Santa Barbara, February 2006*, the auxiliary engine power for large marine vessels (with propulsion engine power of 15MW or above) is about 9.9% that of the propulsion engine. This also agrees with the practice described in the *Commercial Marine Emission Inventory Development, ENVIRON International Corporation, April 2002* prepared for USEPA, to assume auxiliary power is equivalent to 10% of propulsion power. With this 10% practice, the auxiliary load for Panamax, Post-Panamax and Super Post-Panamax cruise vessels during hotelling would be estimated based on the propulsion engine power of Queen Elizabeth II and Queen Mary II to be around 88MW x 10% x load factor for hoteling of 0.64 = 5.6MW.

6.5.26 Additionally, in accordance with the *Draft White Paper on Use of Shore-side Power for Ocean-going Vessels, May 2007* prepared for the American Association of Port Authorities, the average power requirement for cruise ships at berth is 7MW. In the *Final Report on Shoreside Power Feasibility Study for Cruise Ships Berthed at Port of San Francisco, September 2005*, prepared for the Port of San Francisco, the auxiliary load of cruise ships at berth as provided by the operators are estimated to be from less than 2MW to a maximum of 9.5MW.

6.5.27 As in the case of Queen Elizabeth II, the total propulsion engine power of 88MW and the auxiliary engine power is only 7MW. The ratio of auxiliary engine to propulsion engine power is about 8%. While it should be noted that the auxiliary engine power ratio of 27.8% suggested in the *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report* is only an average figure for a particular approach, this average auxiliary engine ratio is however considered not applicable for cruise ships with very high propulsion engine power (e.g., 88MW vs 39.6MW), which would lead to overly conservative estimates of cruise emissions.

6.5.28 Based on the estimates and data presented in the above references, an auxiliary load of 9.5MW for Panamax, Post-Panamax and Super Post-Panamax cruise vessels during hotelling was adopted for the air quality impact assessment as a reasonable and conservative estimate. For sub-Panamax and super sub-Panamax cruise vessels, the auxiliary engine power is estimated as 27.8% of the propulsion engine power of 19.2MW of Costa Allegra.

6.5.29 The stack height of the cruise vessel was also made reference to the above four cruise vessels and is about 34.2m, 46m, 52m and 62m above water surface for super sub-Panamax, sub-Panamax, Panamax and Post-Panamax (or Super Post-Panamax) cruise vessels respectively. With reference to the *Modeling Sulfur Oxides (SOx) Emission Transport from Ship at Sea, July 2007*, USPEA, the average chimney exhaust velocity, temperature and stack diameter assumed for ocean-going vessels (including cruise vessels) were 24.6m/s, 537K and 1.9m.

6.5.30 Besides, with reference to the *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report*, practically all ocean-going vessels operate their main propulsion engines on residual oil and most cruise vessels also use residual oil (with sulphur content of 2.7 percent) for their auxiliary engines. However, in accordance to the Merchant Shipping (Prevention of Air Pollution) Regulation in Hong Kong, the sulphur content of ship's fuel should refer to Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL). For the local fuel suppliers, the average sulphur content of fuel supplied/used in Hong Kong is 3.8%. With reference to the *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report*, SO_2 and particulates emission factors are directly proportional to the sulphur content of the fuel, SO_2 and particulates emission factors should be adjusted if the sulphur content of the fuel is different from the assumption of 2.7% assumed in the reference. Therefore, for the purpose of this assessment, a correction factor of 1.41 (i.e. 3.8/2.7) was applied in the estimation of emission rates of SO_2 and particulates for propulsion engines and auxiliary engines.

6.5.31 In this assessment, it is also assumed that the cruise vessel will be assisted by two tug boats during the 30 minutes berthing in or berthing out motions. The emission rates of the tug boats were also estimated in accordance with the *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report* based on average engine power and load factor for tug boats. The detailed calculations of the emissions from tug boats are shown in **Appendix 6.4**.

6.5.32 **Table 6.9** summarizes the air pollutants emission rates estimated for different classes of cruise vessel under different movement mode. The emissions during hotelling are applicable for cruise vessels that are not equipped with cold-ironing during the short period of berthing in and berthing out. The detailed calculations of cruise emissions are presented in **Appendix 6.4**.

Table 6.9 Cruise Air Pollutants Emission Rates

Engine	Movement Mode	Air Pollutant	Super Sub-Panamax / Sub-Panamax	Panamax vessel	Post-Panamax and Super Post-Panamax vessel
Propulsion Engine	Manoeuvring	NO_x, kg/hr	24.89	24.64	24.08
		SO_2, kg/hr	6.00	27.50	26.87
		RSP, kg/hr	4.49	2.83	2.76
		CO, kg/hr	4.22	1.94	1.89
	Hotelling	NO_x, kg/hr	0.00	0.00	0.00
		SO_2, kg/hr	0.00	0.00	0.00
		RSP, kg/hr	0.00	0.00	0.00
		CO, kg/hr	0.00	0.00	0.00
Auxiliary Engine	Manoeuvring	NO_x, kg/hr	62.77	174.56	174.56
		SO_2, kg/hr	66.71	185.50	185.50
		RSP, kg/hr	6.85	19.05	19.05
		CO, kg/hr	4.70	13.06	13.06
	Hotelling*	NO_x, kg/hr	50.22	139.65	139.65
		SO_2, kg/hr	53.37	148.41	148.41
		RSP, kg/hr	5.48	15.24	15.24
		CO, kg/hr	3.76	10.45	10.45
Boiler	Manoeuvring	NO_x, kg/hr	0.15	0.15	0.15
		SO_2, kg/hr	0.95	0.95	0.95
		RSP, kg/hr	0.02	0.02	0.02
		CO, kg/hr	0.06	0.06	0.06
	Hotelling*	NO_x, kg/hr	0.15	0.15	0.15
		SO_2, kg/hr	0.95	0.95	0.95
		RSP, kg/hr	0.02	0.02	0.02
		CO, kg/hr	0.06	0.06	0.06
Total Emission	Manoeuvring	NO_x, kg/hr	87.81	199.36	198.80
		SO_2, kg/hr	73.66	213.96	213.33
		RSP, kg/hr	11.37	21.90	21.84
		CO, kg/hr	8.98	15.06	15.01
	Hotelling*	NO_x, kg/hr	50.37	139.80	139.80
		SO_2, kg/hr	54.32	149.36	149.36
		RSP, kg/hr	5.50	15.27	15.27
		CO, kg/hr	3.82	10.51	10.51

Note: * Estimated emissions for cruise vessels not equipped with cold-ironing.
The correction factors 1.41 for 3.8% sulphur content were included for calculating SO_2 and RSP emission rates.

Sensitivity Test Scenarios

6.5.33 **Table 6.10** summarizes the sensitivity test scenarios to be examined under the cruise emission impact assessment. Scenarios 1 to 10 in are the scenarios with both berths occupied by different combinations of cruise vessels without cold-ironing.

Table 6.10 Sensitivity Test Scenarios

Scenario	**Berth 1 (south)**	**Berth 2 (north)**
	Vessel class	**Vessel class**
1	Super Sub-Panamax	Super Sub-Panamax
2	Sub-Panamax	Sub-Panamax
3	Sub-Panamax	Panamax
4	Sub-Panamax	Post-panamax or Super post-panamax
5	Panamax	Sub-Panamax
6	Panamax	Panamax
7	Panamax	Post-panamax or Super post-panamax
8	Post-panamax or Super post-panamax	Sub-Panamax
9	Post-panamax or Super post-panamax	Panamax
10	Post-panamax or Super post-panamax	Post-panamax or Super post-panamax

6.5.34 The sensitive test results are presented in **Appendix 6.5**. It was identified that Scenario 6 with Panamax vessels berthed at both Phase 1 and Phase II Berths is the worst case scenario by comparing the highest impacts among the ASRs. Scenario 6 was therefore adopted in the cumulative air quality assessment.

6.5.35 With reference to the total emission data for the Panamax vessel during manoeuvring presented in **Table 6.9**, the ratio of total NO_2 (as 20% of NO_X), SO_2, RSP, and CO emissions to the corresponding 24-hour average AQO (there is no 24-hour average AQO for CO, the AQO of CO for shorter period of 8-hour CO is used) is 0.266, 0.611, 0.122, and 0.0015 respectively. This indicates that NO_2 and SO_2 are the two most critical air pollutants of concern for the Panamax vessel during manoeuvring. In other words, if the predicted NO_2 and SO_2 concentrations comply with the corresponding AQO, air pollutants like RSP and CO with lower ratio will also comply with their respective AQO. Similar observations are also noted for other vessel types during both manoeuvring and hotelling. NO_2 and SO_2 were therefore the two most critical air pollutants for cruise emissions. For the purpose of cumulative assessment, NO_2, SO_2 and RSP emissions were considered.

6.5.36 ISCST3 Model was used for the prediction of the hourly and daily average NO_2 and SO_2 and daily RSP concentrations arising from the manoeuvring and hotelling of cruise vessels at the proposed cruise terminal. The conversion factor from NO_x to NO_2 was assumed to be 20% in accordance with EPD's Guidelines on Choice of Models and Model Parameters on predicting near field traffic emission impacts.

6.5.37 With some preliminary review of the stack position of cruise vessels, it is note that the stacks of cruise vessels are typically located at 1/4th to 1/3rd of the vessel length from the stern of the vessels. In this assessment, it was assumed that the cruise vessels are pointing south and that the stack of the cruise vessels is located at 1/4th of the vessel length from the stern of the vessels such that the stacks are located closer to the elevated ASRs as a conservative assumption. For the purpose of this assessment, the cruise emissions during manoeuvring and hotelling were modelled as point sources at the stack location of the cruise vessels. During the manoeuvring between the navigation channel and the cruise terminal, the point source is located mid way between the berth and the navigation channel in the ISCST3 model. During the final manoeuvring near the berth and during hotelling, the point source is located at the stack location of final berthing position described above.

6.5.38 Hourly meteorological data for the Year 2006 (including wind speed, wind direction, air temperature, Pasquill stability class and mixing height) of the South East Kowloon Weather Station was employed for the model run. As South East Kowloon Weather Station does not record temperature data, the ambient temperature data at the King's Park Weather Station were adopted. The urban dispersion mode in ISCST3 model was selected.

Emissions from the Kwun Tong Typhoon Shelter and To Kwa Wan Typhoon Shelter

6.5.39 The loading/unloading are the major activities within typhoon shelters. Based on the site observation, around 40 & 20 barges were parking within Kwun Tong Typhoon Shelter and To Kwa Wan Typhoon Shelter, respectively. Around 20 barges have loading / unloading activities at Kwun Tong Typhoon Shelter. For those barges parked in the To Kwa Wan Typhoon Shelter, it was observed no loading / unloading activities and without started engine. For this assessment, we assumed 60 barges at both typhoon shelters for conservative assessment.

6.5.40 The emission rates of air pollutants from the operation of the auxiliary engine of barges were estimated based on the approach stipulated in the *Current Methodologies and Best Practices in Preparing Port Emission Inventories, Final Report, January 2006* prepared by ICF Consulting for USEPA. The power rating of 82 kW for auxiliary engine and emission height of the barges of about 5m above water surface were adopted for this assessment. The detailed emission calculations are presented in **Appendix 6.6**.

Cumulative Impact of Criteria Air Pollutants

6.5.41 As mentioned above, background pollutant levels within and adjacent to the Study Area, vehicle emissions from open sections of the existing and planned road networks, tunnel portal and ventilation building emissions, all of these will contribute to the cumulative impact. The assessment methodology of road emission, tunnel portal and ventilation building emissions are presented in **Section 3.2**.

6.5.42 The pollutant concentrations at the ASRs was predicted by both CALINE4 and ISCST3 models, where

- the CALINE4 model was used to predict the open road emissions from the existing and planned road networks; and
- the ISCST3 model was used to predict all the portal emissions and ventilation shaft emissions, chimney emissions, emission from hospital, cruise ship, proposed heliport and typhoon shelters.

6.5.43 To obtain the cumulative pollutant concentration at each receptor, the predicted values from the CALINE4 and the ISCST3 models are added together with the background pollutant concentrations.

OPERATIONAL PHASE (ODOUR)

6.5.44 A number of previous studies had been conducted to understand and to address the existing environmental problems associated with the Kai Tak Development. Based on the data collected from previous studies, the key odour problems being identified are at KTAC and its vicinity such as the lower KTN in North Apron, the Jordan Valley Box Culvert (JVBC) and KTTS. Other odour sources in the vicinity of the KTD include the planned sewage pumping stations and the existing sewage treatment works at To Kwa Wan and Kwun Tong. The potential odour impacts associated with the planned sewage pumping stations would be localized and are readily controlled with proper design and odour abatement measures. Details of the environmental assessments for the planned sewage pumping stations in KTD are presented in **Section 4** of this EIA Report. With regards to the existing sewage treatment works at To Kwa Wan and Kwun Tong, these sewage treatment works are existing facilities with ASRs located in the close proximity, odour mitigation measures have been implemented at these sewage treatment works to prevent adverse odour impacts at the surrounding ASRs, adverse odour impacts at the planned ASRs within KTD is therefore not expected. The proposed upgrading of Kwun Tong PTW is classified as a DP under Item F.1, Part I, Schedule 2 of the EIAO. The associated environmental impacts will be adequately addressed in a further detailed EIA study to be prepared and submitted under the EIAO by EPD.

6.5.45 A detailed study with further detailed field surveys and laboratory testing are conducted under this assignment to delineate the odour emitting areas and to determine the mechanism of odour generation of the three key areas namely KTN in North Apron, KTAC and KTTS. Details of the study are included in **Annex A** of this EIA Report with the relevant material on odour impact assessment extracted and presented in this section.

Odour Source Sampling and Analysis

6.5.46 Further detailed field survey was conducted to collect relevant environmental data at different sampling locations within KTAC and KTTS for subsequent analysis of their potential correlation with the odour emission strength. The scopes of the detailed survey include:

- Conduct odour sampling using a wind tunnel method and in-situ H_2S measurements at the designated sampling locations (including one QA/QC station) within KTN, KTAC and KTTS;
- Conduct air sampling using sampling tube and in-situ H_2S measurements at Jordan Valley Culvert Outfall (JVCO) and two box culverts at KTN;

- Carry out H_2S analysis, olfactometry and hedonic tone tests for the collected samples in the laboratory;
- Carry out in-situ measurements of marine water for dissolved oxygen (% saturation and mg/L), water depth (m), salinity (ppt), redox potential (mV) and pH, and ambient air and water temperature (^oC);
- Conduct water sampling at culvert discharges of KTN and odour potential test on water samples in the laboratory; and
- Record site conditions during each sampling.

6.5.47 In order to capture more representative results, all measurements and sampling for KTN, KTAC and KTTS were carried out during neap ebb tide with reference to the tidal chart of the Hong Kong Observatory. For JVC and box culverts, measurements were measured during neap tide at both flood and ebb tides.

6.5.48 On-site observations including odour intensity, odour nature, and possible sources were recorded by the odour panel members during the field odour sampling. Besides, relevant meteorological data such as ambient temperature, relative humidity, wind speed and wind direction, etc. recorded at the Hong Kong Observatory station during the measurement / sampling period were taken for reference purpose.

6.5.49 The detailed field survey was conducted during the hottest days in the summer of 2007 during low tide periods to capture the reasonable worst case odour emissions from KTN, KTAC and KTTS. Odour source samples were collected at a total of 91 sampling locations at 4 water zones namely KTN, northern KTAC (NKTAC), southern KTAC (SKTAC) and KTTS for determining odour emission rate. The sampling locations are shown in **Figure 6.3**.

Determination of Specific Odour Emission Rate

6.5.50 To determine the odour emission rate of an area source such as water surface, odour source sampling was performed by using “hood” method, whereby a wind tunnel was placed on the odour emission surface of the designated measurement locations and a stream of odour-free nitrogen gas from a certified gas cylinder was supplied to generate an air inflow at a fixed velocity inside the wind tunnel. The most appropriate and reliable inflow rate inside the wind tunnel was determined by the wind speed inflow rate sensitivity test.

6.5.51 The emission rate was determined by the air flow rate through the hood and the odour concentration of the exit air. A specific odour emission rate (SOER) of each area source was calculated by the following equation:

$$\text{SOER (ou/m}^2\text{.s)} = \frac{\text{Odour concentration (ou/m}^3\text{) x Air flow rate inside hood (m}^3\text{/s)}}{\text{Covered water surface area (m}^2\text{)}}$$

Olfactometry Analysis

6.5.52 The odour concentration of the collected air sample was determined by a Forced-choice Dynamic Olfactometer (Olfactomat-n2) with a panel of human assessors being the sensor in accordance with the European Standard Method: *Air Quality – Determination of Odour Concentration by Dynamic Olfactometry* (EN13725). The odour concentration is measured by determining the dilution factor required to reach the detection threshold.

6.5.53 The odour laboratory was ventilated so as to maintain an odour-free environment and to provide fresh air to the panel members. Each odour testing session was comprised at least five qualified panellists. All of the panellists were screened beforehand by using 50 ppm solution / mixture of certified n-butanol standard gas.

Odour Emission Inventory

6.5.54 A detailed odour survey was conducted in the summer of 2007 to estimate the worst case existing odour emission strength of KTN, KTAC and KTTS. During the odour survey, odour source samples were collected from KTAC, KTTS, and the section of KTN within the north apron of the former Kai Tak Airport. Details of the odour survey are presented in **Annex A (Section 3)**.

6.5.55 Odour source samples were collected from a total of 91 sampling locations including 7 locations at KTN, 58 locations at KTAC, and 26 locations at KTTS. The existing specific odour emission rates (SOER) derived from the odour concentration of collected samples for each source area are listed in **Table 6.11**. The water depth and bottom dissolved oxygen level measured at the sampling locations during the odour survey are also listed in the table. The odour survey was carried out during the hottest days and under with low tide periods in the summer. Because these conditions are conducive to release of trapped gases, the estimated odour emission rates are considered to represent a reasonable worst-case condition for the existing situation. **Figure 6.3** shows the distribution and ID of the sampling locations and **Figure 6.4** shows a contour plot of the existing odour strength of KTN, KTAC and KTTS based on the findings of odour survey.

Table 6.11 Existing Odour Emission Rates of KTN, KTAC, and KTTS

Location ID	Water Depth (m)	Bottom DO (mg/l)	SOER (ou/m^2/s)
KTN			
A section of the KTN further to the north within 500m away from the project boundary of KTD			0.22 (taken as the SOER of KTN7, see discussion in S.6.5.58)
KTN7	0.60	6.66	0.22
KTN6	0.50	5.55	3.79
KTN5	0.50	5.50	0.90
KTN4	0.80	6.04	0.21
KTN3	0.86	5.79	1.21
KTN2	1.08	3.46	44.58
KTN1	1.04	2.63	9.45
KTAC			
NKTAC93	2.4	0.36	1.83
NKTAC92	1.7	13.15	23.30
NKTAC91	0.8	1.59	18.19
NKTAC85	4.3	0.39	0.61
NKTAC84	3.9	0.46	1.16
NKTAC83	2.2	0.56	2.89
NKTAC82	1.8	5.04	10.25
NKTAC81	0.8	2.30	3.50
NKTAC75	3.7	0.23	0.20
NKTAC74	5.0	0.25	0.36
NKTAC73	3.8	0.47	0.61
NKTAC72	1.9	4.55	9.56
NKTAC71	1.9	0.83	2.46
NKTAC65	4.1	0.39	0.36
NKTAC64	4.2	0.41	0.63
NKTAC63	3.7	0.41	1.35
NKTAC62	2.2	0.41	19.74
NKTAC61	1.3	8.75	24.83
NKTAC55	4.2	0.43	0.44
NKTAC54	4.5	2.48	0.93
NKTAC53	4.0	0.47	1.16
NKTAC52	4.2	0.55	7.41

Location ID	Water Depth (m)	Bottom DO (mg/l)	SOER (ou/m^2/s)
NKTAC51	1.2	3.02	13.51
NKTAC45	4.4	0.39	1.16
NKTAC44	4.2	0.37	0.98
NKTAC43	4.2	0.52	2.30
NKTAC42	4.0	0.34	1.97
NKTAC41	1.9	1.96	1.16
NKTAC35	1.1	3.95	17.10
NKTAC34	3.3	3.49	0.19
NKTAC33	4.0	3.22	0.19
NKTAC32	3.5	4.23	0.20
NKTAC31	1.5	5.77	2.13
NKTAC25	4.3	2.30	2.90
NKTAC24	4.2	2.76	0.86
NKTAC23	3.5	3.04	0.13
NKTAC22	3.1	2.22	0.13
NKTAC21	1.9	2.85	0.83
NKTAC15	4.3	4.20	0.31
NKTAC14	4.9	2.87	1.07
NKTAC13	4.4	2.71	0.30
NKTAC12	3.5	2.06	1.44
NKTAC11	1.9	6.73	1.90
SKTAC35	4.2	8.43	0.33
SKTAC34	4.8	13.20	0.22
SKTAC33	5.1	8.41	0.16
SKTAC32	4.8	7.85	0.19
SKTAC31	3.2	1.70	8.76
SKTAC25	3.9	0.60	2.20
SKTAC24	5.3	0.11	4.87
SKTAC23	5.2	0.12	2.05
SKTAC22	5.5	0.12	4.86
SKTAC21	4.1	5.00	0.15
SKTAC15	3.4	2.34	3.64
SKTAC14	6.2	0.09	3.37
SKTAC13	5.7	0.10	2.05
SKTAC12	5.5	0.13	2.13
SKTAC11	3.5	2.79	2.05
KTTS			
KTTS74	6.8	0.52	0.13
KTTS73	5.8	1.26	0.38
KTTS72	5.7	0.07	1.90
KTTS71	5.2	0.11	1.11
KTTS61	6.1	0.42	0.54
KTTS54	6.1	1.43	0.11
KTTS53	6.0	1.83	0.15
KTTS52	6.2	0.46	1.02
KTTS51	6.0	0.40	0.47
KTTS45	7.3	1.93	0.19
KTTS44	6.2	2.01	0.48
KTTS43	6.2	1.00	0.51
KTTS42	5.1	2.54	0.10
KTTS41	5.6	1.02	0.17
KTTS34	6.2	0.46	0.13
KTTS33	6.2	1.57	0.61
KTTS32	6.3	1.30	0.19

Location ID	Water Depth (m)	Bottom DO (mg/l)	SOER (ou/m^2/s)
KTTS31	5.6	1.50	0.21
KTTS25	6.2	5.29	0.12
KTTS24	6.0	5.23	0.08
KTTS23	7.1	6.51	0.08
KTTS22	6.7	7.22	0.10
KTTS21	7.2	8.00	0.11
KTTS13	7.1	6.40	0.12
KTTS12	6.8	8.30	0.08
KTTS11	6.2	8.17	0.08

Air Dispersion Model

6.5.56 Odour impacts were assessed using the Industrial Source Complex Short Term 3 Model (ISCST3), an air dispersion model acceptable to the Environmental Protection Department (EPD). Hourly meteorological data for year 2006 (including wind speed, wind direction, air temperature, Pasquill stability class and mixing height) recorded at the Hong Kong Observatory King's Park Meteorological Station was employed for the model run. Because the study area is in an urban area, the "Urban" dispersion model option was selected.

6.5.57 The modelled hourly odour concentrations at the ASRs were converted into peak 5-second odour concentrations so as to compare with the EIAO-TM odour criteria. EPD's "Guidelines on Choice of Models and Model Parameters", recommends the methodologies proposed by Duffee et al.[1] and Keddie[2] in performing the conversion from hourly to 5-second average concentration. However, it is noted that these methodologies are based on findings of earlier researchers on dispersion of odour emissions from point sources. More recent researchers have indicated that the peak-to-mean ratio used for odour dispersion assessments would depend upon the type of source, atmospheric stability and distance downwind. For example, depending on the physical size of source in relation to the distance to the ASR, the peak-to-mean ratio of odour dispersion from area source could be far smaller than that from point source. In this assessment, the major odour sources to be studied, namely the water surfaces of KTN, KTAC and KTTS, are in the form of large area sources. Therefore, for the purpose of this assessment, to produce more realistic predictions for odour dispersion from area sources, reference was made to the peak-to-mean ratio for area sources stipulated in "Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales" published by the Department of Environment and Conservation, New South Wales, Australia (NSW Approved Method).

6.5.58 The dispersion modelling techniques employed for this assessment followed those described in EPD's "Guidelines on Choice of Models and Model Parameters" using ISCST3 model except the use of alternative peak-to-mean ratios discussed above. However, it should be noted that the peak-to-mean ratios stated in the NSW Approved Method are derived based on experimental and theoretical analyses and assuming a 0.1% exceedance level (Ref.: Statistical Elements of Predicting the Impact of a Variety of Odour Sources, Peter R. Best, Karen E. Lunney and Christine A. Killip, Water Science and Technology, Australia, 44: 9 pp 157-164 2001). In other words, there would be a 0.1% probability that the actual peak concentration would be higher than those derived with the peak-to-mean ratios stated in the NSW Approved Method.

[1] Richard A. Duffee, Martha A. O"Brien and Ned Ostojic (1991). Odour Modelling – Why and How, Recent Developments and Current Practices in Odour Regulation, Controls and Technology, Air & Waste Management Association.
[2] Keddie, A. W, C(1980). Dispersion of Odours, Odour Control – A concise Guide, Warren Spring Laboratory.

6.5.59 In accordance with the NSW Approved Method, the conversion factors are used for converting the maximum modelled 1-hour average concentrations to corresponding maximum 1-second average concentrations that could occur during that hour. As a conservative approach, these conversion factors were directly adopted for converting the 1-hour average concentrations predicted by the ISCST3 model to 5-second average concentrations for compliance checking with the odour criteria. In this case, the odour sources are located in the vicinity of the ASRs, therefore, the ASRs are considered to be located in the near field region with regards to the odour sources as per the NSW Approved Method. The conversion factors adopted in this assessment for different stability classes are shown in **Table 6.12**.

Table 6.12 Conversion Factors for Hourly to 5-second Average Concentration

Pasquill Stability Class	Conversion Factor (1-hour to 5-second average)
A	2.5
B	2.5
C	2.5
D	2.5
E	2.3
F	2.3

6.5.60 Under the existing (unmitigated) scenario, all the odour source areas listed in **Table 6.11** above were included in the dispersion model for assessing the existing odour impact. In addition, a section of the KTN further to the north within 500m away from the project boundary of KTD was also included in the odour impact assessment as existing odour source under both the existing (unmitigated) scenario and the mitigated scenarios. The location of KTN7 is the northernmost section of KTN with odour survey data and it well represents the potential odour emissions from the section of KTN immediate further north of the apron area. Thus the SOER measured at this location is taken to represent the existing section of KTN further north of the apron area.

6.5.61 The potential odour emissions from the headspace of KTN and JVC and from the accumulated sediment on the northern seawall of former Kai Tak Runway would have transient effect to the cumulative odour impacts at ASRs. However, these potential odour emissions are difficult to quantify and are not included in the odour modelling for the unmitigated scenario. Therefore, there would be certain degree of underestimation in the predicted odour impacts at ASRs under the unmitigated scenario.

Presentation of Assessment Results

6.5.62 The predicted odour concentrations at representative planned ASRs at KTD were determined. The odour concentrations within the study area under existing odour strength scenario and the mitigated scenario(s) are presented in the form of contour plots.

6.6 Identification of Environmental Impacts

<u>Construction Dust</u>

6.6.1 The major potential air quality impact during the construction phase of the Project will be dust arising from haul road emissions, open site erosion, excavation and filling activities. Civil works related to the demolition of existing structures and construction of infrastructure will also cause emissions.

6.6.2 The concurrent works for the SCL, CKR, Road T2 and Anderson Road projects have also been taken into account in assessing the impacts.

Operational Phase

Vehicular Emissions, Cruise Ship Emissions from the proposed Cruise Terminal at Kai Tak, Chimney Emissions from the San Po Kong and Kwun Tong Industrial Areas, Emission from the Planned Hospital and Planned Heliport in Kai Tak and Emission from Typhoon Shelters

6.6.3 The major air pollutant sources during operational phase of the Project would be vehicular emissions (include the planned KTTL), portal emission from the proposed Road T2 tunnel, as well as the emissions from CKR Ventilation Building, Kai Tak Tunnel Ventilation Building and Road T2 Ventilation Building. Other than emissions from tunnel portals, long sections of landscape deck/deckovers may also result in portal emissions. Within the study area, it was identified that decked section of Road D2 may generate portal emissions.

6.6.4 Besides the vehicular emissions, emissions from the cruise ships using the cruise terminal at Kai Tak, emission from the proposed hospital at Kai Tak, chimney emissions within 500m from the Project boundary, planned Heliport and emission from typhoon shelters would also contribute to the cumulative air quality impact. The locations of emission are presented in **Figure 6.2**

Odour Impact from KTN, KTAC and KTTS

6.6.5 An odour study for KTAC and KTTS had been carried out under the Stage 1 Planning Review and based on its findings, further detailed field surveys and laboratory testing were conducted in order to delineate the odour emitting areas and to determine the mechanism of odour generation of the three key areas namely KTN in North Apron, KTAC and KTTS. Details of the KTAC and KTTS studies are included in **Annex A** of this EIA Report.

6.6.6 Based on the findings of the Phase 1 Planning Review and the results from the further detailed field surveys and laboratory testing, the decomposition of organic matters in the sediments were considered to be the main source of odour. There are considered to be four distinct types of odour emissions within the Study Area. The types of odour emissions include (i) the main channel area, (ii) culvert / outfall openings, (iii) seawall along the former Kai Tak runway and (iv) the Kai Tak Nullah (KTN).

Main Channel Area

6.6.7 The main channel area consisted of the whole of KTAC and KTTS and is considered to be the major contributors to odour emissions. The odour mainly generated from the high AVS contained sediments under highly negative redox conditions, which result in the release of H_2S gas to the overlying water and atmosphere. The key factors that affect this type of odour generation are:

- Overlying water depths, influenced by tidal effects;
- Water quality, in particular dissolved oxygen concentration and stratification effect;
- Temperature;
- Sediment quality including total organic content (TOC), redox potential and AVS levels; and
- Water circulation which influence the water quality and rate of sediment deposition in the water system.

Culvert Opening

6.6.8 Based on site observations, odour emissions were detected at the culvert / outfall openings. The culvert / outfall openings include the Jordan Valley Culvert Outfall (JVCO), discharging to north KTAC and three major existing culvert systems discharging to KTN. The three major culvert systems serve the Kowloon City, San Po Kong and Diamond Hill / Ngau Chi Wan catchment areas.

6.6.9 Flows from the culverts were observed to be contaminated with polluted discharges from possible expedient connections. The polluted discharges would cause the deposition of contaminated silts / sediments, releasing odorous chemicals to the overlying water and headspace. During high tide, when the water level rises, odour accumulated in the headspace would be emitted to the atmosphere, outside of the culverts.

6.6.10 The key factors that affect this type of odour generation are:

- Effluent quality of the culverts;
- Culvert dimensions and headspace size; and
- Amount of contaminated silts / sediments deposited onto the bottom of the culverts.

Northern Seawall of Former Kai Tak Runway

6.6.11 The northern seawall of the former Kai Tak runway is sloped and consisted of a relatively flat bench before sloping to the seabed (see **Figure 5.1 of Annex A**). It is constructed of rectangular boulders with gaps in between. Based on site observations, sediments were noted deposited at the gaps and bench area and when the sediments were exposed to air during low tide, odour would be released.

6.6.12 The key factors that affect this type of odour generation are:

- Duration of low tide when sediment is exposed to the atmosphere;
- Size of gaps / bench area for the accumulation of contaminated sediments; and
- Water flow, which influenced the rate of sediment deposition.

Kai Tak Nullah

6.6.13 The KTN can be divided into two sections. The downstream section of KTN is located at the North Apron of the former Kai Tak Airport and is more or less flat in gradient. The section starting from the middle part of the North Apron is affected by the tidal influx and always flooded with water. The water quality starts to deteriorate at this section as there are culverts from the hinterland discharging polluted runoffs into the KTN. While the tidal influence caused backup of seawater, sediments originated from polluted discharges starts to deposit at the channel bed. Bubbles of odorous gases were observed evolving from the deposit of the channel bottom with smell of H_2S.

6.6.14 The flow from the upstream section of KTN is contributed mainly from the THEES (Tolo Harbour Effluent Export Scheme) discharges:- secondary treated effluent from the Tai Po and Sha Tin Sewage Treatment Works. The treated effluent is exported through a tunnel system connecting Sha Tin Sewage Treatment Works to KTN. The THEES effluent is discharging at a location near Wong Tai Sin Police Station. The treated effluent would have some characteristics odour but is not necessarily irritating. As observed on site, it was like "soil odour after rain". The long standing time inside the tunnel system may give rise to some odour generation possibly from the anoxic conditions of the tunnel. The origin is different from the sediment oriented odour of KTAC. The turbulent water surface resulted from the high flow rate promotes the release of odorous chemicals to the atmosphere at the local level. This type of odour was reduced significantly further downstream, as observed. The downstream area of KTN is benefited by the large base flow and the flushing effects provided by THEES.

6.6.15 The key factors that affect this type of odour generation are:

- Effluent quality of the THEES and culverts;
- Temperature; and
- Water depths, influenced by tidal effects.

Odour Impact from existing sewage treatment works at To Kwa Wan and Kwun Tong, Pumping Station No. 6 (PS6), Desilting compound at KTN and DWFI Compound for JVBC

6.6.16 For the existing sewage treatment works (STW) at To Kwa Wan and Kwun Tong, proper odour mitigation measures have been implemented to prevent any adverse odour impacts at their existing adjacent ASRs. With reference to the odour complaint record maintained by EPD, there was no and only one odour related complaint for the Kwun Tong STW and To Kwa Wan STW respectively in the past 5 years. Besides, both the existing Kwun Tong STW and the proposed upgrading of Kwun Tong STW (in Site 6B1) are located at more than 500m from the nearest planned ASRs in KTD, cumulative odour impacts at the planned ASRs in KTD due to Kwun Tong STW and its proposed upgrading is not expected. The proposed upgrading of Kwun Tong STW is classified as a Designated Project under EIAO, the associated environmental impacts will be addressed in a further detailed EIA study to be prepared by the future project proponent. For the existing To Kwa Wan STW, a new deodorisation system has recently been commissioned in year 2006 to mitigate the potential odour emissions from the STW and no odour complaint was received thereafter. Therefore, unacceptable odour impacts associated with the existing To Kwa Wan STW at the surrounding existing and planned ASRs shall not be expected. Cumulative odour impacts at the planned ASRs in KTD are thus also not expected.

6.6.17 Two desilting compounds are proposed for KTN (at Site 1D6 and Site 1P1) and a dry weather flow interceptor (DWFI) compound is proposed for JVC (at Site 3A3) to contain pollution in drainage systems entering the KTAC and KTTS by interception facilities until the ultimate removal of the pollution sources. It is noted that under the Project "Upgrading of Central & East Kowloon Sewerage - Packages 1 to 4", upgrading and construction of about 21km long sewers and associated sewerage works would be carried out for the central and east Kowloon region. This will include upgrading of the existing DWFIs for the drainage catchment of KTN. It is expected that these existing DWFIs at the upstream of KTN can effectively control the polluted flows after upgrading. In addition, under the "Kai Tak Approach Channel – Expedient Connection Survey Study", surveys will be undertaken to identify expedient connections in public drains/sewers and domestic buildings in Kowloon City, Ngau Tau Kok, Kowloon Bay, Wong Tai Sin and Choi Hung, for subsequent rectification. With these improvement works already planned for the upstream of KTN, DWFIs are therefore not recommended for the KTD de-silting compounds. Tidal barrier in form of penstock will be provided at the DWFI compound for JVC. Desiliting facilities will form part of the desilting and DWFI compounds and regular desilting will be carried out by the maintenance department at KTN and JVC to minimize accumulation of sediment within the downstream section of KTN and JVC, and hence fully mitigate the potential odour emissions from the headspace of KTN and JVC near the existing discharge locations. Inspection will be carried out at KTN and JVC in regular intervals each year to monitor silt levels and the requirement to desilt. In the event that unacceptable odour due to headspace emissions from KTN and JVC are noticed by the inspection staff, de-silting can be arranged to clear up the silt accumulated in the box culverts to mitigate the odour problem. The odour generating operations within the proposed desilting compounds and DWFI compound will be fully enclosed and the odorous air will be collected and treated by high efficiency deodorizers before discharge to the atmosphere. Besides, all the three proposed desilting compounds and DWFI compound are separated from the immediate adjacent existing and/or planned ASRs with roads and/or amenity area. The compounds mainly serve to remove, dry and dispose of the sediment deposited at the box culvert of KTN and JVC. The detailed processes will be subjected to the detailed design of the compounds. With regards to the desilting operation, it is anticipated that the operation will be conducted within dry season. Five months from November to March are defined as the dry season and hence all desilting activities shall be scheduled to complete within this period each year as a cycle. Since the dry season is also the period with lower ambient temperature, odour nuisance associated with the operation of the desilting or DWFI compound during this period should also be lower. Therefore, it is anticipated that the residual odour impacts associated with the desilting compounds and the DWFI compound should be minimal and localized if any, and cumulative odour impacts with odour emissions from KTAC and KTTS are not expected.

6.6.18 Potential odour emission from wet well and discharge chamber are possible odour sources of PS6. Wet well and other sewage facilities would be covered and foul air would be ventilated to deodorizer for treatment before discharge to the environment. The ventilation system would also maintain a slight negative pressure within the facilities. Similar odour mitigation measures have also been implemented at other SPS in urban area to successfully control the potential odour impacts. With proper implementation of these odour mitigation measures, adverse odour impact from PS6 would not be expected.

6.6.19 For the other SPSs within KTD including PS1, PS1A, PS2, PN3 and NPS, their environmental impact are addressed in Section 4 of this EIA report.

6.6.20 Therefore, cumulative odour impacts with odour emissions from the above potential odour sources are not expected.

Odour Impact from Maintenance of Box Culvert in KTD

6.6.21 There is a potential for short-term release of odorous gas due to disturbance of the sediments during the maintenance activities of the box culverts in KTD. Nevertheless any odour impacts during the maintenance will be temporary and confined to an area close to odour generating activities. The extent of impacts depends on the amount and duration of exposure of odour sources. Also, maintenance works area likely to be carried out in dry cold conditions during the winter when bioactivity and thus odorous gas production is low.

6.7 Prediction and Evaluation of Environmental Impacts

Construction Dust

6.7.1 The maximum predicted cumulative 1-hour and 24-hour average TSP levels for construction of the Project are summarised in **Table 6.13**. Based on results indicated in **Table 6.13**, no exceedance of 1-hour average and 24-hour average TSP guideline and AQO is predicted at the ASRs 1.5m above ground. The predicted cumulative maximum 1-hour average and 24-hour average TSP concentration contours at 1.5m above local ground are shown in **Figures 3.3** to **3.6** (the bolded contours represent the respective AQOs) and no air sensitive uses are identified within the areas with predicted exceedances.

Table 6.13 Predicted Cumulative Maximum 1-hour Average TSP Concentrations at 1.5m above ground

ASRs	Scenario 1 (Mid 2009 to Mid 2013)		Scenario 2 (Mid 2013 to Late 2016)	
	Predicted 1-hr TSP conc.[1]	Predicted 24-hr TSP conc.[2]	Predicted 1-hr TSP conc.[1]	Predicted 24-hr TSP conc.[2]
A1	228	131	250	133
A2	163	117	165	116
A3	161	114	183	112
A4	163	115	189	114
A5	187	117	174	114
A6	170	111	188	118
A7	170	114	196	124
A8	191	118	208	130
A9	203	124	211	137
A10	218	125	224	139
A11	234	128	240	144
A12	210	123	219	140
A13	238	140	247	159
A14	267	161	280	169
A15	251	152	304	170
A16	250	149	325	173

ASRs	Scenario 1 (Mid 2009 to Mid 2013)		Scenario 2 (Mid 2013 to Late 2016)	
	Predicted 1-hr TSP conc.[1]	Predicted 24-hr TSP conc.[2]	Predicted 1-hr TSP conc.[1]	Predicted 24-hr TSP conc.[2]
A17	304	168	384	220
A18	212	133	267	166
A19	235	161	315	191
A20	194	132	253	156
A21	200	144	248	161
A22	174	128	218	144
A23	160	115	196	126
A24	191	131	212	132
A25	237	124	217	122
A26	234	139	211	117
A27	210	118	177	110
A28	254	128	178	113
A29	192	121	298	156
A30	219	114	308	134
A31	376	183	410	192
A32	290	145	312	169
A33	191	119	303	182
A34	190	118	326	170
A35	208	117	350	176
A36	206	117	360	183
A37	209	107	289	154
A38	193	104	245	139
A39	206	103	230	133
A40	217	106	247	138
A41	229	110	274	149
A42	236	113	291	156
A43	283	123	409	195
A44	251	130	358	182
A45	222	129	239	138
A46	222	121	245	143
A47	246	143	258	152
A48	477	207	481	212
A49	217	128	301	153
A50	212	115	245	135
A51	197	110	236	128
A52	194	111	265	154
A53	188	108	231	124
A54	182	107	204	114
A55	174	106	197	124
A56	165	106	271	151
A57	162	106	223	131
A58	163	106	220	127
A59	159	103	221	128
A60	154	101	201	117
A61	152	100	258	117
A62	157	101	202	126
A63	160	102	169	117
PA1(4)	N/A	N/A	207	123
PA2(4)	N/A	N/A	216	121
PA3(4)	N/A	N/A	225	124
PA4(4)	N/A	N/A	239	128

ASRs	Scenario 1 (Mid 2009 to Mid 2013)		Scenario 2 (Mid 2013 to Late 2016)	
	Predicted 1-hr TSP conc.[1]	Predicted 24-hr TSP conc.[2]	Predicted 1-hr TSP conc.[1]	Predicted 24-hr TSP conc.[2]
PA5(4)	N/A	N/A	242	131
PA6(4)	N/A	N/A	198	117
PA7(4)	N/A	N/A	196	119
PA8(4)	N/A	N/A	210	121
PA9(4)	N/A	N/A	257	137
PA10(4)	N/A	N/A	235	131
PA11(4)	N/A	N/A	227	126
PA12(4)	N/A	N/A	254	131
PA13(4)	N/A	N/A	253	141
PA14(4)	N/A	N/A	292	155
PA15(4)	N/A	N/A	363	193
PA16(4)	N/A	N/A	366	180
PA19(4)	N/A	N/A	274	158
PA31(4)	N/A	N/A	372	199
PA98(4)	N/A	N/A	260	148
PA99(4)	N/A	N/A	246	142
PA100(4)	N/A	N/A	231	133
PA101(4)	N/A	N/A	228	134

Note: (1) An hourly averaged TSP guideline level of 500µg/m^3 should not be exceeded.
(2) A 24-hour averaged TSP criteria of 260µg/m^3 should not be exceeded.
(3) Background TSP concentration of 79µg/m^3 was included.
(4) The population intake is after Year 2012

Operational Phase

Vehicular Emissions, Cruise Ship Emissions from the proposed Cruise Terminal at Kai Tak, Chimney Emissions from the San Po Kong and Kwun Tong Industrial Areas, Emission from the Planned Hospital and Planned Heliport in Kai Tak and Emission from Typhoon Shelters

6.7.2 Vehicular emissions, emissions from the cruise ships, emission from the proposed hospital, proposed heliport, emission from typhoon shelters, chimney emissions (include Sai Tso Wan Landfill) would all contribute to the cumulative air quality impact at KTD. The cumulative 1-hour and 24-hour average NO_2 and SO_2 and 24-hour RSP were calculated and the range of predicted concentrations is presented in **Table 6.14**. The detailed results are presented in **Appendix 3.16** and discussed below.

Table 6.14 Summary of Predicted Results

Emission Sources	Predicted Concentration, µg/m^3				
	NO_2		SO_2		RSP
	1-hr average	24-hr average	1-hr average	24-hr average	24-hr average
EM1	72 – 190	68 – 106	N/A	N/A	57 – 70
EM1a	67 – 75	67 – 70	N/A	N/A	57– 58
EM2	67 – 82	67 – 70	24 – 348	24 – 121	57 – 59
EM3	69 - 118	67 – 76	118 – 927 at A7, 45 – 343 at other ASRs	27 – 177	57 – 61
EM4	92 – 826 at PA108-113, 86 – 253 at other ASRs	72 – 380 at PA108-113, 72 – 109 at other ASRs	145 – 4075 at PA108-113, 681 – 1016 at PA64*, 341 – 410 at PA64**, 110 – 674 at other ASRs	52 – 1698 at PA108-113, 48 – 247 at other ASRs	60 – 228 at PA108-113, 60 – 80 at other ASRs
EM5	71 –169	68 – 84	27 – 105	24 – 38	57 – 66
EM6	67 – 145	67 – 87	24 – 88	24 – 40	57 – 86
C.I.	114 – 835 at PA108-113, 118 – 256 at other ASRs	84 – 384 at PA108-113, 77 – 116 at other ASRs	125 – 927 at A7, 145 – 4075 at PA108-113, 681 – 1016 at PA64*, 341 – 410 at PA64**, 126 – 674 at other ASRs	52 – 1698 at PA108-113, 53 – 247 at other ASRs	64 – 229 at PA108-113, 61 – 91 at other ASRs

Note:
EM1: Predicted worst-case concentration due to vehicular emissions (include open road, portals & ventilation buildings) alone
EM1a: Predicted worst-case concentration due to vehicular emissions (through Road L3) alone.
EM2: Predicted worst-case concentration due to emission from the proposed hospital at Kai Tak alone
EM3: Predicted worst-case concentration due to chimney emissions from San Po Kong and Kwun Tong industrial areas alone
EM4: Predicted worst-case concentration due to cruise emissions from the proposed cruise terminal at Kai Tak alone
EM5: Predicted worst-case concentration due to typhoon shelters emissions alone
EM6: Predicted worst-case concentration due to heliport emission alone
C.I.: Predicted worst-case concentration due to cumulative Impacts from all the above emission sources
Bolded and underlined value exceeds the AQO criteria
* Predicted results for the outdoor air quality at PA64 at assessment heights from 100m to 170m above ground.
** Predicted results for the indoor air quality at PA64 at assessment heights from 100m to 170m above ground (see S.6.7.6 for details).

6.7.3 **Vehicle Emissions, Emission from Proposed Hospital, Proposed Heliport and Existing Typhoon Shelters:** As shown in **Table 6.14** above, no adverse impact due to vehicle emissions, emission from the proposed hospital, proposed heliport and existing typhoon shelter alone. Further air quality assessment should be carried out and results should be submitted to EPD for application of installation chimney for any potential chimney emissions within the hospital site to ensure that there would not be unacceptable air quality impacts on the surrounding ASRs.

6.7.4 **Chimney Emissions within 500m the Project Boundary:** Existing ASR A7 is predicted to have exceedance of the 1-hr average AQO for SO_2 due to the existing chimney emissions from San Po Kong and Kwun Tong industrial areas and not the potential emissions from the Project. Since the fresh air in-take of this ASR is located at 10m above ground, adverse impact at A7 from chimney emission is therefore not expected. Adverse air quality impact due to this Project is also not expected.

6.7.5 **Cruise Emissions:** Based on the predicted results, Site 4D2 (Planned) Tourism Node (PA108 to PA113) is predicted to exceed both the 1-hr average and 24-hr average of NO_2 and SO_2 and 24-hr average RSP AQOs. Exceedances of the AQOs for both 1-hr and 24-hr average SO_2 are predicted at 50m and above. Exceedances of the 1-hr NO_2, 24-hr average NO_2 and 24-hr average RSP are predicted at above 60m, 55m and 90m, respectively. In order to account for the possible variation of stack height of the cruise vessels, the affected heights would be taken as from 40m or above. Given that the Tourism Node is a commercial ASR which will be centrally air-conditioned, it is therefore recommended in this EIA Report as a mitigation measure to position the fresh air intakes of the central air-conditioning system of the Tourism Node at locations with acceptable air quality (i.e. below 40m above ground for the Tourism Node) by future land lease control (see also Table 19.1). With the implementation of this proposed mitigation measure, adverse air quality impacts at the Tourism Node (PA108 to PA113) are not expected.

6.7.6 For ASR PA64, the modelling results demonstrated that no exceedances were predicted from ground level up to the height limit of the site stipulated in the OZP (i.e. up to 95m above ground or 100mPD). However, exceedance of the 1-hr average AQO for SO_2 was found at outdoor environment of ASR PA64 at a height of above 110m to 170m above ground. With reference to the currently available information, the site is under construction as an industrial use building with a maximum height of about 168m above ground. Besides, in accordance with the information shown in the building design drawings of the concerned industrial building, the building will be centrally air-conditioned. Based on the experience of building service engineer and reference design guidelines for air-conditioning system, for an industrial building with central air-conditioning system, the fresh air intake rate would be about 10% of the indoor air supply rate. In other words, the indoor air would be completely replaced by the outside air in about 10 hours and that the outdoor air would be mixed with the indoor air in the air-conditioning system prior to distributing to the occupiers of the building. For the purpose of assessing the worst-case hourly average concentration at those ASRs located within the industrial building at the height of more than 95m above ground (at assessment heights of 100m to 170m above ground), it is conservatively assuming that the indoor air would be completely replaced by the outside air through the fresh air intakes in about 6 hours. The predicted maximum 6-hour average concentration predicted at the site boundary of the industrial building at the respective assessment height is therefore taken as the worst-case hourly average concentration respired by the ASRs located within the industrial building. The predicted 1-hour average SO_2 concentration within the building at assessment heights of 100m to 170m above ground would be in the range of 341 – 410 $\mu g/m^3$ and demonstrated that no adverse indoor air quality impact at PA64 is expected.

6.7.7 **Cumulative Impact:** Based on the predicted results, ASRs A7 and PA108 to PA113 are predicted to exceed some of AQOs. The exceedances are due to the pollution source near to the respective ASR. The affected ASRs are all commercial ASRs. With proper design measure, adverse air quality impacts at the ASRs would not be expected. The predicted cumulative maximum 1-hour average and 24-hour average for both NO_2 and SO_2 and 24-hour average RSP concentration contours at 1.5m, 15m 35m, 40m, 55m, 70m, 95m, 120m, 150m & 160m above local ground are shown in **Figures 3.7** to **3.11** (the bolded contours represent the respective AQOs). As shown in **Figures 3.7, 3.8, 3.9 and 3.10**, localised exceedances of 1-hour average and 24-hour AQO for SO_2 and NO_2 were found at Kwun Tong Industrial area and To Kwa Wan area. The localised exceedances are due to the existing chimney emissions from Kwun Tong industrial area and To Kwa Wan areas and are not associated with the potential emissions from this Project. The detailed discussion on localised exceedance are summarised below. Air quality at representative ASRs PA56 & PA57 for the Stadium Complex located at Site 2D1 are complied with the AQO. In conclusion, adverse air quality impact to the existing and planned ASRs due to this Project is not expected.

Exceedance Area	Remarks
1-hr NO_2 concentration	
Near the two portals of Road T2 tunnel (Exceedance area found at 1.5m above ground)	Exceedance due to portal emission from Road T2 tunnel. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Proposed Heliport (Exceedance area found at 1.5m above ground)	Exceedance due to emission from Helicopter. Since the exceedance area is within the proposed heliport, adverse air quality impact is not expected.
Existing EHC portal and toll plaza (Exceedance area found at 1.5m above ground)	Exceedance due to emission from existing EHC portal and toll plaza. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Existing EHC Ventilation Building (Exceedance area found at 1.5m to 40m above ground)	Exceedance due to emission from existing ventilation building for EHC. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Localized area at Sai Tsoi Wan Landfill (Exceedance area found at 15m above ground)	Exceedance due to existing chimney emissions from Sai Tsoi Wan landfill and are not associated with the potential emissions from this Project. No adverse air quality impact from this Project.
Proposed Ventilation Building for CKR (Exceedance area found at 35m to 70m above ground)	Exceedance due to emission from proposed ventilation building for CKR. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Proposed Ventilation Building for Road T2 within KTD area (Exceedance area found at 35m to 40m above ground)	Exceedance due to emission from proposed ventilation building for Road T2. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Cruise Terminal (Exceedance area found at 55m above ground)	Exceedance due to cruise ship emission. Since the maximum building height of the cruise terminal is only 30m above ground, adverse air quality impact is not expected.
Runway and South Apron Area (Exceedance area found at 70m to 160m above ground)	Exceedance due to cruise ship emission. Since the fresh air intake for Tourism Node will be located at below 40m above ground and exceedance areas are above the maximum building height of the surrounding areas, adverse air quality impact is not expected.
Localized areas at Kwun Tong Area (Exceedance area found at 35m to 55m above ground)	Exceedance due to existing chimney emissions from Kwun Tong industrial area and are not associated with the potential emissions from this Project. No adverse air quality impact from this Project.
24-hr NO_2 concentration	
Near the two portals of the Road T2 tunnel (Exceedance area found at 1.5m above ground)	Exceedance due to portal emission from Road T2. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Proposed Heliport (Exceedance area found at 1.5m above ground)	Exceedance due to emission from Helicopter. Since exceedance area is within the proposed heliport, adverse air quality impact is not expected.
Existing EHC portal and toll plaza (Exceedance area found at 1.5m above ground)	Exceedance due to emission from existing EHC portal and toll plaza. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.

Exceedance Area	Remarks
Localized area at Sai Tsoi Wan Landfill (Exceedance area found at 15m above ground)	Exceedance due to existing chimney emissions from Sai Tsoi Wan landfill and are not associated with the potential emissions from this Project. No adverse air quality impact from this Project.
Proposed Ventilation Building for CKR (Exceedance area found at 35m to 55m above ground)	Exceedance due to emission from proposed ventilation building for CKR. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Proposed Ventilation Building for Road T2 within KTD area (Exceedance area found at 35 to 40m above ground)	Exceedance due to emission from proposed ventilation building for Road T2. No ASRs are identified within the exceedance area, adverse air quality impact is not expected.
Cruise Terminal (Exceedance area found at 55m to 160m above ground)	Exceedance due to cruise ship emission. Since the maximum building height of the cruise terminal is only 30m above ground, adverse air quality impact is not expected.
Runway and South Apron Area (Exceedance area found at 70m to 160m above ground)	Exceedance due to cruise ship emission. Since the fresh air intake for Tourism Node will be located at below 40m above ground and exceedance areas are above the maximum building height of the surrounding areas, adverse air quality impact is not expected.
Localized areas at Kwun Tong Area (Exceedance area found at 55m above ground)	Exceedance due to existing chimney emissions from Kwun Tong industrial area and are not associated with the potential emissions from this Project. No adverse air quality impact from this Project.
1-hr SO_2 concentration	
Localized areas at Kwun Tong Area, San Po Kong Area and To Kwa Wan Area (Exceedance area found at 35m to 70m above ground for San Po Kong Area and Kwun Tong Area 35m to 55m above ground To Kwa Wan Area)	Exceedance due to existing chimney emissions from Kwun Tong industrial area, Sun Po Kong industrial area and To Kwa Wan areas and are not associated with the potential emissions from this Project. No adverse air quality impact from this Project.
Cruise Terminal (Exceedance area found at 40m to 160m above ground)	Exceedance due to cruise ship emission. Since the maximum building height of the cruise terminal is only 30m above ground, adverse air quality impact is not expected.
Runway and South Apron Area (Exceedance area found at 55m to 160m above ground)	Exceedance due to cruise ship emission. Exceedances are predicted at ASR PA64 and the Tourism Node. For ASR PA64 which is an industrial building under construction, the building will be centrally air-conditioned and the air quality inside the building is predicted to be within AQO. For the Tourism Node, since the fresh air intake for Tourism Node will be located at below 40m above ground, adverse air quality impact is not expected. The remaining exceedance areas are above the maximum building height of the surrounding areas.
Kwun Tong Area (Exceedance area found at 120m to 160m above ground)	Exceedance due to cruise ship emission. No existing and planned ASRs are identified within the exceedance areas, adverse air quality impact is not expected.
Near proposed Hospital (Exceedance area found at 70m above ground)	Exceedance due to proposed hospital emission at KTD area. No existing and planned ASRs are identified within exceedance areas, adverse air quality impact is not expected.

Exceedance Area	Remarks
24-hr SO_2 concentration	
Localized areas at San Po Kong Area, To Kwa Wan Area and Kwun Tong Area (Exceedance area found at 35m to 40m above ground for San Po Kong Area and To Kwa Wan Area 35m to 70m above ground To Kwun Tong Area)	Exceedance due to existing chimney emissions from San Po Kong industrial area, To Kwa Wan area and Kwun Tong industrial area and are not associated with the potential emissions from this Project. No adverse air quality impact from this Project.
Runway and South Apron Area (Exceedance area found at 55m to 160m above ground)	Exceedance due to cruise ship emission. Since the fresh air intake for Tourism Node will be located at below 40m above ground and exceedance areas are above the maximum building height of the surrounding areas, adverse air quality impact is not expected.
24-hr RSP concentration	
Cruise Terminal (Exceedance area found at 55m to 160m above ground)	Exceedance due to cruise ship emission. Since the maximum building height of the cruise terminal is only 30m above ground, adverse air quality impact is not expected.
Runway and South Apron Area (Exceedance area found at 70m to 160m above ground)	Exceedance due to cruise ship emission. Since the fresh air intake for Tourism Node will be located at below 40m above ground and exceedance areas are above the maximum building height of the surrounding areas, adverse air quality impact is not expected.

Odour Impact from KTAC and KTN

6.7.8 The predicted odour concentrations in the vicinity of the Kai Tak Development under the existing scenario due to odour impacts arising from KTN, KTAC and KTTS are presented in **Figures 6.7a to 6.7d** in the form of contour plots for assessment heights of 1.5m, 10m, 20m, and 30m above ground respectively.

6.7.9 The predicted odour concentrations at the representative ASRs are listed in **Table 6.16**. Under the existing (unmitigated) scenario, the predicted odour concentrations at 1.5m level of the representative ASRs in the runway area would be in the range of 66.8 – 675.0 ou/m^3. Whereas the predicted odour concentrations at 1.5m level of the representative ASRs in the north apron area and the south apron area would be in the range of 86.3 – 550.6 ou/m^3 and 79.6 – 447.0 ou/m^3 respectively. The predicted odour concentrations at 1.5m level of the representative existing ASRs in the Kwun Tong and Kowloon City areas would be in the range of 56.2 – 71.9 ou/m^3. The dominant odour sources are the southern section of KTN and the northern portion of KTAC.

6.8 Mitigation of Environmental Impacts

Construction Phase

6.8.1 As shown in **Table 6.13**, the cumulative maximum 1-hour average and 24-hour average TSP concentrations are predicted to comply with the TSP criteria at all representative ASRs with watering on the active works areas eight times a day. In order to reduce the dust impacts further, requirements of the Air Pollution Control (Construction Dust) Regulation shall also be adhered to during the construction period. An environmental monitoring and audit program shall be implemented to monitor the construction process in order to enforce controls and to modify methods of work if dusty conditions arise. In addition, the following good site practices are recommended to minimise dust impacts during transportation and handling of dusty materials:

- Stockpiling site(s) should be lined with impermeable sheeting and bunded. Stockpiles should be fully covered by impermeable sheeting to reduce dust emission.
- Misting for the dusty material should be carried out before being loaded into the vehicle.
- Any vehicle with an open load carrying area should have properly fitted side and tail boards.
- Material having the potential to create dust should not be loaded from a level higher than the side and tail boards and should be dampened and covered by a clean tarpaulin.
- The tarpaulin should be properly secured and should extent at least 300 mm over the edges of the sides and tailboards. The material should also be dampened if necessary before transportation.
- The vehicles should be restricted to maximum speed of 10 km per hour and confined haulage and delivery vehicle to designated roadways insider the site. On-site unpaved roads should be compacted and kept free of lose materials.
- Vehicle washing facilities should be provided at every vehicle exit point.
- The area where vehicle washing takes place and the section of the road between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores.
- Every main haul road should be scaled with concrete and kept clear of dusty materials or sprayed with water so as to maintain the entire road surface wet.
- Every stock of more than 20 bags of cement should be covered entirely by impervious sheeting placed in an area sheltered on the top and the three sides.
- Every vehicle should be washed to remove any dusty materials from its body and wheels before leaving the construction sites.

Operational Phase

Vehicular Emissions, Cruise Ship Emissions from the proposed Cruise Terminal at Kai Tak, Chimney Emissions from the San Po Kong and Kwun Tong Industrial Areas, Emission from the Planned Hospital and Planned Heliport in Kai Tak and Emission from Typhoon Shelters

6.8.2 Exceedances of the 1-hr and 24-hr average AQOs due to potential emissions from this Project are predicted at the planned commercial ASR namely the Tourism Node and mainly due to cruise ship emissions from the proposed cruise terminal at Kai Tak. However, given that the Tourism Node will be centrally air-conditioned, it is therefore recommended in this EIA Report as a mitigation measure to position the fresh air intakes of the central air-conditioning system of the Tourism Node at locations with acceptable air quality (i.e. below 40m above ground for the Tourism Node) by future land lease control (see also **Table 19.1**). With the implementation of this proposed mitigation measure, adverse air quality impacts at the Tourism Node are not expected. Exceedances of the 1-hr average AQO for SO_2 are also predicted at the outdoor environment of ASR PA64 which is an industrial building under construction. Since the building will be centrally air-conditioned and the air quality inside the building is predicted to be within AQO, no mitigation measure would therefore be required. In addition to the mitigation measure recommended above, given that the cruise terminal will be financed by the Government, on-shore power supplies system could be installed at the cruise terminal when there is policy decision for its implementation and necessary funding approval. The on-shore power supplies system could reduce the emissions from those cruise vessels that are equipped with cold-ironing during their hotelling at the cruise terminal.

Odour Impact from KTN, KTAC and KTTS

6.8.3 The potential odour emissions from KTAC and KTTS would be mitigated by a series of odour reduction measures including *in-situ* sediment treatment by bioremediation, maintenance dredging to provide a sufficient water depth as capping layer for the sediment, improvement of water circulation to increase the DO level in KTAC and KTTS, and containment of pollution entering KTAC and KTTS.

6.8.4 The following assumptions were made in estimating the SOER for the source areas in KTAC and KTTS with the implementation of the proposed mitigation measures:

1. Localised maintenance dredging: It is assumed that localised maintenance dredging will provide water depth of not less than 3.5m over the whole of KTAC and KTTS. With reference to the water depth data recorded during the odour survey, only some areas along the edge of KTAC, in particular the area near the northern edge and the area near the JVC discharge have water depths shallower than 3.5m. The area involved would be about one-third of the KTAC and the dredging depth required would be from about 2.7m to less than 1m. **Figure 6.5** shows the sampling grids with water depth smaller than 3.5m during the odour survey. The dredging volume involved is estimated to be about 120,000 m^3. With the use of one closed grab dredger of $8m^3$ capacity and a daily dredging rate of about 1,000 m^3, the localized maintenance dredging would be finished within a total dredging period of about 120 days. The dredged sediment will be disposed of in accordance with the ETWB TCW No. 34/2002 *Management of Dredged / Excavated Sediment*. The proposed localized maintenance dredging will be implemented prior to the occupation of the future development in the immediate vicinity of the concerned section of KTAC. With regards to the handling of dredged materials during localized maintenance dredging, mitigation measures will be proposed to minimize the potential impacts, these include: (i) careful control of dredging rate; (ii) covering of the dredged materials; and (iii) dredging during non-summer season. With the implementation of these measures, the potential odour nuisance could be minimized and adverse odour impact at nearby ASRs is not expected.

2. Improvement of water circulation in KTAC and KTTS: As discussed in **Annex A (Section 7)**, with the proposed 600m gap opening at the northern part of the former Kai Tak runway, the water circulation in KTAC and KTTS would be substantially improved. Together with the improvement in water circulation, the DO level in KTAC and KTTS would also be increased. As shown in **Annex A (second figure in Appendix 7.4)**, under the existing situation, the 10 percentile bottom DO level in almost the entire KTAC and KTTS would be below the Water Quality Objectives of 2 mg/l. With the proposed 600m gap opening at the former Kai Tak runway, the bottom DO level in the entire KTAC and KTTS would be increased to 2 – 4 mg/l and fully complied with the Water Quality Objectives.

3. Combined effect of increased water depth and increased DO level: With reference to the odour survey results collected from KTAC and KTTS, at sampling locations with water depth not less than 3.5m and the bottom DO level not less than 2 mg/l, the highest recorded SOER was 2.90 $ou/m^2/s$. Therefore, for the purpose of this assessment, it was assumed that the combined effect of increased water depth and increased DO level (by implementing item 1 and item 2 above) would bring down the SOER of high odour emission areas to 2.90 $ou/m^2/s$. This residual SOER is a key assumption estimated based on the limited survey data collected under this study.

4. In-situ sediment treatment by bioremediation: Bioremediation would be applied to the entire KTAC and KTTS. The areas proposed for in-situ bioremediation are shown in **Figure 6.6**. With reference to results of the laboratory testing presented in **Annex A (Section 4)**, the odour removal efficiency of bioremediation improves with greater water depth and higher temperature. Taking into account the proposed measure to increase the water depth to not less than 3.5m under Item 1 above, the laboratory testing results with water column of 1.2m are considered more relevant. Based on the laboratory testing results with water column of 1.2m and under testing temperature of 25^oC, the odour removal efficiency of bioremediation was measured to be about 80-94%. At higher testing temperature of 35^oC (but with water column of 0.8m), the odour removal efficiency of bioremediation was even higher and measured to be about 97-98%. The odour removal efficiency of bioremediation would depend on a number of factors including by not limited to dosage, depth of injection, frequency of injection, etc (also see **Annex A (Section 6)** for more discussion). For the purpose of this assessment, two levels of odour removal efficiency by bioremediation, 80% and 90%, were examined. For the bioremediation operation, as discussed in **Annex A (Section 6)**, the final products of the bioremediation process will mainly be odourless gases namely nitrogen and carbon dioxide. Besides, based on the experience of previous field trial on bioremediation, the vessel injecting the liquid calcium nitrate solution would be travelling at a very slow speed of about 0.2m/sec. With this slow speed, any physical disturbance to the sediment and hence bubbling of H_2S gas would be instantaneous reacted with the calcium nitrate solution and odour emission during the bioremediation process is not expected. Odour emissions during the bioremediation process are therefore not anticipated, and this also agreed with the site observations during the previous field trials.

5. Containment of pollution entering KTAC and KTTS: Two desilting compounds are proposed for KTN (at Site 1D6 and Site 1P1) and a dry weather flow interceptor (DWFI) compound is proposed for JVC (at Site 3A3) to contain pollution in drainage systems entering the KTAC and KTTS by interception facilities until the ultimate removal of the pollution sources. Tidal barriers and desiliting facilities will form part of the compounds to prevent any accumulation of sediment within the downstream section of KTN and JVC and hence fully mitigate the potential odour emissions from the headspace of KTN and JVC near the existing discharge locations. The odour generating operations within the proposed desilting compounds and DWFI compound will be fully enclosed and the odorous air will be collected and treated by high efficiency deodorizers before discharge to the atmosphere.

6.8.5 In this assessment, following the discussion in **Section 2.7** on alternative development options for KTN, four mitigated scenarios for KTN, KTAC and KTTS were examined. The four mitigated scenarios are:

Mitigated Scenario A1: Decking of KTN within apron area + full mitigation of KTN and JVC headspace + desilting enhancement + localised maintenance dredging + 600m gap opening + in-situ bioremediation to achieve further 80% odour removal efficiency

Mitigated Scenario A2: Decking of KTN within apron area + full mitigation of KTN and JVC headspace + desilting enhancement + localised maintenance dredging + 600m gap opening + in-situ bioremediation to achieve further 90% odour removal efficiency

Mitigated Scenario B1: Reconstruct KTN into Kai Tak River within apron area + full mitigation of KTN and JVC headspace + desilting enhancement + localised maintenance dredging + 600m gap opening + in-situ bioremediation to achieve further 80% odour removal efficiency

Mitigated Scenario B2: Reconstruct KTN into Kai Tak River within apron area + full mitigation of KTN and JVC headspace + desilting enhancement + localised maintenance dredging + 600m gap opening + in-situ bioremediation to achieve further 90% odour removal efficiency

6.8.6 A section of the KTN further to the north within 500m away from the project boundary of KTD was also included in the odour impact assessment as existing odour source under all the mitigated scenarios. The location of KTN7 is the northernmost section of KTN with odour survey data and it well represents the potential odour emissions from the section of KTN immediate further north of the apron area. Thus the SOER measured at this location is taken to represent the existing section of KTN further north of the apron area.

6.8.7 Under all the mitigated scenarios, two desilting compounds are proposed for KTN (at Site 1D6 and Site 1P1) and a dry weather flow interceptor (DWFI) compound is proposed for JVC (at Site 3A3) to contain pollution in drainage systems entering the KTAC and KTTS by interception facilities until the ultimate removal of the pollution sources. It is noted that under the Project "Upgrading of Central & East Kowloon Sewerage - Packages 1 to 4", upgrading and construction of about 21km long sewers and associated sewerage works would be carried out for the central and east Kowloon region. This will include upgrading of the existing DWFIs for the drainage catchment of KTN. It is expected that these existing DWFIs at the upstream of KTN can effectively control the polluted flows after upgrading. In addition, under the "Kai Tak Approach Channel – Expedient Connection Survey Study", surveys will be undertaken to identify expedient connections in public drains/sewers and domestic buildings in Kowloon City, Ngau Tau Kok, Kowloon Bay, Wong Tai Sin and Choi Hung, for subsequent rectification. With these improvement works already planned for the upstream of KTN, DWFIs are therefore not recommended for the KTD de-silting compounds. Tidal barrier in form of penstock will be provided at the DWFI compound for JVC. Desiliting facilities will form part of the desilting and DWFI compounds and regular desilting will be carried out by the maintenance department at KTN and JVC to minimize accumulation of sediment within the downstream section of KTN and JVC, and hence fully mitigate the potential odour emissions from the headspace of KTN and JVC near the existing discharge locations. Inspection will be carried out at KTN and JVC in regular intervals each year to monitor silt levels and the requirement to desilt. In the event that unacceptable odour due to headspace emissions from KTN and JVC are noticed by the inspection staff, de-silting can be arranged to clear up the silt accumulated in the box culverts to mitigate the odour problem. The odour generating operations within the proposed desilting compounds and DWFI compound will be fully enclosed and the odorous air will be collected and treated by high efficiency deodorizers before discharge to the atmosphere. Besides, all the three proposed desilting compounds and DWFI compound are separated from the immediate adjacent existing and/or planned ASRs with roads and/or amenity area. The compounds mainly serve to remove, dry and dispose of the sediment deposited at the box culvert of KTN and JVC. The detailed processes will be subjected to the detailed design of the compounds. With regards to the desilting operation, it is anticipated that the operation will be conducted within dry season. Five months from November to March are defined as the dry season and hence all desilting activities shall be scheduled to complete within this period each year as a cycle. Since the dry season is also the period with lower ambient temperature, odour nuisance associated with the operation of the desilting or DWFI compound during this period should also be lower. Therefore, it is anticipated that the residual odour impacts associated with the desilting compounds and the DWFI compound should be minimal and localized if any, and cumulative odour impacts with odour emissions from KTAC and KTTS are not expected.

6.8.8 Besides, a large section of the northern seawall of the former Kai Tak Runway with deposition of sediment will be removed due to the construction of 600m gap opening under the mitigated scenarios. Any residual sediment deposited on the remaining section of northern seawall will also be cleaned up with the measures discussed in **Annex A (Section 6.7)**. Significant residual odour emissions from the seawall of the former Kai Tak Runway are therefore not expected.

6.8.9 Under Mitigated Scenarios B1 and B2, the existing Kai Tak Nullah within the former Apron area will be re-constructed into Kai Tak River from the south of Road D1 to the north of Road D2 along the existing alignment of KTN. The Kai Tak River will compose of a number of channels flowing with non-odorous fresh water and THEES effluent. The channel flowing with THEES effluent will be designed with the width of water surface of not more than 16m. For the purpose of the odour impact assessment, the SOER of the 16m wide THEES effluent flowing in the Kai Tak River will be taken as the SOER estimated for location KTN7 (the northern-most section of KTN within the former apron area). The location of KTN7 is now predominately flowing with THEES effluent without much influence from other runoff or expedient connections. Thus the SOER measured at this location is taken to conservatively represent the future THEES effluent-only flow in Kai Tak River.

6.8.10 The SOER assumed for the odour emitting areas in KTN, KTAC and KTTS under the unmitigated scenario and the four mitigated scenarios are tabulated in **Table 6.15**.

Table 6.15 Odour Emission Rates (SOER ($ou/m^2/s$) of KTN, KTAC, and KTTS under Different Modelling Scenarios

Location ID	Existing (Unmitigated Scenario)	Mitigated Scenarios A1 & B1		Mitigated Scenario A2 & B2	
KTN					
A section of the KTN further to the north within 500m away from the project boundary of KTD	0.22	0.22	0.22	0.22	0.22
KTN7	0.22	**Scenario A1** 0.00 (for the whole length of KTN within KTD)	**Scenario B1** 0.22 (for the whole length of Kai Tak River)	**Scenario A2** 0.00 (for the whole length of KTN within KTD)	**Scenario B2** 0.22 (for the whole length of Kai Tak River)
KTN6	3.79				
KTN5	0.90				
KTN4	0.21				
KTN3	1.21				
KTN2	44.58				
KTN1	9.45				
KTAC					
NKTAC93	1.83	0.366		0.183	
NKTAC92	23.30	0.580 *		0.290 *	
NKTAC91	18.19	0.580 *		0.290 *	
NKTAC85	0.61	0.122		0.061	
NKTAC84	1.16	0.232		0.116	
NKTAC83	2.89	0.578		0.289	
NKTAC82	10.25	0.580 *		0.290 *	
NKTAC81	3.50	0.580 *		0.290 *	
NKTAC75	0.20	0.040		0.020	
NKTAC74	0.36	0.072		0.036	
NKTAC73	0.61	0.122		0.061	
NKTAC72	9.56	0.580 *		0.290 *	
NKTAC71	2.46	0.492		0.246	
NKTAC65	0.36	0.072		0.036	
NKTAC64	0.63	0.126		0.063	
NKTAC63	1.35	0.270		0.135	
NKTAC62	19.74	0.580 *		0.290 *	
NKTAC61	24.83	0.580 *		0.290 *	
NKTAC55	0.44	0.088		0.044	
NKTAC54	0.93	0.186		0.093	
NKTAC53	1.16	0.232		0.116	
NKTAC52	7.41	0.580 *		0.290 *	
NKTAC51	13.51	0.580 *		0.290 *	
NKTAC45	1.16	0.232		0.116	
NKTAC44	0.98	0.196		0.098	
NKTAC43	2.30	0.460		0.230	
NKTAC42	1.97	0.394		0.197	
NKTAC41	1.16	0.232		0.116	
NKTAC35	17.10	0.580 *		0.290 *	

Location ID	Existing (Unmitigated Scenario)	Mitigated Scenarios A1 & B1	Mitigated Scenario A2 & B2
NKTAC34	0.19	0.038	0.019
NKTAC33	0.19	0.038	0.019
NKTAC32	0.20	0.040	0.020
NKTAC31	2.13	0.426	0.213
NKTAC25	2.90	0.580	0.290
NKTAC24	0.86	0.172	0.086
NKTAC23	0.13	0.026	0.013
NKTAC22	0.13	0.026	0.013
NKTAC21	0.83	0.166	0.083
NKTAC15	0.31	0.062	0.031
NKTAC14	1.07	0.214	0.107
NKTAC13	0.30	0.060	0.030
NKTAC12	1.44	0.288	0.144
NKTAC11	1.90	0.380	0.190
SKTAC35	0.33	0.066	0.033
SKTAC34	0.22	0.044	0.022
SKTAC33	0.16	0.032	0.016
SKTAC32	0.19	0.038	0.019
SKTAC31	8.76	0.580 *	0.290 *
SKTAC25	2.20	0.440	0.220
SKTAC24	4.87	0.580 *	0.290 *
SKTAC23	2.05	0.410	0.205
SKTAC22	4.86	0.580 *	0.290 *
SKTAC21	0.15	0.030	0.015
SKTAC15	3.64	0.580 *	0.290 *
SKTAC14	3.37	0.580 *	0.290 *
SKTAC13	2.05	0.410	0.205
SKTAC12	2.13	0.426	0.213
SKTAC11	2.05	0.410	0.205
KTTS			
KTTS74	0.13	0.026	0.013
KTTS73	0.38	0.076	0.038
KTTS72	1.90	0.380	0.190
KTTS71	1.11	0.222	0.111
KTTS61	0.54	0.108	0.054
KTTS54	0.11	0.022	0.011
KTTS53	0.15	0.030	0.015
KTTS52	1.02	0.204	0.102
KTTS51	0.47	0.094	0.047
KTTS45	0.19	0.038	0.019
KTTS44	0.48	0.096	0.048
KTTS43	0.51	0.102	0.051
KTTS42	0.10	0.020	0.010
KTTS41	0.17	0.034	0.017
KTTS34	0.13	0.026	0.013
KTTS33	0.61	0.122	0.061
KTTS32	0.19	0.038	0.019
KTTS31	0.21	0.042	0.021
KTTS25	0.12	0.024	0.012
KTTS24	0.08	0.016	0.008
KTTS23	0.08	0.016	0.008
KTTS22	0.10	0.020	0.010
KTTS21	0.11	0.022	0.011

Location ID	Existing (Unmitigated Scenario)	Mitigated Scenarios A1 & B1	Mitigated Scenario A2 & B2
KTTS13	0.12	0.024	0.012
KTTS12	0.08	0.016	0.008
KTTS11	0.08	0.016	0.008

Note: * As discussed in S6.8.4 item 3 above, for the purpose of this assessment, it was assumed that the combined effect of increased water depth and increased DO level (by implementing item 1 and item 2 of S6.8.4) would bring down the SOER of these high odour emission areas to 2.90 ou/m^2/s. The mitigated SOER is therefore calculated as 20% x 2.90 = 0.580 ou/m^2/s under Mitigated Scenarios A1 & B1 and 10% x 2.90 = 0.290 ou/m^2/s under Mitigated Scenarios A2 & B2.

Mitigated Scenario A1

6.8.11 **Figure 6.8a to 6.8d** are the odour contour plots for the predicted odour concentrations in the vicinity of the Kai Tak Development at assessment height of 1.5m, 10m, 20m, and 30m above ground respectively, based on the implementation of the proposed mitigation measures including in-situ treatment of the most contaminated sediment by bioremediation to achieve further 80% odour removal efficiency together with decking of KTN within apron area.

6.8.12 The odour contour plots show that the predicted odour concentrations in the vicinity of the Kai Tak Development have been reduced significantly. Besides, as shown in **Table 6.16**, the predicted odour concentrations at 1.5m level of the representative ASRs in the runway area would be reduced from 66.8 – 675.0 ou/m^3 to 6.9 – 25.1 ou/m^3. Whereas the predicted odour concentrations at 1.5m level of the representative ASRs in the north apron area and the south apron area would be reduced from 86.3 – 550.6 ou/m^3 to 4.1 – 20.5 ou/m^3 and from 79.6 – 447.0 ou/m^3 to 8.0 – 32.2 ou/m^3 respectively. The predicted odour concentrations at 1.5m level of the representative existing ASRs in the Kwun Tong and Kowloon City areas would be in the range of 4.2 – 11.2 ou/m^3. Exceedances of the odour criteria of 5 ou/m^3 are predicted at all the selected planned ASRs in the runway and south apron areas and some ASRs in the north apron area and the existing Kwun Tong and Kowloon City areas under the worst-case conditions.

6.8.13 Besides, as shown by the modelling results at different assessment heights in **Figures 6.10a to 6.10d** and in **Table 6.16**, depends on the area of concern, the predicted odour concentrations dropped by about 10% to more than 70% when assessment height increases from 1.5m to 30m above ground level. The modelling results indicate that exceedances of the odour criteria of 5 ou/m^3 are not predicted at the upper levels of the some of the ASRs, in particular those in the north apron area under the worst-case conditions.

Mitigated Scenario B1

6.8.14 **Figure 6.9a to 6.9d** are the odour contour plots for the predicted odour concentrations in the vicinity of the Kai Tak Development at assessment height of 1.5m, 10m, 20m, and 30m above ground respectively, based on the implementation of the proposed mitigation measures the same as those for Mitigated Scenario A1 except with the reconstruction of KTN into Kai Tak River within apron area. In other words, as compared with Mitigated Scenario A1, there will be some additional minor odour emissions from the water surface of the Kai Tak River that is flowing with the THEES effluent under Mitigated Scenario B1.

6.8.15 The odour contour plots show that the predicted odour concentrations in the vicinity of the Kai Tak Development would be very similar to those predicted under Mitigated Scenario A1 except at the lower levels of some ASRs in the north apron area along the Kai Tak River. As shown in **Table 6.16**, the ranges of the predicted odour concentrations at 1.5m level of the representative ASRs in different areas are similar to those predicted under Mitigated Scenario A1. The predicted odour concentrations at 1.5m level of the representative ASRs in the runway area would be reduced from 66.8 – 675.0 ou/m^3 to 7.0 – 25.1 ou/m^3. Whereas the predicted odour concentrations at 1.5m level of the representative ASRs in the north apron area and the south apron area would be reduced from 86.3 – 550.6 ou/m^3 to 4.5 – 20.5 ou/m^3 and from 79.6 – 447.0 ou/m^3 to 8.0 – 32.2 ou/m^3 respectively. The predicted odour concentrations at 1.5m level of the representative existing ASRs in the Kwun Tong and Kowloon City areas would be in the range of 4.9 – 11.2 ou/m^3. Exceedances of the odour criteria of 5 ou/m^3 are predicted at all the selected planned ASRs in the runway and south apron areas and some ASRs in the north apron area and the existing Kwun Tong and Kowloon City areas under the worst-case conditions.

6.8.16 Besides, similar to Mitigated Scenario A1, the modelling results at different assessment heights shown in **Figures 6.9a to 6.9d** and in **Table 6.16** indicate that the predicted odour concentrations dropped by about 10% to more than 70% when assessment height increases from 1.5m to 30m above ground level. The modelling results indicate that exceedances of the odour criteria of 5 ou/m^3 are not predicted at the upper levels of the some of the ASRs, in particular those in the north apron area under the worst-case conditions.

Mitigated Scenario A2

6.8.17 **Figure 6.10a to 6.10d** are the odour contour plots for the predicted odour concentrations in the vicinity of the Kai Tak Development at assessment height of 1.5m, 10m, 20m, and 30m above ground respectively, based on the implementation of the proposed mitigation measures including in-situ treatment of the most contaminated sediment by bioremediation to achieve further 90% odour removal efficiency together with decking of KTN within apron area.

6.8.18 The odour contour plots show that the predicted odour concentrations in the vicinity of the Kai Tak Development have been reduced significantly. Besides, as shown in **Table 6.16**, the predicted odour concentrations at 1.5m level of the representative ASRs in the runway area would be reduced from 66.8 – 675.0 ou/m^3 to 3.5 – 12.6 ou/m^3. Whereas the predicted odour concentrations at 1.5m level of the representative ASRs in the north apron area and the south apron area would be reduced from 86.3 – 550.6 ou/m^3 to 2.1 – 10.3 ou/m^3 and from 79.6 – 447.0 ou/m^3 to 4.0 – 16.1 ou/m^3 respectively. The predicted odour concentrations at 1.5m level of the representative existing ASRs in the Kwun Tong and Kowloon City areas would be in the range of 3.7 – 11.2 ou/m^3. Exceedances of the odour criteria of 5 ou/m^3 are predicted at some of the selected planned ASRs in the runway, south apron, and north apron areas under worst-case conditions. Exceedance is also predicted at 1.5m level of ASR OA41 in the existing Kowloon City area. The same odour concentrations were predicted at the 1.5m level of ASR OA41 under both Mitigation Scenario A1 and Mitigated Scenario A2, this indicates that the predicted exceedance at ASR OA41 is due to the odour emission from the existing KTN to the north of Prince Edward Road East rather than the residual odour emission from KTAC or Kai Tak River.

6.8.19 Besides, as shown by the modelling results at different assessment heights in **Figures 6.10a to 6.10d** and in **Table 6.16**, depends on the area of concern, the predicted odour concentrations dropped by about 10% to more than 70% when assessment height increases from 1.5m to 30m above ground level. The modelling results indicate that exceedances of the odour criteria of 5 ou/m^3 are not predicted at 30m level of most of the ASRs under the worst-case conditions.

Mitigated Scenario B2

6.8.20 **Figure 6.11a to 6.11d** are the odour contour plots for the predicted odour concentrations in the vicinity of the Kai Tak Development at assessment height of 1.5m, 10m, 20m, and 30m above ground respectively, based on the implementation of the proposed mitigation measures the same as those for Mitigated Scenario A2 except with the reconstruction of KTN into Kai Tak River within apron area. In other words, as compared with Mitigated Scenario A2, there will be some additional minor odour emissions from the water surface of the Kai Tak River that is flowing with the THEES effluent under Mitigated Scenario B2.

6.8.21 The odour contour plots show that the predicted odour concentrations in the vicinity of the Kai Tak Development would be very similar to those predicted under Mitigated Scenario A2 except at the lower levels of some ASRs in the north apron area along the Kai Tak River. As shown in **Table 6.16**, the ranges of the predicted odour concentrations at 1.5m level of the representative ASRs in different areas are similar to those predicted under Mitigated Scenario A2. The predicted odour concentrations at 1.5m level of the representative ASRs in the runway area would be reduced from 66.8 – 675.0 ou/m^3 to 3.5 – 12.6 ou/m^3. Whereas the predicted odour concentrations at 1.5m level of the representative ASRs in the north apron area and the south apron area would be reduced from 86.3 – 550.6 ou/m^3 to 2.5 – 10.3 ou/m^3 and from 79.6 – 447.0 ou/m^3 to 4.0 – 16.1 ou/m^3 respectively. The predicted odour concentrations at 1.5m level of the representative existing ASRs in the Kwun Tong and Kowloon City areas would be in the range of 3.7 – 11.2 ou/m^3.

6.8.22 Exceedances of the odour criteria of 5 ou/m^3 are predicted at some of the selected planned ASRs in the runway, south apron, and north apron areas under worst-case conditions. However, exceedances are not predicted at the ASRs on the two sides of the Kai Tak River under this mitigated scenario. Exceedance is predicted at 1.5m level of ASR OA41 in the existing Kowloon City area. As discussed above, the predicted exceedance at ASR OA41 is due to the odour emission from the existing KTN to the north of Prince Edward Road East rather than the residual odour emission from KTAC or Kai Tak River.

6.8.23 Besides, similar to Mitigated Scenario A2, the modelling results at different assessment heights shown in **Figures 6.11a to 6.11d** and in **Table 6.16** indicate that the predicted odour concentrations dropped by about 10% to more than 70% when assessment height increases from 1.5m to 30m above ground level. The modelling results indicate that exceedances of the odour criteria of 5 ou/m^3 are not predicted at 30m level of most of the ASRs under the worst-case conditions.

Odour Impact from PS6

6.8.24 The major odour sources (wet well and distribution chambers) of SPS would be located within enclosed building structures. With proper enclosure and ventilation system to divert the odour emissions to deodorizer for treatment before discharge to environment, odour impacts could be mitigated to an acceptable level and no insurmountable environmental impact is therefore expected.

Odour Impact from Maintenance of Box Culvert in KTD

6.8.25 Any odour impacts during the maintenance of box culvert will be temporary and confined to an area close to odour generating activities. The extent of impacts depends on the amount and duration of exposure of odour sources. Also, maintenance works area likely to be carried out in dry cold conditions during the winter when bioactivity and thus odorous gas production is low. The following controls and mitigation measures should be undertaken where practicable to reduce the impact:

- During the maintenance process, there is a potential for release of odorous gas due to disturbance of the sediments. A temporary shed will be provided at the maintenance opening and the odour impacts could be reduced by extracting the air through portable odour control equipment.

- Sediments with odorous emission should be carried by vehicles with closed container to minimise odour impact during transportation.

- The material temporarily stockpiled along the maintenance access road next to the box culvert should be properly covered. The area shall be sheltered by a 2.5m high rock catcher berm.

6.9 Residual of Environmental Impacts

<u>Construction Phase</u>

6.9.1 With the implementation of the proposed mitigation measures and the dust suppression measures stipulated in Air Pollution Control (Construction Dust) Regulation during the construction phase, no adverse residual air quality impact would be expected.

<u>Operational Phase</u>

Vehicular Emissions, Cruise Ship Emissions from the proposed Cruise Terminal at Kai Tak, Chimney Emissions from the San Po Kong and Kwun Tong Industrial Areas, Emission from the Planned Hospital and Planned Heliport in Kai Tak and Emission from Typhoon Shelters

6.9.2 The predicted cumulative air quality impacts on the existing and planned residential ASRs due to potential emissions from this Project are complying with the AQO. AQO exceedance due to potential emissions from this Project would not be expected on the commercial ASRs (Tourism Node) if the fresh air intakes of the central air-conditioning system are located at locations (i.e. below 40m above ground for the Tourism Node) with acceptable air quality. For ASR PA64 which is an industrial building under construction, exceedances of the 1-hour average AQO for SO_2 are predicted at its outdoor environment. Since the building will be centrally air-conditioned and the air quality inside the building is predicted to be within AQO, no residual impact is anticipated.

Odour Impact from KTN, KTAC and KTTS

6.9.3 Exceedance of odour criterion is still predicted at some representative planned ASRs under the worst case condition though proposed mitigation measures are in place. In order to investigate the frequency of exceedance of the odour criterion at the representative ASRs under the four mitigated scenarios, odour modelling was conducted for every hour of a year based on year 2006 hourly meteorological data. However, as discussed above in Section 9.5.3, the peak-to-mean ratios stated in the NSW Approved Method employed in this odour assessment has assumed a 0.1% exceedance level. Therefore, there is a 0.1% probability that the actual peak concentration would be higher than those derived with the peak-to-mean ratios stated in the NSW Approved Method. Conservatively, if we assume all of this 0.1% actual peak concentration (which are higher than the predicted peak concentration) exceeded the odour criterion, then there would be 0.1% more of time exceedance in year at the ASRs. The predicted frequency of exceedance at the representative ASRs under the mitigated scenarios, including the additional 0.1% due to intrinsic uncertainty of the modelling approach, are shown in **Tables 6.17 and 6.18**.

6.9.4 The odour modelling results indicate that with the implementation of the proposed mitigation measures, the existing odour problems in the vicinity of Kai Tak Development would be alleviated to a large extent. However, exceedances of the odour criterion are still predicted at some ASRs under the worst case condition. The following points should be noted with reference to Section 4.4.3 of the EIAO-TM regarding the predicted residual odour impacts at these ASRs:

(i) Effects on public health and health of biota or risk to life:

In terms of human health effects of hydrogen sulphide[3], respiratory, neurological, and ocular effects are the most sensitive end-points in humans following inhalation exposures. There are no adequate data on carcinogenicity. Exposure of H_2S at 2.0 ppm would cause bronchial constriction in asthmatic individuals; while exposure of 3.6 ppm H_2S would cause increase eye complaints for general population; and exposure of 20 ppm H_2S would cause fatigue, loss of appetite, headache, irritability, poor memory, and dizziness. Besides, with reference to the Integrated Risk Information System (IRIS) of USEPA, the reference concentration of H_2S for chronic inhalation exposure to human population without an appreciable risk of deleterious effects during a lifetime is 2×10^{-3} mg/m^3 (or 0.00142 ppm).

As shown in **Table 6.16**, the predicted maximum odour concentrations at the representative ASRs among the four mitigated scenarios would be 32.2 ou/m^3 over 5 second average. With reference to the detailed laboratory testing results for sediments collected from bioremediation test area as presented in **Table 4.2 of Annex A**, the ratio of H_2S concentration (in ppb) to odour concentration (ou/m^3) ranges from 0.38% to 2.00%. If we take the highest ratio of 2.00%, 32.2 ou/m^3 is equivalent to H_2S concentration of about 0.000644 ppm which is more than 3000 times below the H_2S concentration of 2.0 ppm with adverse health symptom on asthmatic individuals. This level of H_2S concentration is also less than 50% of the reference chronic inhalation exposure concentration stipulated in the USEPA IRIS.

To conclude, it is expected that no adverse health impact to human for exposure under such a low concentration of H_2S.

(ii) The magnitude of adverse environmental impacts:

The predicted worst-case odour concentrations at the representative ASRs under the four mitigated scenarios are tabulated in **Table 6.16**.

[3] Concise International Chemical Assessment Document 53, Hydrogen Sulfide: Human Health Aspects, World Health Organization, 2003

(iii) The geographic extent of the adverse environmental impacts:

The extent of exceedance of the odour criterion are shown in **Figures 6.8 to 6.11** for the four mitigated scenarios.

(iv) The duration and frequency of the adverse environmental impacts:

The duration and frequency of exceedance of odour criterion at the representative ASRs under the four mitigated scenarios are tabulated in **Tables 6.17 and 6.18**. Exceedances of one time and two times of the odour criterion at some ASRs in close proximity to KTAC and KTTS would still occur for 46.9% and 32.7% of time respectively in a year under Mitigated Scenarios A1 and B1. Whereas under Mitigated Scenarios A2 and B2, exceedances of one time and two times of the odour criterion at some ASRs in close proximity to KTAC and KTTS would occur for 32.7% and 10.2% of time respectively in a year. However, it should be noted that these frequencies of exceedances only take into account the variation of wind direction and wind speed over the year but assuming worst-case odour emission conditions (i.e. the highest odour emissions captured under this study during low tides in the hottest days in summer season) prevail over the entire year. With reference to the findings of the laboratory testing presented in **Section 4 of Annex A**, substantial increase in H_2S and odour emissions were observed when the temperature increase from 25^oC to 35^oC under the laboratory conditions. Based on the year 2006 hourly meteorological data, the percentage of time over a year with ambient temperature at or exceeding 25^oC is about 45%. By assuming that the worst case odour emissions would occur during period with ambient temperature at or exceeding 25^oC and during low tides (say 50% of time in a day), under Mitigated Scenarios A1 and B1, exceedances of one time and two times of the odour criterion at some ASRs in close proximity to KTAC and KTTS would be roughly estimated to occur for about 10.6% and 7.4% of time respectively in a year, whereas under Mitigated Scenarios A2 and B2, exceedances of one time and two times of the odour criterion at some ASRs in close proximity to KTAC and KTTS would be roughly estimated to occur for about 7.4% and 2.3% of time respectively in a year.

(v) The likely size of the community or the environment that may be affected by the adverse impacts:

As indicated in **Figures 6.8 to 6.11**, with the implementation of proposed odour mitigation measures, the odour concentrations in the vicinity of the Kai Tak Development would be reduced substantially as compared with the existing (unmitigated) scenario. However, exceedances of the odour criterion are still predicted at some ASRs under the four mitigated scenarios. Yet the modelling results indicate that the worst-case odour impacts would only occur near the ground level of the ASRs. Under Mitigated Scenarios A2 and B2, at 30m above ground, the modelling results only indicate localised exceedances around a southern part of the runway area and around the stadium complex. In other words, the affected population would be limited to those stay in close proximity to KTAC and KTTS and at or close to ground levels.

(vi) The degree to which adverse environmental impacts are reversible or irreversible:

The existing odour nuisance at the ASRs will be alleviated with the implementation of the odour mitigation measures proposed under this study. Besides, with the continuous improvement in controlling pollution entering KTAC and KTTS, the odour impact at the affected ASRs would be further minimized in the longer term.

(vii) The ecological context:

The predicted exceedance would not involve any ecological context.

(viii) The degree of disruption to sites of cultural heritage:

The predicted exceedance would not involve any cultural heritage context.

(ix) International and regional importance:

The predicted exceedance would not involve any international and regional importance.

(x) Both the likelihood and degree of uncertainty of adverse environmental impacts:

The degree of certainty of the predicted odour impacts depends on the accuracy of the estimated odour emission rates and the air dispersion modelling. The number of air samples collected as well as the intrinsic limitations of the air sampling technique and the olfactometry analysis would also affect the accuracy of odour emission rate estimation.

Given that the odour surveys were carried out in a limited number of days, the measured odour concentrations are basically snapshot values. However, the odour emission rates obtained from the survey were under worst case conditions with the sampling exercise carried out during the hottest days in the summer season of 2007 with low tide and extremely high ambient air temperature (28^{o}C – 35^{o}C and with about 75% of the samples collected at or above 32^{o}C). It is believed that the estimated odour emission rates are representing reasonable worst case conditions.

Air sampling is an important step in the process of measuring the odour concentrations of the sources, it would affect the quality and reliability of the results. All the odour sampling was carried out by the odour sampling team of Hong Kong Polytechnic University (HKPU) which has the most extensive local experience in odour sampling. The potential error associated with odour sampling process is considered to be on the low side.

It should be noted that all the odour concentrations (in ou/m^3) and hence area source emission rates (in ou/m^2/s) were measured by olfactometry analysis carried out at the Odour Research Laboratory of HKPU in accordance with the European Standard Method (EN13725). This European Standard Method specifies a method for the objective determination of the odour concentration of a gaseous sample using dynamic olfactometry with human assessors. The detection limit for this European Standard Method is 10 ou/m^3. Yet the detection limit of this European Standard Method could vary between laboratories. Therefore, in reviewing the odour concentration results (in ou/m^3), it should be noted that a measured low odour concentration value would normally has a higher degree of error due to the inherent properties of the olfactometry analysis method.

Besides, the degree of certainty of the predicted odour impacts under mitigated scenarios would depend on the accuracy of the estimated mitigated odour emission rates. For the purpose of this assessment, it was assumed that the combined effect of increased water depth and increased DO level (by localised maintenance dredging and improvement of water circulation in KTAC and KTTS with the 600m gap opening) would bring down the SOER of high odour emission areas to 2.90 ou/m^2/s. This residual SOER is a key assumption estimated based on the survey data collected under this study.

In addition, the odour removal efficiency of bioremediation would depend on a number of factors including by not limited to dosage, depth of injection, frequency of injection, etc. For the purpose of this assessment, two levels of odour removal efficiency by bioremediation, 80% and 90%, were therefore examined to address any uncertainty of the residual odour impact after mitigation. Based on the limited findings of the laboratory tests and pilot field trials, 80% odour removal efficiency is considered to be on the conservative side whereas 90% odour removal efficiency is considered to be more realistic in view of the fact that *in-situ* bioremediation had been successful applied in tackling the odour problem generated from contaminated sediments in Hong Kong namely in Shing Mun River and Sam Ka Tsuen Typhoon Shelter. Having said that, since the pilot field trial at KTAC had only been conducted for a year, the long term effectiveness of the bioremediation at KTAC and KTTS would need to be verified by the odour patrol specified in the EM&A programme of this study after the proposed full-scale bioremediation.

There is also uncertainty on the effectiveness of the proposed desilting at KTN and JVC to fully mitigate the potential odour emissions from the headspace of KTN and JVC near the existing discharge locations. The actual performance would need to be verified by the odour patrol specified in the EM&A programme of this study.

6.9.5 Referring to the points discussed in Section 6.9.4 above, no adverse health or risk impact is expected at the ASRs in the vicinity of the Kai Tak Development though their odour levels exceeded the EIAO-TM criteria in accordance with the air modelling results under the worst case condition. The highest odour levels predicted at the ASRs among the four mitigated scenarios would be 32.2 ou/m^3, which is more than 3000 times below the H_2S concentration of 2.0 ppm with adverse health symptom on asthmatic individuals. Hence, with the implementation of the proposed odour mitigation measures, no adverse odour impact is expected at the existing and planned ASRs in the vicinity of the Kai Tak Development.

6.9.6 Based on the current implementation programme, most of the proposed odour mitigation measures under the above four mitigated scenarios, except the 600m runway gap opening, will be substantially completed by mid 2012 before the first population intake of the public housing development in Area 1 and the commissioning of the proposed cruise terminal in late 2012. The odour nuisance associated with the KTN, KTAC, and KTTS would be largely improved by then. Yet the reduction of the odour levels at the ASRs as predicted under the four mitigated scenarios could not be fully achieved prior to the completion of the 600m runway gap opening in 2014 to improve the water circulation in KTAC and KTTS. During the interim period after the first occupation of KTD and before the completion of the 600m gap opening, residual odour impacts slightly worse than those predicted for the four mitigated scenarios would be expected at the ASRs in Area 1 and the cruise terminal. However, given that the proposed *in-situ* bioremediation works would be substantially completed before the first population intake, with the assumed odour removal efficiency of bioremediation of 80% to 90%, the odour levels at the ASRs in Area 1 would likely be reduced from about 50 – 150 ou/m^3 under the unmitigated scenario (see **Figure 6.7a**) to about 5 – 30 ou/m^3 during the interim period. For the proposed cruise terminal, the odour levels at the ASRs would likely be reduced from 50 – 100 ou/m^3 under the unmitigated scenario (also see **Figure 6.7a**) to about 5 – 20 ou/m^3 during the interim period. The level of residual odour impacts at these ASRs during the interim period would be similar or lower than the residual odour impacts at the worst-affected ASRs in KTD under the ultimate scenario.

6.10 Environmental Monitoring and Audit

Construction Phase

6.10.1 With the implementation of the proposed mitigation measures and the dust suppression measures stipulated in Air Pollution Control (Construction Dust) Regulation during the construction phase, no adverse residual air quality impact would be expected. Details of the dust monitoring requirements during the construction phase are provided in the EM&A Manual.

Operational Phase

Vehicular Emissions, Cruise Ship Emissions from the proposed Cruise Terminal at Kai Tak, Chimney Emissions from the San Po Kong and Kwun Tong Industrial Areas, Emission from the Planned Hospital and Planned Heliport in Kai Tak and Emission from Typhoon Shelters

6.10.2 With the implementation of the proposed mitigation measures, the predicted air quality at the ASRs would comply with AQO. No environmental monitoring and audit would be necessary during the operational phase.

Odour Impact from KTN, KTAC and KTTS

6.10.3 Monthly (from July to September) monitoring of odour impacts, for a period of 2 years, is proposed during the operational phase of the Project to ascertain the effectiveness of the proposed mitigation measures over time, and to monitor any on-going odour impacts at the ASRs. If residual odour impact is still found at the end of the odour monitoring programme, further investigation would be carried out to review the odour problem and to identify the parties responsible for further remedial action.

6.10.4 In order to determine the effectiveness of the bioremediation monitoring of treated sediment is proposed. Annual sediment sampling for a period of 2 years should be conducted during the operational phase after completion of the odour remediation works conducted at KTAC and KTTS including the full-scale in-situ bioremediation, localized maintenance dredging and the 600m gap opening.

Odour Impact from PS6

6.10.5 No residual odour impact would be expected. To facilitate compliance of the odour criterion stipulated in the EIAO-TM, commissioning tests for all deodorization systems should be included in the Design and Construction Contract Document.

6.11 Summary

Construction Phase

6.11.1 The major potential air quality impact during the construction phase of the project will be dust arising from haul road emissions, open site erosion, excavation and filling activities. Civil works related to the demolition of existing structures and construction of infrastructure will also cause emissions. Two worst case scenarios based on the latest construction schedules have been identified and assessed. The findings of the construction phase air quality assessment indicate that no exceedance of the 1-hour and 24-hour average TSP criteria and AQO are predicted at ASRs in the vicinity of the construction sites. In order to ensure compliance with the TSP criteria at the ASRs at all times, the dust suppression measures and requirements of the Air Pollution Control (Construction Dust) Regulation should be adhered to during the construction period. In addition, a comprehensive dust monitoring and audit programme are recommended to ensure the effective implementation of dust suppression measures.

Operational Phase

Vehicular Emissions, Cruise Ship Emissions from the proposed Cruise Terminal at Kai Tak, Chimney Emissions from the San Po Kong and Kwun Tong Industrial Areas, Emission from the Planned Hospital and Planned Heliport in Kai Tak and Emission from Typhoon Shelters

6.11.2 The cumulative effect arising from the cruise ships, proposed hospital and chimney emission from the San Po Kong and Kwun Tong industrial areas was assessed. Results show that the predicted air quality at all the existing and planned residential ASRs would comply with the AQOs. Besides, adverse air quality impact on the commercial ASRs would be not be expected if the fresh air intakes of the central air-conditioning system are located at locations below 40m above ground with acceptable air quality.

Odour Impact from KTN, KTAC and KTTS

6.11.3 Apart from the above potential air quality impacts, odour nuisance associated with the Kai Tak Approach Channel (KTAC) is an existing environmental problem. In order to improve the environment, this Project will take the opportunity to mitigate the potential sources of odour nuisance within the Project area so as to alleviate this existing environmental problem, as well as to provide an acceptable environment for the future land uses within the project area.

6.11.4 Mitigation measures have been formulated to alleviate this existing odour problem. These include reconstruction or decking of Kai Tak Nullah (KTN) within the former apron area, full mitigation of the potential odour emissions from the headspace of KTN and JVBC near the existing discharge locations, localised maintenance dredging within KTAC, 600m gap opening at the northern section of the former runway to improve the water circulation in KTAC, and the implementation of in-situ bioremediation to treat the sediment accumulated at KTAC and Kwun Tong Typhoon Shelter (KTTS). With the implementation of these odour mitigation measures, the predicted odour levels in the vicinity of KTAC would be reduced significantly. In other words, this Project will alleviate the existing odour problems in the vicinity of KTAC to a large extent by implementing the proposed mitigation measures. However, some exceedances of the odour criterion are still predicted at some of the ASRs under the worst case conditions. Nevertheless, the residual odour levels are predicted to be very low and no adverse health effect on human is expected. Hence, with the implementation of the proposed odour mitigation measures, adverse odour impact is not expected at the existing and planned ASRs in the vicinity of the Kai Tak Development.

Table 6.16 Predicted Odour Concentrations at Representative ASRs under Different Assessment Scenarios

ASR ID	Assessment Height (m)	Region	Description	Predicted Odour Concentration (ou/m3 in 5-s average)				
				Existing (unmitigated) Scenario	Mitigated Scenario A1	Mitigated Scenario B1	Mitigated Scenario A2	Mitigated Scenario B2
OA1	1.5	North apron area of Kai Tak Development	Planned stadium, site2D	290.9	20.5	20.5	10.3	10.3
	10			269.7	19.3	19.3	9.7	9.7
	20			217.0	16.3	16.3	8.2	8.2
	30			157.5	12.8	12.8	6.4	6.4
OA2	1.5		Planned residential site 1L3	192.0	8.4	8.4	4.2	4.2
	10			163.1	8.0	8.0	4.0	4.0
	20			129.4	7.0	7.0	3.5	3.5
	30			101.2	5.7	5.7	2.8	2.8
OA3	1.5		Existing EMSD Headquarters, site 1N	330.1	6.5	6.5	3.2	3.2
	10			218.2	6.1	6.1	3.0	3.0
	20			110.8	5.0	5.0	2.5	2.5
	30			67.2	4.2	4.2	2.1	2.1
OA4	1.5	South apron area of Kai Tak Development	Planned government site 3B1	277.6	15.5	15.5	7.7	7.7
	10			197.1	11.0	11.0	5.5	5.5
	20			138.2	9.6	9.6	4.8	4.8
	30			80.0	8.0	8.0	4.0	4.0
OA5	1.5		Planned government site 3B2	258.5	13.4	13.4	6.7	6.7
	10			194.3	12.5	12.5	6.2	6.2
	20			103.7	10.4	10.4	5.2	5.2
	30			73.5	8.3	8.3	4.2	4.2
OA6	1.5		Planned government site 3B3	258.4	16.3	16.3	8.2	8.2
	10			196.5	14.4	14.4	7.2	7.2
	20			106.1	11.1	11.1	5.6	5.6
	30			71.8	8.2	8.2	4.1	4.1
OA7	1.5		Planned government site 3B4	335.5	17.7	17.7	8.9	8.9
	10			188.1	14.5	14.5	7.2	7.2
	20			115.9	10.4	10.4	5.2	5.2
	30			71.8	7.8	7.8	3.9	3.9
OA8	1.5		Planned hospital site	447.0	23.2	23.2	11.6	11.6
	10			302.8	15.9	15.9	8.0	8.0
	20			155.7	10.8	10.8	5.4	5.4
	30			94.1	7.9	7.9	4.0	4.0

ASR ID	Assessment Height (m)	Region	Description	Predicted Odour Concentration (ou/m3 in 5-s average)				
				Existing (unmitigated) Scenario	Mitigated Scenario A1	Mitigated Scenario B1	Mitigated Scenario A2	Mitigated Scenario B2
OA9	1.5	South apron area of Kai Tak Development	Planned hospital site	177.4	27.8	27.8	13.9	13.9
	10			142.9	16.4	16.4	8.2	8.2
	20			124.6	9.3	9.3	4.7	4.7
	30			102.5	7.3	7.3	3.6	3.6
OA10	1.5		Planned district open space, site 3E2	220.8	32.2	32.2	16.1	16.1
OA11	1.5		Planned commercial site 3D4	79.6	8.0	8.0	4.0	4.0
	10			78.2	7.3	7.3	3.7	3.7
	20			74.1	5.6	5.6	2.8	2.8
	30			67.7	4.6	4.6	2.3	2.3
OA12	1.5	Existing Kwun Tong area	Existing World Trade Square	57.1	7.5	7.5	3.7	3.7
	10			56.0	7.0	7.0	3.5	3.5
	20			53.3	6.0	6.0	3.0	3.0
	30			49.7	4.9	4.9	2.5	2.5
OA13	1.5		Existing Kwong Sang Hong Building	56.2	8.5	8.5	4.3	4.3
	10			55.0	8.1	8.1	4.1	4.1
	20			52.1	7.1	7.1	3.6	3.6
	30			48.2	6.0	6.0	3.0	3.0
OA14	1.5		Existing Seapower Industrial Centre	66.9	9.7	9.7	4.9	4.9
	10			65.0	9.3	9.3	4.6	4.6
	20			60.8	8.3	8.3	4.2	4.2
	30			55.7	7.2	7.2	3.6	3.6
OA15	1.5	Runway area of Kai Tak Development	Planned Runway Park, site 4D1	70.2	7.6	7.6	3.8	3.9
OA16	1.5		Planned Runway Park, site 4D1	103.3	12.4	12.4	6.2	6.2
OA17	1.5		Planned Runway Park, site 4D1	136.5	17.6	17.6	8.8	8.8
OA18	1.5		Planned tourism node, site 4D1	129.5	16.4	16.4	8.2	8.2
	10			121.6	14.9	14.9	7.5	7.5
	20			109.0	12.7	12.8	6.4	6.4
	30			94.8	10.4	10.5	5.2	5.3
OA19	1.5		Planned cruise terminal building, site 4D3	66.8	6.9	7.0	3.5	3.5
	10			66.2	6.8	6.9	3.4	3.5
	20			64.2	6.5	6.6	3.3	3.4
	30			61.0	6.1	6.2	3.1	3.1

ASR ID	Assessment Height (m)	Region	Description	Predicted Odour Concentration (ou/m3 in 5-s average)				
				Existing (unmitigated) Scenario	Mitigated Scenario A1	Mitigated Scenario B1	Mitigated Scenario A2	Mitigated Scenario B2
OA20	1.5	Runway area of Kai Tak Development	Planned cruise terminal building, site 4D3	74.4	7.8	7.9	3.9	4.0
	10			73.4	7.6	7.7	3.9	3.9
	20			70.5	7.2	7.3	3.6	3.7
	30			66.2	6.5	6.6	3.3	3.4
OA21	1.5		Planned cruise terminal building, site 4D3	82.0	9.0	9.1	4.5	4.6
	10			80.5	8.7	8.8	4.4	4.4
	20			76.5	7.8	7.8	3.9	4.0
	30			70.5	6.5	6.6	3.3	3.4
OA22	1.5		Planned local open space, site 4B5	117.8	14.2	14.3	7.2	7.3
OA23	1.5		Planned residential site 4B5	128.5	16.1	16.2	8.1	8.2
	10			122.1	14.5	14.7	7.3	7.4
	20			107.1	11.3	11.4	5.7	5.8
	30			90.5	8.4	8.5	4.2	4.3
OA24	1.5		Planned residential site 4B4	134.1	21.0	21.0	10.5	10.5
	10			120.7	14.9	14.9	7.4	7.5
	20			105.6	8.9	9.0	4.5	4.6
	30			90.2	7.0	7.0	3.5	3.5
OA25	1.5		Planned residential site 4B3	145.2	22.2	22.2	11.1	11.1
	10			137.5	12.6	12.6	6.3	6.3
	20			118.5	9.1	9.1	4.6	4.6
	30			97.2	7.2	7.2	3.6	3.6
OA26	1.5		Planned residential site 4B2	190.2	18.2	18.2	9.1	9.1
	10			150.1	14.8	14.8	7.4	7.4
	20			121.6	9.4	9.4	4.7	4.7
	30			100.4	7.1	7.1	3.6	3.6
OA27	1.5		Planned residential site 4B1	232.7	22.9	22.9	11.4	11.4
	10			160.9	15.9	15.9	7.9	7.9
	20			140.3	11.1	11.1	5.6	5.6
	30			115.2	7.3	7.3	3.7	3.7
OA28	1.5		Planned residential site 4A1	235.4	25.1	25.1	12.6	12.6
	10			201.1	20.1	20.1	10.1	10.0
	20			170.0	13.2	13.2	6.6	6.6
	30			131.8	8.7	8.7	4.3	4.3
OA29	1.5		Planned commercial site 4A3	264.5	20.9	20.9	10.4	10.4
	10			244.7	18.2	18.2	9.1	9.1

ASR ID	Assessment Height (m)	Region	Description	Predicted Odour Concentration (ou/m3 in 5-s average)				
				Existing (unmitigated) Scenario	Mitigated Scenario A1	Mitigated Scenario B1	Mitigated Scenario A2	Mitigated Scenario B2
OA29	20	Runway area of Kai Tak Development	Planned commercial site 4A3	197.2	13.5	13.5	6.7	6.7
	30			142.5	9.5	9.5	4.7	4.7
OA30	1.5		Planned regional open space, site 4A	334.5	18.7	18.7	9.3	9.3
OA31	1.5		Planned regional open space, site 4A	547.1	18.8	19.0	9.4	9.6
OA32	1.5		Planned regional open space, site 4A	675.0	21.1	21.1	10.5	10.5
OA33	1.5	North apron area of Kai Tak Development	Planned Site 1L4	440.4	6.5	6.5	3.2	3.2
	10			342.7	6.2	6.2	3.1	3.1
	20			202.6	5.5	5.5	2.7	2.7
	30			123.2	4.4	4.4	2.2	2.2
OA34	1.5		Planned government site 1J3	550.6	5.4	5.4	2.7	3.2
	10			456.8	5.2	5.2	2.6	2.6
	20			277.6	4.7	4.7	2.3	2.3
	30			146.9	3.9	3.9	1.9	1.9
OA35	1.5		Planned Site 1L1	252.6	5.7	5.7	2.8	2.8
	10			227.2	5.5	5.5	2.8	2.8
	20			169.0	5.0	5.0	2.5	2.5
	30			114.5	4.3	4.3	2.2	2.2
OA36	1.5		Planned Site 1I3	289.2	4.9	7.1	2.4	4.7
	10			265.6	4.8	5.7	2.4	3.3
	20			209.6	4.4	4.5	2.2	2.3
	30			147.4	3.8	3.8	1.9	1.9
OA37	1.5		Planned Site 1K1	141.5	4.9	4.9	2.5	2.5
	10			135.5	4.8	4.8	2.4	2.4
	20			118.9	4.6	4.6	2.3	2.3
	30			96.5	4.1	4.1	2.1	2.1
OA38	1.5		Planned Site 1H3	157.8	4.5	6.7	2.2	4.4
	10			145.1	4.4	5.4	2.2	3.4
	20			126.5	4.2	4.4	2.1	2.5
	30			104.8	3.8	3.8	1.9	2.0
OA39	1.5		Planned Site 1M1	86.3	4.5	4.5	2.2	3.7
	10			84.7	4.4	4.4	2.2	2.2

ASR ID	Assessment Height (m)	Region	Description	Predicted Odour Concentration (ou/m3 in 5-s average)				
				Existing (unmitigated) Scenario	Mitigated Scenario A1	Mitigated Scenario B1	Mitigated Scenario A2	Mitigated Scenario B2
OA39	20	North apron area of Kai Tak Development	Planned Site 1M1	80.1	4.3	4.3	2.1	2.2
	30			73.1	4.1	4.1	2.0	2.0
OA40	1.5		Planned Site 1M2	95.1	4.1	6.6	2.1	4.5
	10			91.8	4.1	5.4	2.0	3.5
	20			84.5	3.9	4.3	2.0	2.5
	30			75.5	3.7	3.9	1.9	2.0
OA41	1.5	Existing Kowloon City Area	Existing Lee Kau Yan Memorial School	71.6	11.2	11.2	11.2	11.2
	10			70.7	4.3	4.3	2.7	2.7
	20			68.1	4.2	4.2	2.1	2.1
	30			64.1	4.0	4.0	2.0	2.0
OA42	1.5		Existing Sir Robert Black Health Centre	71.9	4.2	4.9	3.8	3.8
	10			71.0	4.1	4.7	2.1	2.8
	20			68.5	4.0	4.3	2.0	2.3
	30			64.4	3.8	3.9	1.9	2.0

Table 6.17 Predicted Frequency of Exceedance of Odour Criterion at Representative ASRs under Mitigated Scenarios A1 and B1

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A1		Mitigated Scenario B1	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA1	1.5	North apron area of Kai Tak Development	Planned stadium, site2D	3.5%	1.5%	3.5%	1.5%
	10			2.7%	1.0%	2.7%	1.0%
	20			2.4%	0.7%	2.4%	0.7%
	30			1.9%	0.6%	1.9%	0.6%
OA2	1.5		Planned residential site 1L3	1.0%	0.1%	1.0%	0.1%
	10			1.0%	0.1%	1.0%	0.1%
	20			1.0%	0.1%	1.0%	0.1%
	30			0.5%	0.1%	0.5%	0.1%
OA3	1.5		Existing EMSD Headquarters, site 1N	0.5%	0.1%	0.5%	0.1%
	10			0.5%	0.1%	0.5%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA4	1.5	South apron area of Kai Tak Development	Planned government site 3B1	10.9%	4.5%	10.9%	4.5%
	10			9.2%	0.4%	9.2%	0.4%
	20			1.1%	0.1%	1.1%	0.1%
	30			0.5%	0.1%	0.5%	0.1%
OA5	1.5		Planned government site 3B2	10.9%	4.3%	10.9%	4.3%
	10			9.3%	0.5%	9.3%	0.5%
	20			0.8%	0.3%	0.8%	0.3%
	30			0.8%	0.1%	0.8%	0.1%
OA6	1.5		Planned government site 3B3	11.1%	6.8%	11.1%	6.8%
	10			9.7%	0.7%	9.7%	0.7%
	20			1.2%	0.3%	1.2%	0.3%
	30			0.8%	0.1%	0.8%	0.1%
OA7	1.5		Planned government site 3B4	11.5%	7.7%	11.5%	7.7%
	10			9.5%	0.9%	9.5%	0.9%
	20			2.4%	0.1%	2.4%	0.1%
	30			0.7%	0.1%	0.7%	0.1%
OA8	1.5		Planned hospital site	14.7%	8.8%	14.7%	8.8%
	10			5.5%	2.2%	5.5%	2.2%
	20			2.9%	0.3%	2.9%	0.3%
OA8	30	South apron	Planned hospital site	1.1%	0.1%	1.1%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A1		Mitigated Scenario B1	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA9	1.5	area of Kai Tak Development	Planned hospital site	18.3%	10.4%	18.3%	10.4%
	10			8.2%	2.0%	8.2%	2.0%
	20			2.3%	0.1%	2.3%	0.1%
	30			0.5%	0.1%	0.5%	0.1%
OA10	1.5		Planned district open space, site 3E2	23.7%	13.9%	23.7%	13.9%
OA11	1.5		Planned commercial site 3D4	6.2%	0.1%	6.2%	0.1%
	10			4.9%	0.1%	4.9%	0.1%
	20			2.6%	0.1%	2.6%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA12	1.5	Existing Kwun Tong area	Existing World Trade Square	4.1%	0.1%	4.1%	0.1%
	10			2.9%	0.1%	2.9%	0.1%
	20			2.8%	0.1%	2.8%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA13	1.5		Existing Kwong Sang Hong Building	3.3%	0.1%	3.3%	0.1%
	10			3.2%	0.1%	3.2%	0.1%
	20			1.5%	0.1%	1.5%	0.1%
	30			1.3%	0.1%	1.3%	0.1%
OA14	1.5		Existing Seapower Industrial Centre	0.7%	0.1%	0.7%	0.1%
	10			0.7%	0.1%	0.7%	0.1%
	20			0.6%	0.1%	0.6%	0.1%
	30			0.6%	0.1%	0.6%	0.1%
OA15	1.5	Runway area of Kai Tak Development	Planned Runway Park, site 4D1	0.6%	0.1%	0.6%	0.1%
OA16	1.5		Planned Runway Park, site 4D1	0.8%	0.4%	0.8%	0.4%
OA17	1.5		Planned Runway Park, site 4D1	1.9%	0.8%	1.9%	0.8%
OA18	1.5		Planned tourism node, site 4D1	2.5%	0.9%	2.5%	0.9%
	10			1.6%	0.8%	1.6%	0.8%
	20			1.2%	0.6%	1.2%	0.6%
	30			1.0%	0.3%	1.0%	0.3%
OA19	1.5		Planned cruise terminal building, site 4D3	0.7%	0.1%	0.7%	0.1%
	10			0.6%	0.1%	0.7%	0.1%
	20			0.6%	0.1%	0.6%	0.1%
	30			0.5%	0.1%	0.5%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A1		Mitigated Scenario B1	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA20	1.5	Runway area of Kai Tak Development	Planned cruise terminal building, site 4D3	0.9%	0.1%	0.9%	0.1%
	10			0.9%	0.1%	0.9%	0.1%
	20			0.8%	0.1%	0.8%	0.1%
	30			0.7%	0.1%	0.7%	0.1%
OA21	1.5		Planned cruise terminal building, site 4D3	2.1%	0.1%	2.1%	0.1%
	10			2.1%	0.1%	2.1%	0.1%
	20			1.6%	0.1%	1.6%	0.1%
	30			1.3%	0.1%	1.3%	0.1%
OA22	1.5		Planned local open space, site 4B5	13.3%	1.4%	13.3%	1.4%
OA23	1.5		Planned residential site 4B5	18.4%	2.5%	18.4%	2.5%
	10			11.4%	1.7%	11.4%	1.7%
	20			2.5%	0.7%	2.5%	0.7%
	30			1.4%	0.1%	1.4%	0.1%
OA24	1.5		Planned residential site 4B4	33.2%	18.4%	33.2%	18.4%
	10			26.4%	11.1%	26.4%	11.1%
	20			10.5%	0.1%	10.5%	0.1%
	30			1.0%	0.1%	1.0%	0.1%
OA25	1.5		Planned residential site 4B3	46.9%	32.1%	46.9%	32.1%
	10			41.5%	18.1%	41.5%	18.1%
	20			9.8%	0.1%	9.8%	0.1%
	30			0.6%	0.1%	0.6%	0.1%
OA26	1.5		Planned residential site 4B2	43.7%	22.8%	43.7%	22.8%
	10			30.5%	12.0%	30.5%	12.0%
	20			15.2%	0.1%	15.2%	0.1%
	30			2.1%	0.1%	2.1%	0.1%
OA27	1.5		Planned residential site 4B1	46.4%	32.7%	46.4%	32.7%
	10			34.2%	11.7%	34.2%	11.8%
	20			15.2%	3.1%	15.2%	3.1%
	30			6.4%	0.1%	6.4%	0.1%
OA28	1.5		Planned residential site 4A1	43.1%	28.1%	43.1%	28.1%
	10			30.2%	9.8%	30.2%	9.8%
	20			14.3%	3.7%	14.3%	3.7%
	30			6.5%	0.1%	6.5%	0.1%
OA29	1.5		Planned commercial site 4A3	37.1%	15.6%	37.1%	15.6%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A1		Mitigated Scenario B1	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA29	10	Runway area of Kai Tak Development	Planned commercial site 4A3	18.1%	6.4%	18.1%	6.5%
	20			9.1%	4.2%	9.2%	4.2%
	30			6.7%	0.1%	6.7%	0.1%
OA30	1.5		Planned regional open space, site 4A	34.2%	16.4%	34.2%	16.4%
OA31	1.5		Planned regional open space, site 4A	41.3%	24.6%	41.4%	24.6%
OA32	1.5		Planned regional open space, site 4A	33.9%	21.1%	33.9%	21.1%
OA33	1.5	North apron area of Kai Tak Development	Planned Site 1L4	0.8%	0.1%	0.8%	0.1%
	10			0.8%	0.1%	0.8%	0.1%
	20			0.4%	0.1%	0.4%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA34	1.5		Planned government site 1J3	0.2%	0.1%	0.2%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA35	1.5		Planned Site 1L1	0.5%	0.1%	0.5%	0.1%
	10			0.5%	0.1%	0.5%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA36	1.5		Planned Site 1I3	0.1%	0.1%	0.8%	0.1%
	10			0.1%	0.1%	0.5%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA37	1.5		Planned Site 1K1	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA38	1.5		Planned Site 1H3	0.1%	0.1%	1.0%	0.1%
	10			0.1%	0.1%	0.4%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A1		Mitigated Scenario B1	
				Exceeding 5 ou/m³	Exceeding 10 ou/m³	Exceeding 5 ou/m³	Exceeding 10 ou/m³
OA39	1.5	North apron area of Kai Tak Development	Planned Site 1M1	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA40	1.5		Planned Site 1M2	0.1%	0.1%	0.6%	0.1%
	10			0.1%	0.1%	0.4%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA41	1.5	Existing Kowloon City Area	Existing Lee Kau Yan Memorial School	1.7%	0.5%	1.7%	0.5%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA42	1.5		Existing Sir Robert Black Health Centre	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%

Table 6.18 Predicted Frequency of Exceedance of Odour Criterion at Representative ASRs under Mitigated Scenarios A2 and B2

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A2		Mitigated Scenario B2	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA1	1.5	North apron area of Kai Tak Development	Planned stadium, site2D	1.5%	0.3%	1.5%	0.3%
	10			1.0%	0.1%	1.0%	0.1%
	20			0.7%	0.1%	0.7%	0.1%
	30			0.6%	0.1%	0.6%	0.1%
Nil	Nil		Planned residential site 1L3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA3	1.5		Existing EMSD Headquarters, site 1N	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA4	1.5	South apron area of Kai Tak Development	Planned government site 3B1	4.5%	0.1%	4.5%	0.1%
	10			0.4%	0.1%	0.4%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA5	1.5		Planned government site 3B2	4.3%	0.1%	4.3%	0.1%
	10			0.5%	0.1%	0.5%	0.1%
	20			0.3%	0.1%	0.3%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA6	1.5		Planned government site 3B3	6.8%	0.1%	6.8%	0.1%
	10			0.7%	0.1%	0.7%	0.1%
	20			0.3%	0.1%	0.3%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA7	1.5		Planned government site 3B4	7.7%	0.1%	7.7%	0.1%
	10			0.9%	0.1%	0.9%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A2		Mitigated Scenario B2	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA8	1.5		Planned hospital site	8.8%	1.4%	8.8%	1.4%
	10			2.2%	0.1%	2.2%	0.1%
	20			0.3%	0.1%	0.3%	0.1%
OA8	30	South apron area of Kai Tak Development	Planned hospital site	0.1%	0.1%	0.1%	0.1%
OA9	1.5		Planned hospital site	10.4%	4.3%	10.4%	4.3%
	10			2.0%	0.1%	2.0%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA10	1.5		Planned district open space, site 3E2	13.9%	8.3%	13.9%	8.3%
OA11	1.5		Planned commercial site 3D4	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA12	1.5	Existing Kwun Tong area	Existing World Trade Square	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA13	1.5		Existing Kwong Sang Hong Building	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA14	1.5		Existing Seapower Industrial Centre	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA15	1.5	Runway area of Kai Tak Development	Planned Runway Park, site 4D1	0.1%	0.1%	0.1%	0.1%
OA16	1.5		Planned Runway Park, site 4D1	0.4%	0.1%	0.4%	0.1%
OA17	1.5		Planned Runway Park, site 4D1	0.8%	0.1%	0.8%	0.1%
OA18	1.5		Planned tourism node, site 4D1	0.9%	0.1%	0.9%	0.1%
	10			0.8%	0.1%	0.8%	0.1%
	20			0.6%	0.1%	0.6%	0.1%
	30			0.3%	0.1%	0.3%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A2		Mitigated Scenario B2	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA19	1.5	Runway area of Kai Tak Development	Planned cruise terminal building, site 4D3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA20	1.5		Planned cruise terminal building, site 4D3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA21	1.5		Planned cruise terminal building, site 4D3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA22	1.5		Planned local open space, site 4B5	1.4%	0.1%	1.4%	0.1%
OA23	1.5		Planned residential site 4B5	2.5%	0.1%	2.5%	0.1%
	10			1.7%	0.1%	1.7%	0.1%
	20			0.7%	0.1%	0.8%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA24	1.5		Planned residential site 4B4	18.4%	8.3%	18.4%	8.3%
	10			11.1%	0.1%	11.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA25	1.5		Planned residential site 4B3	32.1%	10.2%	32.2%	10.2%
	10			18.1%	0.1%	18.2%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA26	1.5		Planned residential site 4B2	22.8%	0.1%	22.8%	0.1%
	10			12.0%	0.1%	12.0%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA27	1.5		Planned residential site 4B1	32.7%	3.2%	32.7%	3.2%
	10			11.8%	0.1%	11.8%	0.1%
	20			3.1%	0.1%	3.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A2		Mitigated Scenario B2	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA28	1.5		Planned residential site 4A1	28.1%	3.2%	28.1%	3.2%
	10			9.8%	0.8%	9.8%	0.8%
	20			3.8%	0.1%	3.8%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA29	1.5		Planned commercial site 4A3	15.6%	0.4%	15.6%	0.4%
OA29	10	Runway area of Kai Tak Development	Planned commercial site 4A3	6.4%	0.1%	6.5%	0.1%
	20			4.2%	0.1%	4.2%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA30	1.5		Planned regional open space, site 4A	16.4%	0.1%	16.4%	0.1%
OA31	1.5		Planned regional open space, site 4A	24.6%	0.1%	24.6%	0.1%
OA32	1.5		Planned regional open space, site 4A	21.1%	0.9%	21.1%	0.9%
OA33	1.5	North apron area of Kai Tak Development	Planned Site 1L4	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA34	1.5		Planned government site 1J3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA35	1.5		Planned Site 1L1	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA36	1.5		Planned Site 1I3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA37	1.5		Planned Site 1K1	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%

ASR ID	Assessment Height (m)	Region	Description	Predicted Frequency of Exceedance (in % of time in a year)			
				Mitigated Scenario A2		Mitigated Scenario B2	
				Exceeding 5 ou/m^3	Exceeding 10 ou/m^3	Exceeding 5 ou/m^3	Exceeding 10 ou/m^3
OA38	1.5		Planned Site 1H3	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA39	1.5	North apron area of Kai Tak Development	Planned Site 1M1	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA40	1.5		Planned Site 1M2	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA41	1.5	Existing Kowloon City Area	Existing Lee Kau Yan Memorial School	1.7%	0.5%	1.7%	0.5%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%
OA42	1.5		Existing Sir Robert Black Health Centre	0.1%	0.1%	0.1%	0.1%
	10			0.1%	0.1%	0.1%	0.1%
	20			0.1%	0.1%	0.1%	0.1%
	30			0.1%	0.1%	0.1%	0.1%