4 AIR QUALITY IMPACT

4.1 Legislation and Standards

General

4.1.1 The relevant legislations, standards and guidelines applicable to the present study for the assessment of air quality impacts include:

(1) Air Pollution Ordinance (APCO) (Cap 311);

(2) Air Pollution Control (Construction Dust) Regulation; and

(3) Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO), Annex 4 and Annex 12.

4.1.2 The APCO (Cap.311) provides the power for controlling air pollutants from a variety of stationary and mobile sources and encompasses a number of Air Quality Objectives (AQOs).

Air Quality Objectives

4.1.3 In 2007, EPD commissioned a comprehensive study to review the AQOs. The study considered various factors e.g. protection of public health and socio-economic etc., and devised a new set of AQOs and developed a long-term air quality management strategy for Hong Kong. The new AQOs are adopted with effect from 1 January 2014 in respect of the Air Pollution Control (Amendment) Ordinance 2013 and EIAO. **Table 4.1** below summarizes the new AQOs.

Table 4.1: Hong Kong Air Quality Objectives

Pollutant	**Limits on Concentration, μg/m^3 [1] (Number of Exceedance per year allowed in brackets)**				
	10-min	**1-hr**	**8-hr**	**24-hr [2]**	**Annual [2]**
SO_2	500 (3)			125 (3)	
TSP		500 [5]			
RSP (PM10) [3]				100 (9)	50 (0)
FSP (PM2.5) [4]				75 (9)	35 (0)
CO		30,000 (0)	10,000 (0)		
NO_2		200 (18)			40 (0)
O_3			160 (9)		
Pb					0.5 (0)

Note:

[1] Measured at 293K and 101.325 kPa.

[2] Arithmetic mean.

[3] Respirable suspended particulates (RSP) means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometres or smaller.

[4] Fine suspended particulates (FSP) means suspended particulates in air with a nominal aerodynamic diameter of 2.5 micrometres or smaller.

[5] Not an AQO but is a criteria for evaluating air quality impacts as stated in Annex 4 of TM-EIAO.

Air Pollution Control (Construction Dust) Regulation

4.1.4 The Air Pollution Control (Construction Dust) Regulation specifies processes that require special dust control. The Contractors are required to inform the EPD and adopt proper dust suppression measures while carrying out "Notifiable Works" (which requires prior notification by the regulation) and "Regulatory Works" to meet the requirements as defined under the regulation.

Odour Criterion

4.1.5 In accordance with Annex 4 of TM-EIAO, the limit of 5 odour units (OU) based on an averaging time of 5 seconds for odour prediction assessment should not be exceeded at any receivers.

4.1.6 In accordance with Section 3.3.9 of Chapter 9 of HKPSG, some small community uses (i.e. crematoria, livestock yards, stock wagon washing areas and wholesale fishes and poultry markets) can cause significant air pollution nuisance, primarily due to odour. Wherever, practicable, these uses should be sited away from the main urban centres. Usually a buffer distance of at least 200m from nearby sensitive uses is required. Acceptable uses in the buffer area include industrial areas, godowns, cold storages, carparks and amenity areas. Open space uses may be also be tolerated.

4.2 Description of Existing Environment

4.2.1 Historical air quality monitoring data from Kwun Tong Air Quality Monitoring Station (AQMS) has been examined. The latest 5 years of air quality monitoring data published, i.e. 2008 to 2012 are tabulated in **Table 4.2** below.

Table 4.2: Air Quality Monitoring Data (Kwun Tong AQMS, 2008-2012)

Pollutant	Year	Highest 1-Hour Concentration (μg/m^3)[1]	Highest 8-Hour Concentration (μg/m^3) [1]	Highest Daily Concentration (μg/m^3) [1]	Annual Concentration (μg/m^3) [1]
SO_2	2008	258	N/M	69	17
	2009	168	N/M	57	11
	2010	99	N/M	34	10
	2011	115	N/M	42	12
	2012	98	N/M	53	11
	5-year mean	148	-	51 [41%][5]	12
	AQO[3]	N/A	N/A	125 (9)	N/A
NO_2	2008	**243 (11)**[2]	N/M	139	**59**

Pollutant	Year	Highest 1-Hour Concentration (μg/m³)[1]	Highest 8-Hour Concentration (μg/m³) [1]	Highest Daily Concentration (μg/m³) [1]	Annual Concentration (μg/m³) [1]
	2009	**249 (24)**[2]	N/M	134	**58**
	2010	**242 (9)**[2]	N/M	123	**59**
	2011	**285 (41)**[2]	N/M	155	**63**
	2012	**398 (78)**[2]	N/M	179	**59**
	5-year mean	**283 [142%]**[5]	-	146	**60**
	AQO[3]	200 (18)	N/A	N/A	40
RSP (PM10)	2008	238	N/M	**136 (11)**[2]	47
	2009	226	N/M	**169 (8)**[2]	48
	2010	785 [8]	N/M	**681 (9)**[2][6]	47
	2011	205	N/M	**117 (6)**[2]	49
	2012	210	N/M	**169 (8)**[2]	43
	5-year mean	220	-	**148 [148%]**[5]	47
	AQO[3]	N/A	N/A	100 (9)	50
FSP (PM2.5)	2008	N/M	N/M	N/M	N/M
	2009	N/M	N/M	N/M	N/M
	2010	N/M	N/M	N/M	N/M
	2011	124	N/M	**83 (3)**[2]	N/M
	2012	150	N/M	**78 (3)**[2]	28
	5-year mean	-	-	-	-
	AQO[3]	N/A	N/A	75 (9)	35
TSP	2008	N/M	N/M	160	72
	2009	N/M	N/M	186	70
	2010	N/M	N/M	142	67
	2011	N/M	N/M	176	74
	2012	N/M	N/M	132	62
	5-year mean	-	-	159	69
	AQO	500 [5]	N/A	N/A	N/A
O_3	2008	185	142	103	33
	2009	242	158	128	37
	2010	143	132	110	33
	2011	181	146	126	37
	2012	206	155	143	40
	5-year mean	191	147 [91%][5]	122	36
	AQO[3]	N/A	160 (9)	N/A	N/A
CO	2008	N/M	N/M	N/M	N/M

Pollutant	Year	Highest 1-Hour Concentration (μg/m^3)[1]	Highest 8-Hour Concentration (μg/m^3) [1]	Highest Daily Concentration (μg/m^3) [1]	Annual Concentration (μg/m^3) [1]
	2009	N/M	N/M	N/M	N/M
	2010	N/M	N/M	N/M	N/M
	2011	N/M	N/M	N/M	N/M
	2012	N/M	N/M	N/M	N/M
	5-year mean	-	-	-	-
	AQO	30,000	10,000	N/A	N/A

Note:

[1] Bolded values mean exceedance of the AQOs.

[2] Values in ( ) mean the number of exceedance against the AQOs.

[3] Values in ( ) mean the number of exceedances allowed.

[4] Percentage (%) of the AQO is shown in [ ]. The 5-year mean is the arithmetic average.

[5] Not an AQO but is a criteria for evaluating air quality impacts as stated in Annex 4 of TM-EIAO.

[6] The value was recorded during a dust plume originated from northern part of China in March 2010 which was an abnormal event and hence has not been taken to calculate the 5-year mean.

[7] N/A – Not applicable since there are no AQOs for these parameters.

[8] N/M – Not Measured.

4.2.2 The SO_2 concentrations in Kwun Tong were relatively low. The 24-hour SO_2 concentrations are well within the AQO.

4.2.3 It can be seen from the above table that there was no obvious trend in the highest 1-hour, 24-hour and annual NO_2 concentrations. The highest 1-hour NO_2 concentrations ranged from 242 μg/m^3 in 2010 to 398 μg/m^3 in 2012, and the highest 24-hour NO_2 concentrations ranged from 123 μg/m^3 in 2010 to 179 μg/m^3 in 2012. The annual NO_2 concentration remained relatively steady in the range of 58 to 63 μg/m^3. Exceedances of 1-hour and annual NO_2 concentration of AQOs were recorded.

4.2.4 For RSP concentrations in Kwun Tong area, the highest 1–hour and 24-hour concentration of 785 μg/m^3 and 681 μg/m^3, respectively, were recorded in 2010. Nevertheless, these exceedances were due to the dust plume originated from the northern part of China in March 2010, which is an abnormal event. Excluding this year, there was a general decreasing trend of 1-hour RSP concentration. The 24-hour RSP concentrations ranged from 117 μg/m^3 to 169 μg/m^3. Exceedances of 24-hour RSP concentrations of AQO were recorded. For annual RSP concentration, it remained steady in the range of 43 to 49 μg/m^3, and no exceedance of the AQO was recorded.

4.2.5 EPD has recently commenced the regular monitoring of fine suspended particulate (FSP, i.e. PM2.5). However, only limited FSP data are reported during the preparation of this report. Hence, the data set is not sufficient to establish the annual averages over years.

4.2.6 The 8-hour averaged O_3 concentrations ranged from 132 μg/m^3 to 158 μg/m^3, and no exceedance of the AQO was recorded.

4.2.7 It should be noted that Kwun Tong AQMS is located within the urban center of the Kwun Tong District (i.e. on the rooftop of building next to Kwun Tong Road), where the ambient pollutants concentration is significantly influenced by the near field vehicular emission raised from the nearby busy roads include Kwun Tong Road. On the other hand, the Study Area is located more than 1.3 km from Kwun Tong AQMS, and the altitude difference between Kwun Tong District and the Study Area is more than 150m (i.e. Kwun Tong District at approx. +10mPD and Study Area at approx. +180mPD). Besides, the local traffic flow near the Study Area is relatively low in compared with that within the urban center of Kwun Tong District. In view of the differences between Kwun Tong District and the Study Area in terms of geographical and traffic conditions, a more site-specific background air pollutants concentration from PATH model, instead of the air quality monitoring data of Kwun Tong AQMS, is therefore adopted for both construction phase and operational phase air quality assessment. Details of PATH model for construction and operational phase air quality assessment is given in **Section 4.6.17** and **4.6.73** respectively.

4.3 Study Area &Air Sensitive Receivers

Study Area

4.3.1 The Study Area, as delineated in **Figure 227724/E/0001**, is located on the south-western slopes of the Tai Shueng Tok Hill at the far north-eastern edge of urban East Kowloon, and lies close to the major population centres of Kwun Tong, Lam Tin and Sau Mau Ping. Specifically, the Study Area covers an area of about 86 ha, which includes a platform area of about 40 ha.

Sensitive Receivers

4.3.2 In accordance to Annex 12 of the TM-EIAO, Air Sensitive Receivers (ASRs) includes 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. Any other premises or places with which, in terms of duration or number of people affected, has a similar sensitivity to the air pollutant as the aforelisted premises and places would also be considered as a sensitive receiver.

4.3.3 ASRs within a distance of 500m from the Project site have been identified. These ASRs include both the existing and planned developments. Existing ASRs are identified by means of reviewing topographic maps, aerial photos, land status plans, supplemented by site inspections. They mainly include developed residential buildings, educational institutions, hospitals and scattered village houses, etc.

4.3.4 Planned/committed ASRs are identified by making reference to relevant Outline Zoning Plans (OZP), Layout Plans and other published plans in vicinity of the development, including:

- Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (No. S/K13/27);
- Kwun Tong North Outline Zoning Plan (No. S/K14N/13);
- Kwun Tong South Outline Zoning Plan (No. S/K14S/18);
- Tseng Lan Shue Outline Zoning Plan (No. S/SK_TLS/8); and
- Tseung Kwan O Outline Zoning Plan (No. S/TKO/20).

4.3.5 For the planned land uses within the Study Area, potential ASRs have been identified subject to the plan and development design. It is understood the population intake for the possible developments may be implemented in phases. Hence, developments in earlier phase have been also being considered as ASRs where appropriate for assessment of the construction dust impact due to the subsequent development phases. These ASRs have been identified based on RODP.

4.3.6 The location of the representative ASRs for air quality assessment are illustrated in **Figure 227724/E/1010 - Figure 227724/E/1040** and summarized in **Table 4.3a** and **Table 4.3b** below.

Table 4.3a: Representative ASRs within assessment area (outside ARQ site boundary)

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Existing ASRs						
Kwun Tong Government Secondary School	AKTG-01	E	28.0	445	✓	✓
	AKTG-02	E	28.0	415	✓	✓
Shun Wah House	ASCC-01	R	50.0	410	✓	✓
Shun Mei House	ASCC-02	R	50.0	415	✓	✓
Shun Shing House	ASCC-03	R	50.0	455	✓	✓
Shun Tai House	ASCC-04	R	50.0	490	✓	✓
Shun Fung House	ASCC-05	R	50.0	375	✓	✓
Shun Lung House	ASCC-06	R	50.0	380	✓	✓
Shun Chi Court Podium	ASCC-07	R	16.0	375	✓	✓
Shun Fai House	ASCC-08	R	50.0	370	✓	✓
	ASCC-09	R	50.0	360	✓	✓
Shun Cheung House	ASCC-10	R	50.0	315	✓	✓
Shun Lee Community Centre	ASCC-11	GIC	20.0	280	✓	✓
Lee Yip House	ASLE-01	R	45.0	455	✓	✓
	ASLE-02	R	45.0	460	✓	✓
Shun Lee Shopping Centre (Phase 1)	ASLE-03	C	18.0	460	✓	✓
	ASLE-04	C	18.0	485	✓	✓
Lee Yat House	ASLE-05	R	50.0	365	✓	✓
Lee Hong House	ASLE-06	R	47.0	415	✓	✓
Lee Hong House	ASLE-07	R	47.0	380	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Lee Foo House	ASLE-08	R	50.0	290	✓	✓
Shun Lee General Out - Patient Clinic	ASLE-09	H	4.0	285	✓	✓
Lee Foo House	ASLE-10	R	50.0	260	✓	✓
	ASLE-11	R	50.0	265	✓	✓
Shun Lee Shopping Centre (Phase 2)	ASLE-12	C	25.0	325	✓	✓
Shun Lee Tsuen Park (Football Field)	ASLE-13	P	1.5	475	✓	✓
Shun Lee Tsuen Park	ASLE-14	P	1.5	430	✓	✓
	ASLE-15	P	1.5	395	✓	✓
Shun Lee Tsuen Sports Centre	ASLE-16	P	30.0	415	✓	✓
Shun Lee Tsuen Park (Tennis Court)	ASLE-17	P	4.0	460	✓	✓
Carmel Leung Sing Tak School	ALST-01	E	32.0	480	✓	✓
Shun On Kindergarten	ASOE-01	E	8.0	400	✓	✓
On Chung House	ASOE-02	R	80.0	355	✓	✓
	ASOE-03	R	80.0	305	✓	✓
	ASOE-04	R	80.0	320	✓	✓
Shui On Nursing Centre	ASOE-05	H	4.0	380	✓	✓
On Yat House	ASOE-06	R	80.0	395	✓	✓
	ASOE-07	R	80.0	425	✓	✓
Shin Yat Tong On Yat Kindergarten	ASOE-08	E	8.0	465	✓	✓
Tin Wing House	ASTE-01	R	69.0	460	✓	✓
Tin Lok House	ASTE-02	R	69.0	330	✓	✓
Tin Wan House	ASTE-03	R	61.0	250	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Shun Tin Estate Basketball Court	ASTE-04	P	1.5	220	✓	✓
Tin Kam House	ASTE-05	R	61.0	385	✓	✓
Ning Po No.2 College	ANPC-01	E	28.0	255	✓	✓
	ANPC-02	E	28.0	320	✓	✓
United Christian Hospital	AUCH-01	H	112.0	415	✓	✓
	AUCH-02	H	24.0	470	✓	✓
	AUCH-03	H	24.0	470	✓	✓
Sau Ming Road Park	ASMR-01	P	1.5	290	✓	✓
	ASMR-02	P	1.5	240	✓	✓
	ASMR-03	P	1.5	265	✓	✓
	ASMR-04	P	1.5	305	✓	✓
	ASMR-05	P	1.5	285	✓	✓
	ASMR-06	P	1.5	280	✓	✓
Sau Mau Ping Road Safety Town	ASST-01	P	1.5	280	✓	✓
	ASST-02	P	1.5	310	✓	✓
Sau Nga House	ASMP-01	R	112.0	225	✓	✓
Sau Nga House	ASMP-02	R	112.0	255	✓	✓
	ASMP-03	R	112.0	275	✓	✓
Sau Yee House	ASMP-04	R	112.0	215	✓	✓
	ASMP-05	R	112.0	265	✓	✓
	ASMP-06	R	112.0	235	✓	✓
Sau Hong House	ASMP-07	R	101.0	205	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Sau Hong House	ASMP-08	R	101.0	265	✓	✓
Sau Lok House	ASMP-09	R	101.0	200	✓	✓
	ASMP-10	R	101.0	260	✓	✓
The Mission Covenant Church Holm Glad Primary School	AGPS-01	E	28.0	270	✓	✓
	AGPS-02	E	28.0	215	✓	✓
Sau Mau Ping Shopping Centre	ASMP-11	C	15.0	240	✓	✓
	ASMP-12	C	15.0	320	✓	✓
	ASMP-13	C	15.0	305	✓	✓
	ASMP-14	C	15.0	405	✓	✓
Sau Ming School	ASMS-01	E	32.0	265	✓	✓
	ASMS-02	E	32.0	310	✓	✓
	ASMS-03	E	32.0	275	✓	✓
Sau Mau Ping (Central) Estate Community Centre	ASMP-15	GIC	18.0	485	✓	✓
Sau Wah House	ASMP-16	R	112.0	435	✓	✓
	ASMP-17	R	112.0	400	✓	✓
Sau Yat House	ASMP-18	R	112.0	450	✓	✓
	ASMP-19	R	112.0	495	✓	✓
Sau Ching House	ASMP-20	R	112.0	285	✓	✓
	ASMP-21	R	112.0	290	✓	✓
Sau Wai House	ASMP-22	R	112.0	340	✓	✓
	ASMP-23	R	112.0	370	✓	✓
Sau Yin House	ASMP-24	R	112.0	280	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Sau Mau Ping Estate Ancillary Facilities Block	ASMP-25	GIC	25.0	265	✓	✓
	ASMP-26	GIC	25.0	240	✓	✓
Sau Yue House	ASMP-27	R	112.0	400	✓	✓
	ASMP-28	R	112.0	410	✓	✓
Sau King House	ASMP-29	R	112.0	395	✓	✓
Sau Chi House	ASMP-30	R	112.0	350	✓	✓
	ASMP-31	R	112.0	320	✓	✓
Sau Fai House	ASMP-32	R	58.0	250	✓	✓
	ASMP-33	R	58.0	290	✓	✓
	ASMP-34	R	58.0	255	✓	✓
St. Matthew Lutheran School	AMLS-01	E	32.0	425	✓	✓
St. Matthew Lutheran School	AMLS-02	E	32.0	470	✓	✓
St. Matthew Lutheran School Playground	AMLS-03	E	1.5	450	✓	✓
Sau Wong House	ASMP-35	R	112.0	390	✓	✓
	ASMP-36	R	112.0	435	✓	✓
Sau Mau Ping South Estate Playground	ASMP-37	P	1.5	325	✓	✓
Sau Sin House	ASMP-38	R	112.0	485	✓	✓
Sau Mei House	ASMP-39	R	112.0	455	✓	✓
	ASMP-40	R	112.0	425	✓	✓
Tat Cheung House	APTE-01	R	80.0	170	✓	✓
	APTE-02	R	80.0	200	✓	✓
	APTE-03	R	80.0	255	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Sau Mau Ping Catholic Primary School	ACPS-01	E	32.0	145	✓	✓
	ACPS-02	E	1.5	160	✓	✓
Po Tat Estate Badminton Court	APTE-04	P	1.5	100	✓	✓
Tat Hong House	APTE-05	R	112.0	205	✓	✓
Tat Fu House	APTE-06	R	112.0	210	✓	✓
Tat Fung House	APTE-07	R	112.0	175	✓	✓
Tat Chui House	APTE-08	R	112.0	130	✓	✓
Tat Yan House	APTE-09	R	112.0	85	✓	✓
Tat Yi House	APTE-10	R	112.0	75	✓	✓
Tat Hei House	APTE-11	R	122.0	305	✓	✓
	APTE-12	R	122.0	320	✓	✓
CNEC Kei Shek Church	APTE-13	W	15.0	285	✓	✓
Tat Kai House	APTE-14	R	122.0	265	✓	✓
Tat Hin House	APTE-15	R	122.0	215	✓	✓
Tat On House	APTE-16	R	122.0	175	✓	✓
Chung Hong House	AHWC-01	R	104.0	490	✓	✓
Yee Hong House	AHWC-02	R	104.0	485	✓	✓
	AHWC-03	R	104.0	500	✓	✓
Tin Hau Temple	ATHT-01	W	10.0	175	✓	✓
	ATHT-02	W	10.0	185	✓	✓
Kwun Yam Temple	AKYT-01	W	10.0	120	✓	✓
Fat Yuen Temple	AFYT-01	W	6.0	210	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Star Legend Terrace	ASTT-01	R	9.0	40	✓	✓
	ASTT-02	R	9.0	70	✓	✓
Ma Yau Tong Village	AMYT-01	R	9.0	275	✓	✓
	AMYT-02	R	9.0	210	✓	✓
	AMYT-03	R	9.0	145	✓	✓
	AMYT-04	R	9.0	20	✓	✓
	AMYT-05	R	6.0	40	✓	✓
Haven of Hope Sunnyside School	AHSC-01	E	12.0	130	✓	✓
Siu To Yuen Village	ASTY-01	R	9.0	125	✓	✓
Chi Yum Ching She	ACYC-01	W	3.0	120	✓	✓
Lung Wo Tsuen	ALWT-01	R	6.0	180	✓	✓
	ALWT-02	R	6.0	205	✓	✓
	ALWT-03	R	3.0	130	✓	✓
Man King Terrace	AMKT-01	R	9.0	395	✓	✓
	AMKT-02	R	9.0	435	✓	✓
	AMKT-03	R	9.0	470	✓	✓
Hong Kong Lp Gas (Holding) Limited	AHKG-01	C	10.0	340	✓	✓
Denon Terrace	ADET-01	R	9.0	345	✓	✓
Village House near Denon Terrace	AVDT-01	R	3.0	290	✓	✓
	AVDT-02	R	3.0	280	✓	✓
Anderson Road No.11 - Leighton Pavillion	ALEP-01	R	15.0	305	✓	✓
	ALEP-02	R	15.0	260	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Tai Pan Court 1 - 3	ATPC-01	R	9.0	490	✓	✓
	ATPC-02	R	9.0	475	✓	✓
Tan Shan Village	ATSV-01	R	9.0	335	✓	✓
Tseng Lan Shue	ATLS-01	R	9.0	485	✓	✓
Planned ASRs						
Monkey King Temple (under construction)	AMKT-01	W	10.0	160	✓	✓
	AMKT-02	W	10.0	165	✓	✓
City God Temple (under construction)	ACGT-01	W	10.0	135	✓	✓
Block 1, DAR Site A	DARA-01	R	85.2	140	✓	✓
	DARA-02	R	85.2	190	✓	✓
	DARA-03	R	85.2	210	✓	✓
	DARA-04	R	85.2	185	✓	✓
Block 2, DAR Site A	DARA-05	R	93.4	110	✓	✓
	DARA-06	R	93.4	150	✓	✓
Planned School, DAR Site A	DARA-07	E	32.0	85	✓	✓
	DARA-08	E	32.0	90	✓	✓
	DARA-09	E	32.0	95	✓	✓
	DARA-10	E	32.0	100	✓	✓
	DARA-11	E	32.0	135	✓	✓
	DARA-12	E	32.0	160	✓	✓
	DARA-13	E	32.0	170	✓	✓
	DARA-14	E	32.0	140	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Block 3, DAR Site B	DARB-01	R	87.9	170	✓	✓
Basketball Court, DAR Site B	DARB-02	P	1.5	190	✓	✓
Block 4, DAR Site B	DARB-03	R	87.9	220	✓	✓
Block 4, DAR Site B	DARB-04	R	87.9	275	✓	✓
Block 5, DAR Site B	DARB-05	R	90.7	315	✓	✓
	DARB-06	R	90.7	300	✓	✓
	DARB-07	R	90.7	260	✓	✓
Block 6, DAR Site B	DARB-08	R	87.9	220	✓	✓
	DARB-09	R	87.9	190	✓	✓
Block 9, DAR Site B	DARB-10	R	96.2	90	✓	✓
	DARB-11	R	96.2	40	✓	✓
	DARB-12	R	96.2	70	✓	✓
Block 8, DAR Site B	DARB-13	R	96.2	115	✓	✓
	DARB-14	R	96.2	140	✓	✓
Block 7, DAR Site B	DARB-15	R	87.9	170	✓	✓
	DARB-16	R	87.9	195	✓	✓
Block 10, DAR Site C1	DARC-01	R	76.9	80	✓	✓
	DARC-02	R	76.9	60	✓	✓
	DARC-03	R	76.9	40	✓	✓
Block 11, DAR Site C1	DARC-04	R	76.9	120	✓	✓
	DARC-05	R	76.9	150	✓	✓
Badminton Court, DAR Site C1	DARC-06	P	1.5	135	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Planned Clinic and Community Centre, DAR Site C2	DARC-07	H / GIC	27.6	85	✓	✓
	DARC-08	H / GIC	27.6	50	✓	✓
	DARC-09	H / GIC	27.6	15	✓	✓
	DARC-10	H / GIC	27.6	< 10	✓	✓
	DARC-11	H / GIC	27.6	< 10	✓	✓
	DARC-12	H / GIC	27.6	< 10	✓	✓
	DARC-13	H / GIC	27.6	< 10	✓	✓
	DARC-14	H / GIC	27.6	< 10	✓	✓
	DARC-15	H / GIC	27.6	< 10	✓	✓
	DARC-16	H / GIC	27.6	10	✓	✓
Planned School, DAR Site C2	DARC-17	E	32.0	85	✓	✓
	DARC-18	E	32.0	10	✓	✓
	DARC-19	E	32.0	100	✓	✓
	DARC-20	E	32.0	90	✓	✓
	DARC-21	E	32.0	90	✓	✓
	DARC-22	E	32.0	85	✓	✓
	DARC-23	E	32.0	< 10	✓	✓
	DARC-24	E	32.0	< 10	✓	✓
	DARC-25	E	32.0	< 10	✓	✓
	DARC-26	E	32.0	< 10	✓	✓
Planned Park, DAR Site C2	DARC-27	P	1.5	80	✓	✓
	DARC-28	P	1.5	75	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Planned Park, DAR Site C2	DARC-29	P	1.5	70	✓	✓
	DARC-30	P	1.5	65	✓	✓
	DARC-31	P	1.5	65	✓	✓
	DARC-32	P	1.5	65	✓	✓
	DARC-33	P	1.5	65	✓	✓
	DARC-34	P	1.5	10	✓	✓
	DARC-35	P	1.5	10	✓	✓
	DARC-36	P	1.5	15	✓	✓
	DARC-37	P	1.5	15	✓	✓
	DARC-38	P	1.5	15	✓	✓
	DARC-39	P	1.5	15	✓	✓
	DARC-40	P	1.5	15	✓	✓
Block 4, DAR Site D	DARD-01	R	115.4	85	✓	✓
	DARD-02	R	115.4	130	✓	✓
Badminton Court, DAR Site D	DARD-03	P	1.5	90	✓	✓
Basketball Court, DAR Site D	DARD-04	P	1.5	85	✓	✓
Block 3, DAR Site D	DARD-05	R	115.4	100	✓	✓
	DARD-06	R	115.4	140	✓	✓
Block 2, DAR Site D	DARD-07	R	115.4	185	✓	✓
	DARD-08	R	115.4	135	✓	✓
Basketball Court, DAR Site D	DARD-09	P	1.5	150	✓	✓
Block 1, DAR Site D	DARD-10	R	82.4	135	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Block 1, DAR Site D	DARD-11	R	82.4	85	✓	✓
	DARD-12	R	82.4	90	✓	✓
Public Open Space, DAR Site D	DARD-13	P	1.5	105	✓	✓
	DARD-14	P	1.5	125	✓	✓
	DARD-15	P	1.5	110	✓	✓
Public Open Space, DAR Site E	DARE-01	P	1.5	701	✓	✓
	DARE-02	P	1.5	80	✓	✓
	DARE-03	P	1.5	95	✓	✓
	DARE-04	P	1.5	70	✓	✓
Block 5, DAR Site E	DARE-05	R	115.4	55	✓	✓
	DARE-06	R	115.4	35	✓	✓
Block 6, DAR Site E	DARE-07	R	115.4	50	✓	✓
	DARE-08	R	115.4	25	✓	✓
	DARE-09	R	115.4	20	✓	✓
Badminton Court, DAR Site E	DARE-10	P	1.5	30	✓	✓
	DARE-11	P	1.5	45	✓	✓
Block 7, DAR Site E	DARE-12	R	115.4	45	✓	✓
	DARE-13	R	115.4	20	✓	✓
	DARE-14	R	115.4	25	✓	✓
Block 8, DAR Site E	DARE-15	R	126.4	60	✓	✓
	DARE-16	R	126.4	20	✓	✓
Block 9, DAR Site E	DARE-17	R	126.4	< 10	✓	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Site Boundary (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Open Plaza, DAR Site E	DARE-18	P	5.0	95	✓	✓
	DARE-19	P	5.0	95	✓	✓
Block 11, DAR Site E	DARE-20	R	112.7	95	✓	✓
	DARE-21	R	112.7	70	✓	✓
Basketball Court, DAR Site E	DARE-22	P	1.5	< 10	✓	✓
Block 10, DAR Site E	DARE-23	R	112.7	< 10	✓	✓
	DARE-24	R	112.7	25	✓	✓
Planned School, DAR Site E	DARE-25	E	32.0	60	✓	✓
	DARE-26	E	32.0	15	✓	✓
	DARE-27	E	32.0	< 10	✓	✓
	DARE-28	E	32.0	< 10	✓	✓
	DARE-29	E	32.0	< 10	✓	✓
	DARE-30	E	32.0	< 10	✓	✓

Note:

[1] R – Residential; E – Education; H – Clinic / Home for the aged / Hospital; GIC – Government, institution and community; P – Recreational / Park; W – Worship; C – Commerical.

[2] ✓ – The ASR is present at the assessment year and has been assessed; × - The ASR is not present at the assessment year and has not been assessed.

Table 4.3b: Representative ASRs within assessment area (within ARQ site boundary)

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Planned ASRs						
Private Housing, ARQ Site R2-1	ARQR-01	R	68.0	65	×	✓
Private Housing, ARQ Site R2-1	ARQR-02	R	68.0	75	×	✓
	ARQR-03	R	68.0	75	×	✓
	ARQR-04	R	68.0	70	×	✓
	ARQR-05	R	68.0	70	×	✓
	ARQR-06	R	68.0	70	×	✓
	ARQR-07	R	68.0	60	×	✓
	ARQR-08	R	68.0	50	×	✓
	ARQR-09	R	68.0	45	×	✓
	ARQR-10	R	68.0	45	×	✓
	ARQR-11	R	68.0	50	×	✓
	ARQR-12	R	68.0	55	×	✓
Private Housing, ARQ Site R2-2	ARQR-13	R	48.0	60	×	✓
	ARQR-14	R	48.0	75	×	✓
	ARQR-15	R	48.0	80	×	✓
	ARQR-16	R	48.0	80	×	✓
	ARQR-17	R	48.0	90	×	✓
	ARQR-18	R	48.0	90	×	✓
	ARQR-19	R	48.0	100	×	✓
	ARQR-20	R	48.0	100	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-2	ARQR-21	R	48.0	100	×	✓
Private Housing, ARQ Site R2-2	ARQR-22	R	48.0	95	×	✓
	ARQR-23	R	48.0	95	×	✓
	ARQR-24	R	48.0	90	×	✓
	ARQR-25	R	48.0	90	×	✓
	ARQR-26	R	48.0	90	×	✓
	ARQR-27	R	48.0	95	×	✓
	ARQR-28	R	48.0	90	×	✓
	ARQR-29	R	48.0	75	×	✓
	ARQR-30	R	68.0	40	×	✓
	ARQR-31	R	68.0	25	×	✓
	ARQR-32	R	68.0	20	×	✓
	ARQR-33	R	68.0	20	×	✓
	ARQR-34	R	68.0	20	×	✓
	ARQR-35	R	68.0	20	×	✓
	ARQR-36	R	68.0	20	×	✓
	ARQR-37	R	68.0	15	×	✓
	ARQR-38	R	68.0	15	×	✓
	ARQR-39	R	68.0	15	×	✓
	ARQR-40	R	68.0	20	×	✓
	ARQR-41	R	68.0	35	×	✓
Private Housing, ARQ Site R2-3	ARQR-42	R	40.0	15	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-3	ARQR-43	R	40.0	15	×	✓
	ARQR-44	R	40.0	15	×	✓
	ARQR-45	R	40.0	15	×	✓
	ARQR-46	R	40.0	15	×	✓
	ARQR-47	R	35.0	20	×	✓
	ARQR-48	R	35.0	25	×	✓
	ARQR-49	R	35.0	30	×	✓
	ARQR-50	R	35.0	45	×	✓
	ARQR-51	R	35.0	60	×	✓
	ARQR-52	R	35.0	75	×	✓
	ARQR-53	R	35.0	80	×	✓
	ARQR-54	R	35.0	75	×	✓
	ARQR-55	R	40.0	40	×	✓
	ARQR-56	R	40.0	30	×	✓
Private Housing, ARQ Site R2-4	ARQR-57	R	30.0	20	×	✓
	ARQR-58	R	30.0	15	×	✓
	ARQR-59	R	30.0	25	×	✓
	ARQR-60	R	30.0	35	×	✓
	ARQR-61	R	30.0	55	×	✓
Private Housing, ARQ Site R2-4	ARQR-62	R	30.0	65	×	✓
	ARQR-63	R	30.0	85	×	✓
	ARQR-64	R	30.0	90	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-4	ARQR-65	R	30.0	95	×	✓
	ARQR-66	R	30.0	95	×	✓
	ARQR-67	R	30.0	85	×	✓
	ARQR-68	R	30.0	75	×	✓
	ARQR-69	R	80.0	40	×	✓
	ARQR-70	R	80.0	25	×	✓
	ARQR-71	R	80.0	20	×	✓
	ARQR-72	R	80.0	20	×	✓
	ARQR-73	R	80.0	20	×	✓
	ARQR-74	R	80.0	20	×	✓
	ARQR-75	R	80.0	20	×	✓
	ARQR-76	R	80.0	20	×	✓
	ARQR-77	R	80.0	20	×	✓
	ARQR-78	R	80.0	15	×	✓
Private Housing, ARQ Site R2-5	ARQR-79	R	50.0	95	×	✓
	ARQR-80	R	50.0	90	×	✓
	ARQR-81	R	50.0	90	×	✓
Private Housing, ARQ Site R2-5	ARQR-82	R	50.0	90	×	✓
	ARQR-83	R	50.0	90	×	✓
	ARQR-84	R	50.0	95	×	✓
	ARQR-85	R	50.0	100	×	✓
	ARQR-86	R	50.0	120	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-5	ARQR-87	R	50.0	130	×	✓
	ARQR-88	R	50.0	105	×	✓
	ARQR-89	R	50.0	100	×	✓
	ARQR-90	R	50.0	100	×	✓
	ARQR-91	R	50.0	85	×	✓
	ARQR-92	R	68.0	60	×	✓
	ARQR-93	R	68.0	50	×	✓
	ARQR-94	R	68.0	40	×	✓
	ARQR-95	R	68.0	20	×	✓
	ARQR-96	R	68.0	20	×	✓
	ARQR-97	R	68.0	20	×	✓
	ARQR-98	R	68.0	15	×	✓
	ARQR-99	R	68.0	15	×	✓
	ARQS-01	R	68.0	20	×	✓
	ARQS-02	R	68.0	35	×	✓
Primary School, ARQ Site E-1	ARQE-01	E	32.0	40	×	✓
	ARQE-02	E	32.0	80	×	✓
	ARQE-03	E	32.0	80	×	✓
	ARQE-04	E	32.0	20	×	✓
	ARQE-05	E	32.0	20	×	✓
	ARQE-06	E	32.0	35	×	✓
Commercial Building, ARQ Site C-1	ARQC-01	C	15.0	10	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Commercial Building, ARQ Site C-1	ARQC-02	C	15.0	25	×	✓
	ARQC-03	C	15.0	25	×	✓
	ARQC-04	C	15.0	10	×	✓
Private Housing, ARQ Site R2-6	ARQS-03	R	33.0	90	×	✓
	ARQS-04	R	33.0	90	×	✓
	ARQS-05	R	33.0	90	×	✓
	ARQS-06	R	33.0	75	×	✓
	ARQS-07	R	33.0	60	×	✓
	ARQS-08	R	33.0	40	×	✓
	ARQS-09	R	33.0	30	×	✓
	ARQS-10	R	33.0	20	×	✓
	ARQS-11	R	78.0	20	×	✓
	ARQS-12	R	78.0	20	×	✓
Private Housing, ARQ Site R2-6	ARQS-13	R	78.0	25	×	✓
	ARQS-14	R	78.0	25	×	✓
	ARQS-15	R	98.0	25	×	✓
	ARQS-16	R	98.0	25	×	✓
	ARQS-17	R	98.0	25	×	✓
	ARQS-18	R	98.0	25	×	✓
	ARQS-19	R	98.0	30	×	✓
	ARQS-20	R	98.0	45	×	✓
Private Housing, ARQ Site R2-7	ARQS-21	R	35.0	20	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-7	ARQS-22	R	35.0	40	✗	✓
	ARQS-23	R	35.0	60	✗	✓
	ARQS-24	R	35.0	80	✗	✓
	ARQS-25	R	55.0	30	✗	✓
	ARQS-26	R	55.0	25	✗	✓
	ARQS-27	R	55.0	25	✗	✓
	ARQS-28	R	55.0	25	✗	✓
	ARQS-29	R	55.0	25	✗	✓
	ARQS-30	R	55.0	30	✗	✓
Commercial Building, ARQ Site C-2	ARQC-05	C	20.0	10	✗	✓
	ARQC-06	C	20.0	10	✗	✓
Commercial Building, ARQ Site C-2	ARQC-07	C	20.0	10	✗	✓
	ARQC-08	C	20.0	35	✗	✓
	ARQC-09	C	20.0	25	✗	✓
	ARQC-10	C	20.0	25	✗	✓
Sports and Recreational Facilities, ARQ Site G-1	ARQG-01	GIC	16.0	105	✗	✓
	ARQG-02	GIC	16.0	80	✗	✓
	ARQG-03	GIC	16.0	60	✗	✓
	ARQG-04	GIC	16.0	50	✗	✓
	ARQG-05	GIC	16.0	55	✗	✓
	ARQG-06	GIC	16.0	80	✗	✓
	ARQG-07	GIC	16.0	90	✗	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Sports and Recreational Facilities, ARQ Site G-1	ARQG-08	GIC	16.0	95	×	✓
	ARQG-09	GIC	16.0	120	×	✓
	ARQG-10	GIC	16.0	120	×	✓
	ARQG-11	GIC	16.0	140	×	✓
Commercial Building, ARQ Site C-4	ARQC-11	C	18.0	40	×	✓
	ARQC-12	C	18.0	10	×	✓
	ARQC-13	C	18.0	10	×	✓
	ARQC-14	C	18.0	15	×	✓
	ARQC-15	C	18.0	45	×	✓
Commercial Building, ARQ Site C-4	ARQC-16	C	18.0	60	×	✓
	ARQC-17	C	18.0	50	×	✓
	ARQC-18	C	18.0	50	×	✓
	ARQC-19	C	18.0	40	×	✓
Commercial Building, ARQ Site C-5	ARQC-20	C	21.0	15	×	✓
	ARQC-21	C	21.0	50	×	✓
	ARQC-22	C	21.0	60	×	✓
	ARQC-23	C	21.0	35	×	✓
	ARQC-24	C	21.0	20	×	✓
	ARQC-25	C	21.0	20	×	✓
	ARQC-26	C	21.0	15	×	✓
Private Housing, ARQ Site R2-8	ARQS-31	R	63.0	25	×	✓
	ARQS-32	R	63.0	25	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-8	ARQS-33	R	63.0	30	×	✓
	ARQS-34	R	63.0	30	×	✓
	ARQS-35	R	63.0	25	×	✓
	ARQS-36	R	63.0	25	×	✓
	ARQS-37	R	63.0	25	×	✓
	ARQS-38	R	63.0	23	×	✓
	ARQS-39	R	43.0	20	×	✓
Private Housing, ARQ Site R2-8	ARQS-40	R	43.0	30	×	✓
	ARQS-41	R	43.0	40	×	✓
	ARQS-42	R	43.0	45	×	✓
	ARQS-43	R	43.0	60	×	✓
	ARQS-44	R	43.0	70	×	✓
	ARQS-45	R	43.0	100	×	✓
	ARQS-46	R	43.0	110	×	✓
	ARQS-47	R	43.0	95	×	✓
	ARQS-48	R	43.0	90	×	✓
	ARQS-49	R	43.0	80	×	✓
	ARQS-50	R	43.0	70	×	✓
	ARQS-51	R	83.0	30	×	✓
	ARQS-52	R	83.0	25	×	✓
Community Hall, ARQ Site GIC-1	ARQG-23	GIC	23.0	45	×	✓
	ARQG-24	GIC	23.0	15	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Community Hall, ARQ Site GIC-1	ARQG-25	GIC	23.0	35	×	✓
	ARQG-26	GIC	23.0	65	×	✓
Police Station, ARQ Site G-2	ARQG-12	GIC	38.0	10	×	✓
	ARQG-13	GIC	38.0	10	×	✓
	ARQG-14	GIC	38.0	20	×	✓
Police Station, ARQ Site G-2	ARQG-15	GIC	38.0	40	×	✓
	ARQG-16	GIC	38.0	40	×	✓
	ARQG-17	GIC	38.0	10	×	✓
	ARQG-18	GIC	38.0	10	×	✓
Subsidized Housing , ARQ Site RS-1	ARQS-53	R	108.0	45	×	✓
	ARQS-54	R	108.0	25	×	✓
	ARQS-55	R	108.0	25	×	✓
	ARQS-56	R	108.0	30	×	✓
	ARQS-57	R	108.0	10	×	✓
	ARQS-58	R	108.0	105	×	✓
	ARQS-59	R	108.0	60	×	✓
	ARQS-60	R	108.0	55	×	✓
	ARQS-61	R	108.0	20	×	✓
	ARQS-62	R	108.0	45	×	✓
	ARQS-63	R	108.0	25	×	✓
	ARQS-64	R	108.0	25	×	✓
Fire Station, ARQ Site G-3	ARQG-19	GIC	38.0	20	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Fire Station, ARQ Site G-3	ARQG-20	GIC	38.0	40	×	✓
	ARQG-21	GIC	38.0	45	×	✓
	ARQG-22	GIC	38.0	15	×	✓
Primary School, ARQ Site E-2	ARQE-07	E	1.5	20	×	✓
	ARQE-08	E	1.5	20	×	✓
	ARQE-09	E	32.0	25	×	✓
	ARQE-10	E	32.0	25	×	✓
	ARQE-11	E	32.0	70	×	✓
	ARQE-12	E	32.0	75	×	✓
	ARQE-13	E	32.0	50	×	✓
Secondary School, Site E-3	ARQE-14	E	1.5	80	×	✓
	ARQE-15	E	1.5	120	×	✓
	ARQE-16	E	32.0	85	×	✓
	ARQE-17	E	32.0	65	×	✓
	ARQE-18	E	32.0	50	×	✓
	ARQE-19	E	32.0	15	×	✓
	ARQE-20	E	32.0	55	×	✓
Private Housing, ARQ Site R2-9	ARQS-65	R	95.0	60	×	✓
	ARQS-66	R	95.0	70	×	✓
	ARQS-67	R	95.0	80	×	✓
	ARQS-68	R	95.0	105	×	✓
	ARQS-69	R	95.0	115	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Private Housing, ARQ Site R2-9	ARQS-72	R	95.0	40	×	✓
Private Housing, ARQ Site R2-9	ARQS-73	R	95.0	35	×	✓
	ARQS-74	R	95.0	35	×	✓
	ARQS-75	R	70.0	35	×	✓
	ARQS-76	R	70.0	35	×	✓
Private Housing, ARQ Site R2-10	ARQS-70	R	95.0	100	×	✓
	ARQS-71	R	95.0	85	×	✓
	ARQS-77	R	70.0	30	×	✓
	ARQS-78	R	70.0	25	×	✓
	ARQS-79	R	70.0	25	×	✓
	ARQS-80	R	70.0	20	×	✓
	ARQS-81	R	70.0	15	×	✓
	ARQS-82	R	70.0	20	×	✓
	ARQS-83	R	70.0	35	×	✓
Quarry Park, ARQ	ARQP-01	P	1.5	15	×	✓
	ARQP-02	P	1.5	10	×	✓
	ARQP-03	P	1.5	20	×	✓
	ARQP-04	P	1.5	5	×	✓
	ARQP-05	P	1.5	5	×	✓
	ARQP-06	P	1.5	25	×	✓
	ARQP-07	P	1.5	25	×	✓
	ARQP-08	P	1.5	10	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Quarry Park, ARQ	ARQP-09	P	1.5	10	×	✓
	ARQP-10	P	1.5	15	×	✓
	ARQP-11	P	1.5	65	×	✓
	ARQP-12	P	1.5	95	×	✓
	ARQP-13	P	1.5	70	×	✓
	ARQP-14	P	1.5	40	×	✓
	ARQP-15	P	1.5	40	×	✓
	ARQP-16	P	1.5	40	×	✓
	ARQP-17	P	1.5	25	×	✓
	ARQP-18	P	1.5	30	×	✓
	ARQP-19	P	1.5	10	×	✓
	ARQP-20	P	1.5	10	×	✓
	ARQP-21	P	1.5	30	×	✓
	ARQP-22	P	1.5	50	×	✓
	ARQP-23	P	1.5	135	×	✓
	ARQP-24	P	1.5	160	×	✓
	ARQP-25	P	1.5	95	×	✓
	ARQP-26	P	1.5	105	×	✓
	ARQP-27	P	1.5	80	×	✓
	ARQP-28	P	1.5	60	×	✓
	ARQP-29	P	1.5	10	×	✓
	ARQP-30	P	1.5	55	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Quarry Park, ARQ	ARQP-31	P	1.5	95	×	✓
	ARQP-32	P	1.5	100	×	✓
	ARQP-33	P	1.5	90	×	✓
	ARQP-34	P	1.5	70	×	✓
	ARQP-35	P	1.5	180	×	✓
	ARQP-36	P	1.5	180	×	✓
	ARQP-37	P	1.5	145	×	✓
	ARQP-38	P	1.5	130	×	✓
	ARQP-39	P	1.5	150	×	✓
	ARQP-40	P	1.5	130	×	✓
	ARQP-41	P	1.5	5	×	✓
	ARQP-42	P	1.5	5	×	✓
	ARQP-43	P	1.5	10	×	✓
	ARQP-44	P	1.5	25	×	✓
	ARQP-45	P	1.5	75	×	✓
	ARQP-46	P	1.5	130	×	✓
	ARQP-47	P	1.5	130	×	✓
	ARQP-48	P	1.5	90	×	✓
	ARQP-49	P	1.5	30	×	✓
	ARQP-50	P	1.5	65	×	✓
	ARQP-51	P	1.5	105	×	✓
	ARQP-52	P	1.5	95	×	✓

Description	ASR ID	Land use [1]	Building Height Above Ground (approx.) (m)	Separation Distance between ASR and the Nearest Polluting Source (approx.) (m)	Assessment Year [2]	
					Construction Phase	Operation Phase
					2017	2026
Quarry Park, ARQ	ARQP-53	P	1.5	55	×	✓
	ARQP-54	P	1.5	10	×	✓
	ARQP-55	P	1.5	50	×	✓
	ARQP-56	P	1.5	55	×	✓
	ARQP-57	P	1.5	35	×	✓
	ARQP-58	P	1.5	20	×	✓
	ARQP-59	P	1.5	5	×	✓
	ARQP-60	P	1.5	5	×	✓
	ARQP-61	P	1.5	5	×	✓

Note:

[1] R – Residential; E – Education; H – Clinic / Home for the aged / Hospital; GIC – Government, institution and community; P – Recreational / Park; W – Worship; C – Commerical.

[2] ✓ – The ASR is present at the assessment year and has been assessed; × - The ASR is not present at the assessment year and has not been assessed.

4.4 Pollution Sources

Construction Phase

Dust Emission from the Construction Activities of the Project

4.4.1 During the construction phase, at-grade heavy construction activities and daily loading / unloading activities at the proposed stockpiling area at the north side of the study area would generate fugitive dust with potential impacts on neighbouring ASRs from various construction activities, including site clearance, soil excavation, backfilling, transportation of materials, and wind erosion.

4.4.2 Potential dust impact from other construction activities such as laying of utilities and building superstructure works are considered to be minor and no associated adverse dust impact is anticipated.

4.4.3 According to the implementation programme, the Project will be implemented in two phases, namely:

(1) Phase 1 development; and

(2) Phase 2 development.

4.4.4 Since the air quality impact due to different construction phases varies, the assessment identifies the worst case scenario over the entire construction phase to address the specific impacts arising from the different works areas. This two-phases development and the concurrent projects comprises 10 works contracts (WC).

4.4.5 Locations of the dust emission sources and the construction programme of the heavy construction activities are shown in **Appendix 4.1** and **Appendix 4.2**, respectively.

Vehicular Emission from Open Road

4.4.6 Particulate matter generated from road traffic within 500m study area would also have cumulative air quality impact on nearby ASRs during construction phase. The associated cumulative air quality impacts (i.e. TSP, RSP and FSP) due to the vehicular emissions have been assessed.

Industrial Emission

4.4.7 A total of 7 chimneys were identified within the 500m air quality assessment area including the 4 chimneys of the two Chinese restaurants in Shun Lee Estate and Shun On Estate, and 3 chimneys of United Christian Hospital. The locations of these 7 chimneys are shown in **Figure 227724/E/1050** and the emission inventory of these chimneys is shown in **Appendix 4.3**. The associated cumulative air quality impacts due to the chimney emissions during construction phase have been assessed.

Operational Phase

Vehicular Emission

4.4.8 Upon completion of the Project, additional traffic would likely be generated. The associated air quality impact from vehicular emission from the induced traffic would be unavoidable. The associated cumulative air quality impacts due to the vehicular emissions have been assessed.

Industrial Emission

4.4.9 A total of 7 chimneys were identified within the 500m air quality assessment area including the 4 chimneys of the two Chinese restaurants in Shun Lee Estate and Shun On Estate, and 3 chimneys of United Christian Hospital. The locations of these 7 chimneys are shown in **Figure 227724/E/1050** and the emission inventory of these chimneys is shown in **Appendix 4.3**. The associated cumulative air quality impacts due to the chimney emissions have been assessed.

Odour Emission

4.4.10 One pig farm at Lung Wo Tsuen is identified as a potential odour source within 500m from the boundary of the Project. The location of pig farm is illustrated in **Figure 227724/E/1060**. As shown in **Figure 227724/E/1060**, the Quarry Park (ASQP), a passive open space and odour tolerated ASR, is the nearest ASR in ARQ development to the pig farm, and the shortest horizontal distance between northern boundary of Quarry Park and the pig farm is about 210m. In addition, the distance between the pig farm and the nearest odour sensitive ASR (i.e. Proposed Permanent Residential Building) is about 420m, which fully complied with the 200m Buffer Zone requirement in Section 3.3.9 of Chapter 9 of HKPSG that a buffer distance of at least 200m is required for odour sources from nearby sensitive uses. Furthermore, there is a hill with height of approximately 270 mPD located right between the pig farm (i.e. approximately 204 mPD) and the nearest odour sensitive ASR (i.e. approximately 204 mPD at ground level), which will minimize any odour nuisance, if any, from the pig farm. In view of the long horizontal distance (i.e. over 400m) between the pig farm and the odour sensitive ASRs, and the present of a hill located between the pig farm and odour sensitive ASRs (i.e. over 60m vertical difference), odour nuisance from the pig farm on the proposed development is therefore not anticipated.

4.4.11 On the other hand, two restored landfills, Ma Yau Tong (Central) and Ma Yau Tong (West), are also identified as potential odour sources within 500m from the boundary of the Project. Both of these 2 restored landfills are located over 350m from the boundary of the Project. These two landfills were closed in 1986 and 1981, respectively. After restoration, both landfills have been developed into a sitting-out area for recreational uses in 2011. Hence, odour nuisances from these two restored landfills are not anticipated. The locations of 2 restored landfills are illustrated in **Figure 227724/E/1060**. Since adverse odour impact from the potential odour sources (i.e. a pig farm and 2 restored landfills) are not anticipated, quantitative odour impact assessment is considered unnecessary.

4.5 Potential Concurrent Projects/ Sources

4.5.1 In order to assess the cumulative impacts, it is critical to identify the implementation programme and details of concurrent projects in the vicinity that would have an environmental bearing on the air sensitive receivers for the Project.

4.5.2 After collating the information available in the public domain (e.g. approved EIA reports, LegCo paper etc.), the project proponents of these concurrent projects has been approached to verify the best available information for incorporation into the report. Referring to **Section 3.8**, there are four major concurrent projects including the Development at Anderson Road (DAR); Road improvement works at J/O Lin Tak Road and Sau Mau Ping Road, at J/O New Clear Water Bay Road and Anderson Road, as well as at the merging lane at Clear Water Bay Road near Shun Lee Tsuen Road;

proposed rock cavern development within ARQ, and pedestrian connection. Locations of the concurrent projects are shown in **Figure 227724/E/0008.** Each concurrent projects are discussed in the following.

<u>Development at Anderson Road (DAR)</u>

4.5.3 DAR is located in the East Kowloon District. It is bounded by Anderson Road to the north, the realigned Sau Mau Ping Road to the south, Po Lam Road to the east, and Lee On Road and Shun On Road to the west. The scope of works of DAR includes construction of site formation, roads, drains and upgrading of existing infrastructure to provide usable land of about 20 hectares for housing and associated government, institution or community uses at the site between existing Anderson Road Quarry and Sau Mau Ping Road in Kwun Tong District. The construction works of DAR has commenced in early-2008 and is scheduled for completion in early-2017 according to the latest programme advised by Housing Department. As mentioned in **Section 3.8**, the tentative major construction work of ARQ is envisaged to commence in mid-2016. Although there may have half year overlapping period from late 2016 to early 2017, the major construction works of DAR including site formation and building foundation would be completed in 2016, and the remaining works would be minor building works. As such, the cumulative construction dust impact from DAR is unlikely and is not included in the assessment. However, vehicular emission due to the induced traffic from DAR would have cumulative air quality impact on nearby ASRs. As such the vehicular emission from the induced traffic has been considered in both construction and operational air quality assessment.

<u>Road Improvement Works</u>

4.5.4 Road improvement works at J/O Lin Tak Road and Sau Mau Ping Road, at J/O New Clear Water Bay Road and Anderson Road, as well as at the merging lane at Clear Water Bay Road near Shun Lee Tsuen Road are located within the 500m assessment area of Study Area. The construction of these road improvement works is scheduled from 2017 to 2022. Cumulative construction dust impact from these concurrent projects is expected and has been included in the assessment. In addition, vehicular emission form the induced traffic has also been considered in both construction and operational air quality assessment.

<u>Proposed Rock Cavern Development within ARQ and Pedestrian Connectivity</u>

4.5.5 The proposed rock cavern with the ARQ and pedestrian connectivity are located within the 500m assessment area. The construction phase of these projects ranged from 2016 to 2018. As such, cumulative dust impact from these projects has been considered in the construction dust assessment.

4.6 Assessment Methodology

Construction Phase

<u>Identification of Pollution Sources and Representative Pollutants</u>

4.6.1 A review on the construction methodology has been conducted. Construction of the Project would inevitably generate fugitive dust with potential impacts on neighbouring ASRs. In general, construction dust, as the representative pollutants, will be potentially generated mainly from the land-based at-grade heavy construction works including site clearance, soil excavation, backfilling, temporary storage, handling and transportation of material, and wind erosion of open sites.

4.6.2 According to Section 13.2.4.3 of USEPA AP-42, most of the particles in fugitive dust have an aerodynamic diameter of <30 µm and 47% of particles have an aerodynamic diameter of <10 µm. Hence, it is appropriate to adopt Total Suspended Particulates (TSP) (with aerodynamic diameter ≦30 µm) and Respirable Suspended Particulates (RSP) (with aerodynamic diameter ≦10 µm) as the representative pollutant for construction phase. Fine Suspended Particulates (FSP) has been added in the new AQOs with effect from 1 January 2014,. As a conservative approach, FSP will also be assessed under the construction dust assessment, notwithstanding that it only constitutes 7% of the total particles in fugitive dust. Therefore, 1-hour TSP, 24-hour RSP, annual RSP, 24-hour FSP and annual FSP concentrations would be assessed.

Emission Inventory of Dust Emission from Construction Activities

4.6.3 Potential air quality impact is anticipated during the construction of the Project and has been assessed based on the following conservative assumptions of the construction activities:

(1) Heavy construction activities including site clearance, ground excavation, backfilling, road construction, retaining wall construction;

(2) Daily loading and unloading activities at stockpiling area;

(3) Wind erosion of all active open sites;

(4) Construction working periods of 26 days a month and 12 hours a day from 7:00am to 7:00pm, except Sundays and public holidays.

4.6.4 The prediction of dust emissions is based on the typical values and emission factors obtained from the United States Environmental Protection Agency (USEPA) Compilation of Air Pollution Emission Factors, AP-42, 5th edition. References of calculations of dust emission factors of TSP for different dust generating activities are listed in **Table 4.4**.

Table 4.4: Reference of the calculation of dust emission factor (TSP)

Operating Sites	Activities	Equations and Assumptions	Reference
All construction and excavation sites	Heavy construction activities including land clearance, ground excavation, cut and fill operations, construction of the facilities, haul road, etc	E = 1.2 tons/acre/month of activity or = 2.69Mg/hectare/month of activity	USEPA AP42, S.13.2.3.3
All construction sites	Wind Erosion	E = 0.85 Mg/hectare/yr (24 hour emission)	USEPA AP42, S.11.9, Table 11.9.4
Stockpiles	Loading/Unloading at stockpile	$E = k(0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} (kg/megagram)$ k is particle size multiplier U is average wind speed M is material moisture content	USEPA AP42, S13.2.4

4.6.5 RSP and FSP emission factors for heavy construction and wind erosion are estimated based on the particle size distribution stated in Section 13.2.4.3 of USEPA. According to the particle size distribution, RSP (aerodynamic diameter ≦10 µm) and FSP (aerodynamic diameter ≦2.5 µm) constitute 47% and 7% of the TSP (aerodynamic diameter ≦ 30 μm), respectively. Hence, conversion factors of 0.47 and 0.07 are adopted to estimate the RSP and FSP emissions from TSP emission, respectively. The particle size distribution is tabulated in **Table 4.5**.

Table 4.5: Particle size distribution of construction dust

AQO Parameters	Particle Size (μm)	Particle Size Multiplier (k) in AP42	Conversion Factor (Based on TSP emission)
FSP	< 2.5	0.053	= FSP / TSP = 0.053 / 0.74 = 0.07 = 7%
RSP	< 10	0.35	= RSP / TSP = 0.35 / 0.74 = 0.47 = 47%
TSP	< 30	0.74	--

4.6.6 Dust emission from construction vehicle movement will generally be limited within the confined worksites area and the heavy construction emission factor given in AP-42 Section 13.2.3.3 has taken this factor into account. Watering facilities will be provided at every designated vehicular exit point. Effective from September 2009, all grab-mounted dump trucks travelling into and out of the construction sites should be equipped with suitable covers before the trucks leaving the sites. Since all vehicles will be washed at exit points and vehicle loaded with the dusty materials will be covered entirely by clean impervious sheeting before leaving the construction site, dust nuisance from construction vehicle movement outside the worksites is unlikely to be significant.

<u>Determination of Assessment Year</u>

4.6.7 The construction programme of heavy construction activities of the Project has been reviewed to identify the assessment years to be adopted.

4.6.8 TSP emissions from the Project during the construction phase are calculated based on the dust emission factors in AP-42 with the active operating area and construction programme. The detail calculation of the TSP emission inventory is presented in **Appendix 4.4. Table 4.6** below summarise the TSP emission during the construction phase.

Table 4.6: Annual TSP emission from the Project during the construction phase

Year	Annual TSP Emission (tonnes/year)
2016	12
2017	43
2018	28
2019	36
2020	25
2021	4
2022	0

4.6.9 According to **Table 4.6**, the TSP emissions from the Project reach maximum at year 2017 during the construction phase. As mentioned in **Section 4.6.5**, conversion factors of 0.47 and 0.07 are applied to estimate RSP and FSP from TSP emissions, respectively. Therefore, maximum RSP and FSP emissions are also found in Year 2017. As such, year 2017 is assumed as the worst assessment year. The extents of work areas of the Project and concurrent projects are illustrated in the **Appendix 4.1**.

4.6.10 The construction of the public housing of Phase 1 development will be completed in October 2022. As revealed from the construction programme given in the **Appendix 4.2**, all major dust generating activities will be completed before October 2022. Therefore, no additional assessment year for the planned ASRs of Phase 1 development is considered necessary.

4.6.11 The assessment year with respective works contracts included are summarised in **Table 4.7** below.

Table 4.7: Dust emission sources for dust impact assessment

Assessment Year	Works Contract	Description
2017	WC01_PL5A	Pedestrian Connectivity - PL5A (SMP Estate to Kwun Tong MTR)
	WC01_PL5B	Pedestrian Connectivity - PL5B (SMP Estate to Kwun Tong MTR)
	WC02_PL7	Pedestrian Connectivity _ PL7 (Po Tat Estate To BBI at Tsueng Kwan O Tunnel Road)
	WC03_PH1	Site Formation and Engineering Infrastructure at Main Site - Phase 1 area
	WC03_PLR	Access Road to Po Lam Road (Connection between Main Site and Po Lam Road)
	WC05	Drainage Retention Tank
	WC06_LTRW	Road Improvement Works - Area 2 (Lin Tak Road Widening)
	WC07_A3	Road Improvement Works - Area 3 (Clear Water Bay Road)
	WC07_A4	Road Improvement Works - Area 4 (Shun Lee Tsuen Road)

<u>Vehicular Emission from Open Road (Construction Phase)</u>

4.6.12 Major roads in the vicinity of the Study Area at assessment year (i.e. Year 2017) are illustrated in **Figure 227724/E/1065** to **Figure 227724/E/1067**.

4.6.13 EmFAC-HK v2.6 was used to calculate the vehicular tailpipe emission in lieu of the traditional fleet average emission factors. The road grouping, traffic flows and key assumptions for the EmFAC-HK v2.6 in Year 2017 are shown in **Appendix 4.5**.

<u>Vehicular Emission from Tunnel Portal (Construction Phase)</u>

4.6.14 The tunnel portal of the Tseung Kwan O Tunnel on the Kowloon side is located within the 500m boundary of the Project. Therefore, the tunnel portal emission from Tseung Kwan O Tunnel at Kowloon side has been included in the near field model. Although the tunnel portal of Tseung Kwan O Tunnel on Tseung Kwan O side is located outside of the study area, the emission of this tunnel portal has also been included in the assessment due to the significant amount of vehicular emission within the tunnel. As Tseung Kwan O Tunnel uses jet fans for ventilation, all the vehicular emission is assumed at the exit of the tunnel.

4.6.15 Detailed calculations of the portal emission are given in **Appendix 4.6.** The locations of portals are illustrated in **Figure 227724/E/1065** to **Figure 227724/E/1067**.

Industrial Emission

4.6.16 A total of 7 chimneys were identified within the 500m air quality assessment area including the 4 chimneys of the two Chinese restaurants in Shun Lee Estate and Shun On Estate, and 3 chimneys of United Christian Hospital. The locations of these 7 chimneys are shown in **Figure 227724/E/1050** and the emission inventory of these chimneys is given in **Appendix 4.3**. The associated cumulative air quality impacts due to the chimney emissions are assessed.

Background Pollutant Concentration – PATH Model

4.6.17 PATH model was used to quantify the background air quality during the construction phase of the Project. The emission sources including those in Pearl River Delta Economic Zone, roads, marine, airport, power plants and industries within Hong Kong were all considered in the PATH model. The hourly data of background concentration predicted by the PATH model provided by EPD were for Year 2015. As presented in **Sections 4.6.9**, Year 2017 was selected as the assessment year for the construction phase air quality impact assessment. Therefore, as a conservative assumption, Year 2015 background concentration were adopted in the calculation of the cumulative results. The PATH background concentrations for the concerned grids for Year 2015 are presented in **Appendix 4.7**.

4.6.18 It is understood that only hourly RSP concentrations are available from PATH model. According to EPD's "*Guideline on the Estimation of PM2.5 for Air Quality Assessment in Hong Kong",* the conservative correction factors of 0.71 and 0.75 are applied on the annual and daily RSP concentration to generate annual and daily FSP concentration, respectively. For hourly background TSP concentration, it is considered reasonable to adopt hourly RSP concentrations from PATH as the ambient TSP background concentrations, since the particulate of sizes larger than 10 µm generated from far-field dust sources would have been largely settled before reaching the ASRs, which in turn most of the particulates from far-field sources affecting ASRs will likely be those less than or equal to 10 µm (i.e. RSP).

Three Tiers Assessment Approach

4.6.19 Due to the size of the work sites and the need for orderly sequencing of construction activities, active construction activities will occur in different locations of the work site at different period of time. Therefore, it is not possible to pinpoint the exact locations of the individual dust emission sources over the entire work site in any short-term period (i.e. 1-hour and 24-hour). Nevertheless, a conservative "Three Tiers" assessment approach has been adopted including an initial Tier 1 and Tier 2 screening test and the subsequent Tier 3 assessment.

Tier 1 Screening Assessment

4.6.20 Tier 1 screening assessment aims to establish a theoretical worst case scenario for identifying hot spot areas with potential short term 1-hour and 24-hour impacts on the ASRs. A flatted terrain is assumed for the worst-case scenario assessment that all dust emission sources and ASRs are located at the same height level and theoretical maximum TSP, RSP and FSP concentrations at ASRs have been assessed for screening purpose for subsequent Tier 2 and Tier 3 assessment. The basis of the Tier 1 screening assessment for short term impact has assumed a 100% active works area for all work sites. Hot spot locations where the criteria have been exceeded are subjected to a Tier 2 assessment.

Tier 2 Screening Assessment

4.6.21 Based on engineer's estimation, there would be no more than 10% of active works areas in each work site during any short period of time. Hence the chance of having all 10% active works areas is unlikely within an individual work site. **Appendix 4.8** presents the justifications for the percentage of active areas.

4.6.22 In Tier 2 assessment, each hot spot area identified in Tier 1 screening assessment is assumed to have a 10% active works area occurring nearest to the potentially worst affected ASRs, while the active works area of the concurrent projects are assumed as 100% for worst-case scenario assessment. In addition, a flatted terrain is also assumed for the worst-case scenario assessment that all dust emission sources and identified hot spot ASRs are located at the same height level and theoretical maximum TSP, RSP and FSP concentration at the ASRs have been assessed for screening purpose for subsequent Tier 3 assessment. Nevertheless, Tier 2 assessment is still considered to be conservative as it assumes that all works activities within that 10% active works area will take place at the same time in the closest proximity to the potentially affected ASRs which, in reality, is unlikely to occur.

Tier 3 Assessment

4.6.23 For Tier 1 and Tier 2 assessment, a flatted terrain is assumed for the worst-case scenario assessment for screening purpose that results are unlikely to occur in real situation.

4.6.24 In Tier 3 assessment, the local terrain effect on the fugitive dust dispersion in each hotspot areas has been considered. The heights above datum of emission sources and ASRs are incorporated in the dust dispersion model. Assumption on the active works area of the Project and the concurrent projects is the same as Tier 2 assessment, 10% for site under the Project and 100% for sites under the concurrent projects, respectively. Results of Tier 3 assessment serves a representation of the detailed construction dust impact prediction for the study.

Long-term Annual Predictions

4.6.25 Dust modelling assessment for long term annual predictions assumes that all the active construction activities would likely be moving work fronts spreading across the whole work site. On this basis, it is assumed that the dust emission would be distributed across the whole area of each site to reasonably represent this mode of construction works. As the annual average active operating area is less than 10%, 10% of daily dust emission rates are adopted to produce this effect in the assessment. A flatted terrain is assumed for the worst-case scenario assessment that all dust emission sources and ASRs are located at the same height level and theoretical maximum TSP concentrations at ASRs have been assessed. **Appendix 4.8** presents the justifications for the percentage of active areas.

Dust Dispersion Model for Emission from Construction Activities - FDM

4.6.26 Dust impact assessment has been undertaken using the Fugitive Dust Model (FDM) developed by the United States Environmental Protection Agency (USEPA) and approved by EPD. It is a Gaussian plume model for computing air dispersion due to fugitive dust emission. Modelling parameters including dust emission factors, particle size distributions, surface roughness, etc. can be referred to in EPD guideline entitled "Guideline on Choice of Models and model parameters in Air Quality Assessment" and the USEPA AP-42. The density of dust was assumed to be 2.5g/m^3.

4.6.27 As mentioned in **Section 4.6.5**, particle size distribution is estimated based on Section 13.2.4.3 of USEPA AP-42. The particle size distribution of TSP, RSP and FSP are presented in **Table 4.8**.

Table 4.8: Particle size distribution of FDM

Particle Size (µm)	Average Particle Size (µm)	Particle Size Multiplier (k) in AP42	Relative Particle Size Fraction	Particle Size Distribution		
				TSP	RSP	FSP
0 – 2.5	1.25	0.053	0.053	7%	15%	100%
2.5 - 5	3.75	0.20	0.147	20%	42%	-
5 -10	7.5	0.35	0.150	20%	43%	-
10 – 15	12.5	0.48	0.130	18%	-	-
15 - 30	22.5	0.74	0.260	35%	-	-
Total				100%	100%	100%

4.6.28 During daytime working hours (7am to 7pm), it is assumed that dust emissions would be generated from all dust generating activities and site erosion. During night-time non-working hours (7pm – 7am the next day), Sunday and public holidays, dust emission would be from site erosion only as there would not normally be any construction activities during these hours.

4.6.29 Fugitive dust impacts have been modelled for ASR heights at 1.5m, 5m and 10m above ground for Tier 1 and Tier 2 assessment. Since all the dust generating sources associated with the Project are at ground level only, these assessment levels would therefore represent the worst-case scenario.

4.6.30 For Tier 3 assessment, the terrain effect on the dust dispersion has been considered, in which the heights above datum of emission sources and the ASRs are incorporated in the assessment. In view of the limitation of the model (FDM), elevated sources higher than 20m were set to the maximum height of 20m to represent the condition, albeit in a more conservative manner. Fugitive dust impacts have been modelled for ASR heights at 1.5m, 5m, 10m, 15m, 20m, 25m and 30m above ground to include ASRs at height from 1.5m above ground to 10m above ground of local elevated sources.

4.6.31 Both the unmitigated and mitigated scenarios for the Project are presented. The dispersion of the pollutants has also been investigated using contours generated from 100x100m grid.

4.6.32 The key modelling parameters are summarized in **Table 4.9**.

Table 4.9: Modelling parameters

Parameters	Input	Remark
Particle size distribution	Refer to **Table 4.8**.	Reference from S13.2.4.3 of USEPA AP-42
Modelling mode	Flatted terrain Elevated terrain	For Tier 1 and Tier 2 assessment For Tier 3 assessment
Meteorological data	MM5 data extracted from PATH Model	-
Anemometer height	10m above ground	-
Surface roughness	100 cm	-
Emission period	General construction activities during daytime working hours (7am to 7pm) Wind erosion during both day-time (7am to 7pm) and night-time (7pm to 7am of the next day)	-
Assessment height	1.5m, 5m and 10m above ground of local dust emission sources	-

Model for Vehicular Emission from Open Roads – CALINE4

4.6.33 Model parameters adopted are the same as the operational phase assessment. Details are given in **Section 4.6.74** to **Section 4.6.77**.

4.6.34 A 24-hour daily profile in terms of total traffic flow has been assumed for all vehicle classes. **Appendix 4.5** and **Appendix 4.9** present the detailed estimation of the vehicular emission factors and the composite emission factors from open roads for RSP and FSP within the assessment area.

Model for Portal Emission – ISCST3

4.6.35 Model parameters and hourly emission rates calculation method adopted are the same as the operational phase assessment. Details are given in **Section 4.6.78** to **Section 4.6.81**.

4.6.36 The portal emission factors are summarised in **Appendix 4.6**.

Model for Chimney Emission – ISCST3

4.6.37 Model parameters and hourly emission rates calculation method adopted are the same as the operational phase assessment. Details are given in **Section 4.6.82** to **Section 4.6.84**. The assumptions, chimney configuration and emission rates are presented in **Appendix 4.3**.

Cumulative Impact of Criteria Air Pollutants

4.6.38 The PATH model outputs based on Year 2015 emission inventories were added to the sum of the FDM, CALINE4 and ISCST3 model results sequentially on an hour-by-hour basis to derive the short-term and long-term cumulative impacts at each ASR. As particulate matters from vehicular emission and small industrial/commercial boiler using light fuel oil are RSP, the near-field contribution to cumulative TSP level from these sources is considered the same as their RSP contribution. The highest pollutant concentration predicted at an ASR amongst the 8760 hours (i.e. 24 hours x 365 days) is taken as the worst predicted hourly pollutant concentration for that ASR. The maximum 24-hour average pollutant concentration at an ASR amongst the 365 days is the highest predicted daily average concentration. The annual average pollutant concentration at an ASR is the average of 8760 hourly concentrations. The maximum predicted 1-hour TSP, 24-hour RSP, annual RSP, 24-hour FSP and annual FSP concentrations at each assessment level of each ASR therefore represent the worst-case scenario and are then compared with the respective AQOs.

Operational Phase

Identification of Pollution Sources and Representative Pollutants

4.6.39 As mentioned in **Section 4.4**, induced road traffic emission from proposed and existing road network is the major emission source generated by the Project. Existing chimney emissions from two Chinese restaurants and United Christian Hospital are also assessed for the cumulative operational air quality impact.

4.6.40 Vehicular emission comprises a number of pollutants, including Nitrogen Oxides (NO_x), Respirable Suspended Particulates (RSP), Sulphur Dioxides (SO_2), Carbon Monoxide (CO), Lead (Pb), Toxic Air Pollutants (TAPs) etc. Accordingly to "An Overview on Air Quality and Air Pollution Control in Hong Kong" published by EPD, motor vehicles are the main causes of high concentrations of respirable suspended particulates (RSP) and nitrogen oxides (NO_x) at street level in Hong Kong. As induced traffic flow raised from the Project is the major source of the operational air quality impact, RSP and NO_x are considered as key air quality pollutants. In addition, FSP is one of the compositions of RSP, and has also been assessed in the operational air quality assessment in this Project. For other pollutants, due to the low concentration in vehicular emission, they are not considered as key pollutants for the purpose of this study.

Nitrogen Dioxide (NO_2)

4.6.41 Nitrogen oxides (NO_x) is known to be one of the pollutants emitted by vehicles. According to the 2011 Environmental Performance Report published by EPD (http://www.epd.gov.hk/epd/misc/er/er2011/eg/contents_04_01.html), the dominant source of NO_x generated in HK is the electricity generation which constitutes about 45% of the total in 2009. Road transport is the second largest NO_x emission group, accounting for about 22% of the total in the same year.

4.6.42 Together with VOC and in the presence of O_3 under sunlight, NO_x would be transformed to NO_2. The operation of the Project would inevitably increase the traffic flow and hence the NO_x emission and subsequently the NO_2 concentrations near to the roadside. Hence, NO_2 is one of the key / representative pollutants for the operational air quality assessment of the Project. 1-hour and annual averaged concentrations at each identified ASRs have been assessed and compared with the AQOs to determine the compliance.

Respirable Suspended Particulates (RSP or PM10) and Fine Suspended Particulates (FSP or PM2.5)

4.6.43 Respirable Suspended Particulates (RSP or PM10) refers to suspended particulates with a nominal aerodynamic diameter of 10μm or less. According to the EPD's data (http://www.epd.gov.hk/epd/misc/er/er2011/eg/contents_04_01.html), road vehicles, particularly diesel vehicles, are one of the sources of RSP in Hong Kong. According to the statistics of EPD's 2011 Environmental Performance Report(http://www.epd.gov.hk/epd/misc/er/er2011/eg/contents_04_01.html), road transport is the second largest source of RSP accounting for 29% of the total emissions.

4.6.44 The operation of the Project would inevitably increase the traffic flow and hence the RSP concentrations near to the roadside. Hence, RSP is also one of the key representative pollutants for the operational air quality assessment of the Project. The 24-hour and annual averaged concentrations at each identified ASRs have been assessed and compared with the AQOs to determine the compliance.

4.6.45 Fine Suspended Particulates (FSP or PM2.5) refers to suspended particulates with a nominal aerodynamic diameter of 2.5μm or less. As FSP is one of the compositions of RSP that has been identified as one of the key pollutants for this Project, FSP should also be assessed in the operational air quality assessment in this Project. The 24-hour and annual averaged concentrations at each identified ASRs have been assessed and compared with the AQOs to determine the compliance.

Sulphur Dioxide (SO_2)

4.6.46 According to the statistics of EPD's 2011 Environmental Performance Report(http://www.epd.gov.hk/epd/misc/er/er2011/eg/contents_04_01.html), the dominant source of Sulphur Dioxide (SO_2) in Hong Kong is electricity generation which constitutes the majority of the emissions (about 92%). Although SO_2 is also one of the pollutants emitted by vehicles, road transport is the smallest emission source of SO_2 and only constitutes 0.5% of the total SO_2. The introduction of ultra low sulphur diesel for vehicle fleet in Year 2000 has also helped reducing the SO_2 emission in Hong Kong. Similarly, the airport contribution to the total SO_2 emission is also very little compared to the electricity generation.

4.6.47 Under the Air Pollution Control (Fuel Restriction) Regulations, only ultra-low sulphur fuel (sulphur content not more than 0.005% by weight) is allowed for chimney operation. As discussed in **Section 4.2**, the latest 5-year average of annual SO_2 concentrations in Kwun Tong is only 18% of the prevailing AQO. This clearly indicates that the AQOs for SO_2 could be well achieved with great margin in the assessment area. Given that road transport only contributes a very small amount of SO_2 and there is still a large margin to the AQO compared to the other pollutants such as RSP and NO_2. Therefore, SO_2 is not considered as key pollutants for quantitative assessment for the operational phase of the project.

Ozone (O_3)

4.6.48 O_3 is not a primary pollutant emitted from man-made sources but is formed by a set of complex chain reactions between various chemical species, including NO_x and VOC, in the presence of sunlight. Concentration of O_3 is governed by both precursors and atmospheric transport from other areas. When precursors transport along under favourable meteorological conditions and sunlight, ozone will be produced. This explains why higher ozone levels are generally not produced in the urban core or industrial area but rather at some distance downwind after photochemical reactions have taken place. In the presence of large amounts of NO_x in the roadside environment, O_3 reacts with NO to give NO_2 and thus results in O_3 removal. O_3 is therefore not considered as a key air pollutant for the operational air quality assessment of this project.

Carbon Monoxide (CO)

4.6.49 Carbon Monoxide (CO) is one of the primary pollutants emitted by road transport. According to the 2007 statistics published in EPD website (http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html), CO emissions from road transport contributed about 82% of total CO emission in 2007. It is understood that road transportation is the dominant source of CO emission; nevertheless, the air quality impact due to CO is still relatively minor considering its existing concentrations. It is clearly indicated that the AQOs for CO would be well achieved with great margin in the assessment area. The highest 1-hour CO concentration and highest 8-hour concentration in Causeway Bay (i.e. the highest CO recorded location) are only 13% and 33% of their respective prevailing AQOs, which are far below the criteria. Given that there is still a large margin to the AQO compared to the other pollutants such as RSP and NO_2, CO is not considered as the key pollutants for quantitative assessment for the operational air quality assessment.

Toxic Air Pollutants (TAPs)

4.6.50 There are six kinds of Toxic Air Pollutants (TAPs) routinely monitored in HK, including diesel particulate matters, polychlorinated biphenyl (PCBs), dioxins, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), carbonyls, and toxic elemental species.

4.6.51 Dioxins, carbonyls, PCBs and most toxic elemental species are not considered primary sources of vehicular emissions (http://www.epd.gov.hk/epd/english/environmentinhk/air/studyrpts/assessment_of_tap_measurements.html & http://www.eea.europa.eu/publications/EMEPCORINAIR5/Sources_of_PCB_emissions.pdf/view), and hence, these three TAPs are not considered as key / representative air pollutants for the operational air quality assessment.

4.6.52 Vehicular emissions may be a source of diesel particulate matters, PAHs and VOCs. Elemental carbon, which constitutes a large portion of diesel particulate matters mass, is commonly used as a surrogate for diesel particulate matter. According to the data from EPD, the elemental carbon showed a significant decrease in concentration in Mong Kok by 47.5% from 2001 to 2009, and Tsuen Wan by 51.3% from 1999 to 2009. This is because the implementation of EURO III vehicle emission standard to goods vehicle and bus in 2001 and EURO IV standard to all types of vehicle in 2006-2007 (http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html). It is not considered as a key air pollutant for the operational air quality assessment.

4.6.53 Currently, no ambient air quality standards have been set for PAHs. However, with reference to US and European Community air quality guidelines, the European commission has a very stringent guideline concentration for PAHs. According to the latest EPD study report in 2011 - "Annual Air Quality Monitoring Results - Air Quality in Hong Kong 2011" (http://www.epdasg.gov.hk/english/report/files/AQR2011e_final.pdf), the concentration of PAHs level (Benzo[a]pyrene, BaP) in Hong Kong was 0.22 ng/m^3 monitored at both the Tsuen Wan and Central/Western stations respectively in 2011 which was still much lower than the guidelines of European Communities of 1 ng/m^3.

4.6.54 There are different standards for different VOC compounds. According to the latest EPD study report in 2011 – "Annual Air Quality Monitoring Results – Air Quality in Hong Kong 2011" (http://www.epd-asg.gov.hk/english/report/files/AQR2011e_final.pdf), benzene, 1-3 butadiene, formaldehyde and perchloroethlene are the VOCs that may have more health concern, and the USEPA also identified benzene and 1-3 butadiene are carcinogenic.

Table 4.10: Comparison of VOCs concentration in Hong Kong (2011) and the EU Air Quality Standards

TAP	Guidelines / Standards ($\mu g/m^3$)	Highest average concentration at Tsuen Wan Station ($\mu g/m^3$)	Highest average concentration at Central/Western Station ($\mu g/m^3$)	Compliance
Benzene	5 (Annual Average) [1]	1.62	1.53	Well Achieved
1-3 butadiene	2.25 (Running Annual) [1]	0.13	0.13	Well Achieved
Formaldehyde [2]	9 (Annual Average) [3]	-	3.61	Well Achieved
Perchloroethylene	40 (Annual Average) [4]	0.47	0.51	Well Achieved

Note:

[1] Referenced from the UK National Air Quality Strategy (NAQS) (http://www.medway.gov.uk/environmentandplanning/environmentalhealth/airquality/airqualityfordevelopers.aspx)

[2] The measurement of formaldehyde was affected by influence from renovation works at Princess Alexandra Community Centre as well as nearby buildings of Tsuen Wan Station. Hence, only formaldehyde concentration at the Central/Western station is reported.

[3] Referenced from the Office of Environmental Health Hazard Assessment (OEHHA) Toxicity Criteria Database, California, USA (http://www.oehha.ca.gov/tcdb/index.asp)

[4] Referenced from the Integrated Risk Information System (IRIS), USEPA (http://www.epa.gov/iris/subst/0106.htm)

4.6.55 As shown in the **Table 4.10**, the measured VOCs concentration in Hong Kong urban area is far below the UK and US standards. Also, according to Hong Kong Air Pollutants Emission Inventory (http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html), the VOCs level has dropped by approximately 50% in 2007 since 1990 due to the EPD progressive improvement of EURO standard vehicles over the past two decades. With reference to the EPD's 2011 Environmental Performance Report (http://www.epd.gov.hk/epd/misc/er/er2011/eg/contents_04_01.html), vehicular emission is also not the primary source of VOCs, accounting for about 27% of the total in Hong Kong. Besides, according to another study - "Seasonal and diurnal variations of volatile organic compounds (VOCs) in the atmosphere of Hong Kong", benzene, and 1-3 butadiene only contributed about 6-13% of overall vehicular emission VOCs. In other words, only 1.6-3.5% of the overall VOC emissions in Hong Kong are benzene and 1-3 butadiene contributed by vehicular emission.

4.6.56 The historical monitoring data showed that the concentrations of PAHs and VOCs were only in small amount. It is also reasonably believed that the emission of PAHs and VOCs should be significantly decreased after the implementation of EURO V standard vehicles in 2013; and the elimination of most of the pre-EURO standard and EURO I vehicles. The TAPs is also not specified under the current AQO. Based on above reasons, TAPs is not considered as a key air pollutant for the operational air quality assessment.

Lead (Pb)

4.6.57 As leaded petrol had been banned in Hong Kong in 1999, it is no longer considered as a primary source in Hong Kong. According to the "Annual Air Quality Monitoring Results - Air Quality in Hong Kong 2011" from EPD (http://www.epdasg.gov.hk/english/report/files/AQR2011e_final.pdf), the measured 3-month averaged lead level was 0.020 µg/m^3 in Kwun Tong. The measured concentration is much lower than the 3-month AQO of 1.5 µg/m^3. Therefore, lead is not considered as a key / representative air pollutant for the operational air quality assessment.

4.6.58 As discussed in the above sections, NO_2, RSP and FSP have been concluded to be the representative air pollutants. These three pollutants are stipulated in the AQOs.

Emission Inventory

4.6.59 As discussed in **Section 4.6.40** to **Section 4.6.58**, NO_2, RSP and FSP are the air pollutants of primary concern during operational phase of the Project and hence are assessed in the study.

4.6.60 In assessing the operational air quality impact to the ASRs, contributions from emission sources, including vehicular emission from open road and tunnel portal, and industrial emission, have been considered.

Vehicular Emission from Open Road

4.6.61 Major sources of vehicular emission include:

(1) Vehicular emission from proposed internal road network within the Study Area;

(2) Vehicular emission from existing road networks within 500m from the Study Area boundary;

(3) Cumulative vehicular emission impacts from concurrent projects as detailed in **Section 4.5**.

4.6.62 Upon completion of the ARQ development, vehicular emissions would be generated from the additional road network in the study area. Additional traffic flow would also be induced on the existing roads and therefore a corresponding increase in vehicular emissions is anticipated. Major roads in the vicinity of the Study Area are illustrated in **Figure 227724/E/1070** to **Figure 227724/E/1090**.

4.6.63 EmFAC-HK v2.6 was used to calculate the vehicular tailpipe emission in lieu of the traditional fleet average emission factors. The road grouping for this assessment is shown in **Appendix 4.5**.

4.6.64 Preliminary traffic flows in each assessment year (i.e. Year 2022, 2025, 2026, 2027, 2031, 2036 and 2041) have been reviewed and the peak traffic flows for each assessment years have been selected to represent the worst case. **Appendix 4.5** presents the key assumptions for the EmFAC-HK modelling.

Vehicular Emission from Tunnel Portal

4.6.65 The tunnel portal of the Tseung Kwan O Tunnel on the Kowloon side is located within the 500m boundary of the Project. Therefore, the tunnel portal emission from Tseung Kwan O Tunnel at the Kowloon side has been included in the near field model. Although the tunnel portal of Tseung Kwan O Tunnel on the Tseung Kwan O side is located outside of the study area, the emission of this tunnel portal has been included in the assessment due to the significant amount of vehicular emission within the tunnel. As Tseung Kwan O Tunnel uses jet fans for ventilation, all the vehicular emission is assumed at the exit of the tunnel.

4.6.66 During the operation of the ARQ, a short portion of local road will go beneath a landscape deck. In addition, an underpass has been proposed at the access road to the Po Lam Road. The portal emissions from the landscape deck and the proposed underpass have been included in the near field model. As no detail design of the landscape deck and proposed underpass is available at this moment, all the vehicular emission is assumed at the exits of the landscape deck and the proposed underpass by considering that no ventilation building is required for the short length of road go beneath the landscape deck and short length of the proposed underpass.

4.6.67 Detailed calculations of the portal emission are given in **Appendix 4.10.** The locations of portals are illustrated in **Figure 227724/E/1070** to **Figure 227724/E/1090**.

Industrial Emission

4.6.68 A total of 7 chimneys were identified within the 500m air quality assessment area including the 4 chimneys of the two Chinese restaurants in Shun Lee Estate and Shun On Estate, and 3 chimneys of United Christian Hospital. The locations of these 7 chimneys are shown in **Figure 227724/E/1050** and the emission inventory of these chimneys is given in **Appendix 4.3**. The associated cumulative air quality impacts due to the chimney emissions are assessed.

Determination of Assessment Year

4.6.69 According to Section 4(i) of Appendix A of the EIA Study Brief for the Project, the air pollution impacts of future road traffic impacts at the identified ASRs should be assessed based on assumed reasonably worst-case scenario under the normal operating conditions. The highest emission strength from road within the next 15 years upon full population intake year is used for assessing the air pollutant impacts from the future road traffic.

4.6.70 Vehicular tailpipe emissions from open roads are calculated based on EPD EmFAC-HK v2.6. The assessment year was determined based on the highest vehicular emission from the roads in the Study Area using the EmFAC-HK model. **Appendix 4.5** presents the methodology and assumptions adopted in estimating the emission factors and the calculated results. **Table 4.11** below summarise the total emission of NO_x, RSP and FSP for Year 2022, 2025, 2026, 2027, 2031, 2036 and 2041.

Table 4.11: Total Emission of NO_x, RSP and FSP for Year 2022, 2025, 2026, 2027, 2031, 2036 and 2041

Year	Annual Emission (kg/year)		
	NO_x	RSP	FSP
2022	72,525	2,865	2,633
2025	86,036	3,922	3,607
2026	98,612	4,614	4,245
2027	94,625	4,556	4,192
2031	69,512	3,465	3,190
2036	54,098	2,907	2,677
2041	54,492	3,065	2,823

4.6.71 As shown in **Table 4.11**, it was concluded that the highest vehicular emissions will be found in Year 2026. Therefore, Year 2026 was selected as the assessment year for the operational phase air quality impact assessment. The hourly emission of NO_x, RSP and FSP were divided by the number of vehicles and the distance travelled to obtain the emission factors in gram per miles per vehicle. The calculated 24-hour emission factors of 16 vehicle classes for different road types in Year 2026 adopted in this air quality impact assessment are presented in **Appendix 4.11**.

4.6.72 Both Phase 1 and Phase 2 developments will be completed in Year 2026, which means that all ASRs and emission sources of ARQ development would be presented in year 2026. As year 2026 has been selected as assessment year and operational phase air quality impacts of all ASRs have been assessed, therefore, additional assessment year is considered not required.

Background Pollutant Concentration – PATH Model

4.6.73 PATH model was used to quantify the background air quality during the operational phase of the Project. The emission sources including those in Pearl River Delta Economic Zone, roads, marine, airport, power plants and industries within Hong Kong were all considered in the PATH model. The hourly data of background concentration predicted by the PATH model provided by EPD were for Year 2020. As presented in **Sections 4.6.71**, Year 2026 was selected as the assessment year for the operation phase air quality impact assessment. Therefore, as a conservative assumption, Year 2020 background concentration were adopted in the calculation of the cumulative results. The PATH background concentrations for the concerned grids for Year 2020 are presented in **Appendix 4.12**.

Model for Vehicular Emission from Open Roads – CALINE4

4.6.74 The air dispersion model, CALINE4 developed by the California Department of Transport and approved by USEPA was used to assess vehicular emission impacts from the existing and planned road network. In view of the limitation of the model, elevated roads higher than 10m were set to the maximum height of 10m to represent the condition, albeit in a more conservative manner. Meteorological data extracted from PATH model was adopted for the dispersion modelling.

4.6.75 The surface roughness height is closely related to the land use characteristics, and the surface roughness is estimated as 3 to 10 percent of the average height of physical structure within 1 km of study area. Surface roughness of 100cm was assumed to represent the urbanized terrain. The wind standard deviation is estimated in accordance with the "Guideline on Air Quality Models (Revised), 1986", as summarised in **Table 4.12.** For barriers along roads, the line source was modelled at the tip of the barrier and the mixing width is limited to the actual uncovered road width in order to address the associated secondary environmental impact. The road type of the concerned road type was set to "fill" option in CALINE4.

Table 4.12: Summary of Wind Standard Deviation for Surface Roughness of 100cm

Stability Class	Wind Standard Deviation (degrees)
A	33
B	33
C	26
D	18
E	11
F	5.6

4.6.76 Ozone Limiting Method (OLM) was adopted for the conversion of NO_x to NO_2, using the predicted O_3 and NO_2 levels from the PATH model. According to EPD's Guidelines on Choice of Models and Model Parameters, the vehicular tailpipe NO_2 emission was assumed to be 7.5% of NO_x. The NO_2/NO_x conversion was calculated as follows:

$$[NO_2]pred = 0.075x[NO_x]pred + MIN \{0.925x[NO_x]pred, \text{ or } (46/48) \text{ x } [O_3]bkgd\}$$

where

$[NO_2]$pred	is the predicted NO_2 concentration
$[NO_x]$pred	is the predicted NO_x concentration
MIN	means the minimum of the two values within the brackets
$[O_3]$bkgd	is the representative O_3 background concentration
(46/48)	is the molecular weight of NO_2 divided by the molecular weight of O_3

4.6.77 A 24-hour daily profile in terms of total traffic flow has been assumed for all vehicle classes. **Appendix 4.5** and **Appendix 4.11** present the detailed estimation of the vehicular emission factors and the composite emission factors from open roads for NO_2, RSP and FSP within the assessment area.

Model for Portal Emission － ISCST3

4.6.78 The USEPA approved model, ISCST3, has been adopted to model the vehicular emission from tunnel portals and portals of landscape deck. The modelling parameters are listed in **Table 4.13**.

Table 4.13: Modelling parameters for ISCST3

Parameters	**Input**
Modelling mode	Urban with terrain effect
Meteorological data	MM5 data extracted from PATH Model

4.6.79 The hourly emission rates of the tunnel portal of the Tseung Kwan O Tunnel, portals of Landscape Deck and portals of the proposed underpass at the access road to Po Lam Road were obtained by multiplying the emission strength (g/mile/veh to be determined from EmFAC-HK as described in previous sections) by the products of traffic flow (veh/hr) and tunnel length (km). Since the Tseung Kwan O Tunnel uses jet fans for ventilation, all the vehicular emission was assumed at the exit of the tunnel.

4.6.80 The portal emission was modelled in accordance with the Permanent International Association of Road Congress Report (PIARC) assuming a jet effect to discharge to the first 100-250m of the open road section in the direction of the vehicular, with 2/3 of the total emission strength for the first 50% sources and 1/3 of the total emission strength for the remaining 50% sources. The emission was modelled as volume sources by ISCST3.

4.6.81 The portal emission factors are summarised in **Appendix 4.10**.

Model for Chimney Emission － ISCST3

4.6.82 Gaseous emissions from the identified existing chimneys identified have been assessed by using ISCST3 model. The modelling parameters are listed in **Table 4.14**. The assumptions, chimney configuration and emission rates are presented in **Appendix 4.3**.

Table 4.14: Modelling parameters for ISCST3

Parameters	Input
Modelling mode	Urban with terrain effect
Meteorological data	MM5 data extracted from PATH Model

4.6.83 Ozone Limiting Method (OLM) was adopted for the conversion of NO_x to NO_2 based on the predicted O_3 level from PATH. The rural dispersion mode in ISCST3 model was selected depending on the land uses where the ASRs are located. The NO_2/NO_x conversion is calculated as follows:

$[NO_2]pred = 0.1x[NO_x]pred + MIN \{0.9x[NO_x]pred, or (46/48)x[O_3]bkgd\}$

where

$[NO_2]pred$	is the predicted NO_2 concentration
$[NO_x]pred$	is the predicted NO_x concentration
MIN	means the minimum of the two values within the brackets
$[O_3]bkgd$	is the representative O_3 background concentration
(46/48)	is the molecular weight of NO_2 divided by the molecular weight of O_3

Cumulative Impact of Criteria Air Pollutants

4.6.84 The PATH model outputs based on Year 2020 emission inventories were added to the sum of the CALINE4 and ISCST3 model results sequentially on an hour-by-hour basis to derive the short-term and long-term cumulative impacts at each ASR. The highest pollutant concentration predicted at an ASR amongst the 8760 hours (i.e. 24 hours x 365 days) is taken as the worst predicted hourly pollutant concentration for that ASR. The maximum 24-hour average pollutant concentration at an ASR amongst the 365 days is the highest predicted daily average concentration. The annual average pollutant concentration at an ASR is the average of 8760 hourly concentrations. Based on the chimney emission results, the highest concentrations of pollutants were found at the height of less than 30m above ground. Since all the vehicular emissions associated with the Project are from ground level only, the worst hit levels are predicted less than 30m above ground. The maximum predicted 1-hour, 24-hour and annual NO_2, RSP, and FSP concentrations at each ASR at 7 levels (including 1.5m, 5m, 10m, 15m, 20m, 25m and 30m) therefore represent the worst-case scenario and are then compared with the respective AQOs.

4.7 Construction Dust Assessment

Assessment Result – Unmitigated Scenario

4.7.1 For cumulative fugitive dust impacts, the environmental performance of the unmitigated scenario would likely to exceed the criterion at majority of ASR locations. Therefore, mitigation measures are needed to reduce the potential adverse dust impacts. **Appendix 4.13** shows the results of unmitigated scenarios and **Table 4.15** summarizes the assessment results. **Figure 227724/E/1100** to **Figure 227724/E/1106** show the contours of unmitigated cumulative 1-hour TSP, 24-hour RSP, annual RSP, 24-hour FSP and annual FSP concentrations in the Study Area.

Table 4.15: Summary of TSP, RSP and FSP concentrations under unmitigated scenario

Pollutant	Averaging Time	AQOs / Criteria of TM-EIAO ($\mu g/m^3$)[1]	Concentration at Various Height ($\mu g/m^3$)[2][3]		
			1.5m	5m	10m
TSP	1-hour	500	**629 - 7372**	**664 - 4456**	**592 - 3100**
RSP	24-hour	100 (9)	**119** – **1005** (4 – **10**)	**121** – **660** (4 – **10**)	**120** – **477** (4 – **10**)
	Annual	50	43 **- 323**	43 **- 207**	43 **- 157**
FSP	24-hour	75 (9)	**82** – **183** (1 – **10**)	**82 - 129** (1 – **10**)	**82** – **103** (1 – **10**)
	Annual	35	29 **- 72**	29 **- 53**	29 **- 46**

Note:

[1] Values in ( ) mean the number of exceedances allowed.

[2] Values which exceeded the AQO or criterion of TM-EIAO are shown as bolded characters

[3] Values in ( ) mean the number of exceedance against the AQOs.

Mitigation Measures

4.7.2 In order to reduce the dust impact and achieve compliances of TSP, RSP and FSP criteria at ASRs, mitigation measures in the form of regular watering under good site practice should be adopted.

4.7.3 In accordance with the "Control of Open Fugitive Dust Sources" (USEPA AP-42), watering once per hour on exposed worksites and haul road is recommended to achieve dust removal efficiency of 91.7%. **Appendix 4.8** presents the calculation of the dust removal efficiency. The dust suppression efficiency is derived based on the following conservative assumptions:

- Maximum haul road traffic of 70 vehicles/hour as estimated by Engineer:
- Average evaporation rate obtained from Hong Kong Observatory; and
- Hourly application intensity of 1.75 L/m2 for respective watering.

4.7.4 For the loading/unloading activities at stockpiling area, a conservative assumption of 50% dust suppression is adopted. **Appendix 4.8** presents the justification of the dust removal efficiency that could be achieved with hourly application intensity of 1.75 L/m^2.

4.7.5 Any potential dust impact and watering mitigation would be subject to the actual site conditions. For example, a construction activity that produces inherently wet conditions or in cases during rainy weather, the above water application intensity may not be unreservedly applied. While the above watering frequency is to be followed, the extent of watering may vary depending on actual site conditions but should be sufficient to maintain an equivalent intensity of no less than 1.75 L/m^2 to achieve the respective dust removal efficiencies. For example, water sprinkler and watering truck with flow control should be installed and applied to ensure of no less than 1.75 L/m^2 of water spraying on site. The dust levels would be monitored and managed under an EM&A programme as specified in the EM&A Manual.

4.7.6 In addition to the watering and required intensity, the Contractor will also be obliged to follow the procedures and requirements given in the Air Pollution Control (Construction Dust) Regulation. This stipulates the construction dust control requirements for both Notifiable (e.g. site formation) and Regulatory (e.g. road opening) Works to be carried out by the Contractor. The following dust suppression measures should be incorporated by the Contractor to control the dust nuisance throughout the construction phase:

(1) Any excavated or stockpile of dusty material should be covered entirely by impervious sheeting or sprayed with water to maintain the entire surface wet and then removed or backfilled or reinstated where practicable within 24 hours of the excavation or unloading;

(2) Any dusty material remaining after a stockpile is removed should be wetted with water and cleared from the surface of roads;

(3) A stockpile of dusty material should not extend beyond the pedestrian barriers, fencing or traffic cones;;

(4) The load of dusty materials on a vehicles leaving a construction site should be covered entirely by impervious sheeting to ensure that the dusty materials do not leak form the vehicle;

(5) Where practicable, vehicles washing facilities including a high pressure water jet should be provided at every discernible or designated vehicle exit point. The area where vehicle washing takes place and the road section between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores;

(6) When there are open excavation and reinstatement works, hoarding of not less than 2.4m high should be provided as far as practicable along the site boundary with provision for public crossing. Good site practice shall also be adopted by the Contractor to ensure the conditions of the hoardings are properly maintained throughout the construction period;

(7) The portion of any road leading only to construction site that is within 30m of a vehicle entrance or exit should be kept clear of dusty materials;

(8) Surfaces where any pneumatic or power-driven drilling, cutting, polishing or other mechanical breaking operation takes place should be sprayed with water or a dust suppression chemical continuously;

(9) Any area that involves demolition activities should be sprayed with water or a dust suppression chemical immediately prior to, during and immediately after the activities so as to maintain the entire surface wet;

(10) Where a scaffolding is erected around the perimeter of a building under construction, effective dust screens, sheeting or netting should be provided to enclose the scaffolding from the ground floor level of the building, or a canopy should be provided from the first floor level up to the highest level of the scaffolding;

(11) Any skip hoist for material transport should be totally enclosed by impervious sheeting;

(12) Every stock of more than 20 bags of cement or dry pulverised fuel ash (PFA) should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the three sides;

(13) Cement or dry PFA delivered in bulk should be stored in a closed silo fitted with an audible high level alarm which is interlocked with the material filling line and no overfilling is allowed; and

(14) Exposed earth should be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shortcrete or other suitable surface stabiliser within six months after the last construction activity on the construction site or part of the construction site where the exposed earth lies.

4.7.7 These requirements should be incorporated into the contract specification for the civil work. In addition, a monitoring and audit programme during the construction phase should be implemented by the project proponent to ensure that the construction dust impacts are controlled to within the required criteria. Detailed requirements for the monitoring and audit programme are given separately in the EM&A Manual.

Assessment Result – Mitigated Scenario

Short-term Assessment (Tier 1) – Year 2017

4.7.8 The maximum 1-hour TSP, 24-hour RSP and 24-hour FSP concentrations from Tier 1 screening assessment have been predicted. **Appendix 4.13** shows the assessment results and **Table 4.16** below summarise the cumulative 1-hour TSP, 24-hour RSP and 24-hour FSP impact (Tier 1) at the concerned ASRs, respectively. The results indicate that, for most of the ASRs, non-compliance of criteria would not be anticipated even with this theoretical worst case situation, whereby the entire worksites were assumed active (i.e. 100%). However, for the ASRs near the worksites (e.g. Ma Yau Tong Village, Site C2 and Site E of DAR), non-compliance of 1-hour TSP, 24-hour RSP and 24-hour FSP are still predicted. As the Tier 1 assessment is for screening purposes only and does not reflect the actual on-site activities, a more focused Tier 2 assessment has been undertaken.

4.7.9 **Figure 227724/E/1160** to **Figure 227724/E/1164** show the contours of Tier 1 1-hour TSP, 24-hour RSP and 24-hour FSP concentrations.

Table 4.16: Tier 1 assessment – Summary of 1-hour TSP, 24-hour RSP and 24-hour FSP concentration results under mitigated scenario in Year 2017

Pollutant	Averaging time	AQOs / Criteria of TM-EIAO (µg/m³)[1]	Concentration at Various Height (µg/m³)[2][3]		
			1.5m	5m	10m
TSP	1-hour	500	148 **- 640**	148 - 445	148 - 281
RSP	24-hour	100 (9)	**110** – **135** (1 – **10**)	**110** – **129** (1 – 9)	**110** – **123** (1 – 3)
FSP	24-hour	75 (9)	**82** – **125** (1 – **10**)	**82** – **102** (1 – **10**)	**82** – **98** (1 – 9)

Note:

[1] Values in ( ) mean the number of exceedances allowed.

[2] Non-compliance of AQO or criterion of TM-EIAO are shown as bolded characters

[3] Values in ( ) mean the number of exceedance against the AQOs.

Short-term Assessment (Tier 2) – Year 2017

4.7.10 A more focused Tier 2 assessment has been conducted with the assumed 10% active works areas for the adjacent construction site positioned nearest to the potentially worst affected ASRs, while the active area of worksites of concurrent project is assumed still 100%. As mentioned in **Section 4.6**, the Tier 2 assessment is also very conservative and will lead to over prediction of the dust impacts.

4.7.11 The 1-hour TSP, 24-hour RSP and 24-hour FSP concentrations from Tier 2 screening assessment have been predicted. **Appendix 4.13** shows the assessment results and **Table 4.17** to **Table 4.19** below summarises the cumulative 1-hour TSP, 24-hour RSP and 24-hour FSP impact (Tier 2) at the concerned ASRs. Results show that, the cumulative 1-hour TSP, 24-hour RSP and 24-hour FSP concentrations would comply with the respective criterion except Planned Park at Site C2 of DAR. As such, adverse short-term construction dust impact is not anticipated.

4.7.12 Contours have been presented in **Figure 227724/E/1179** to **Figure 227724/E/1189** for 1-hour TSP, 24-hour RSP and 24-hour FSP (Tier 2) at 1.5m above the ground to illustrate the short-term dust impact on the ASRs.

Table 4.17: Tier 2 assessment – Summary of 1-hour TSP concentrations of concerned ASRs under mitigated scenario in Year 2017

Locations	ASR	1-hour TSP concentrations at various height (μg/m^3) (TM-EIAO Criterion = 500 μg/m^3)		
		1.5m	5m	10m
Planned Park, Site C2	DARC-32	354	-	-
Planned Park, Site C2	DARC-33	**571**	-	-
Planned Park, Site C2	DARC-38	466	-	-
Planned Park, Site C2	DARC-39	455	-	-
Planned Park, Site C2	DARC-40	**507**	-	-
Planned School, Site E	DARE-27	412	219	154
Planned School, Site E	DARE-28	326	203	146
Planned Park, Site C2	DARC-36	324	-	-
Planned Park, Site C2	DARC-37	487	-	-
Ma Yau Tong Village	AMYT-04	470	281	204
Ma Yau Tong Village	AMYT-05	421	279	203

Note:

[1] Non-compliance of criterion of 500 μg/m^3 are shown as bolded characters

Table 4.18: Tier 2 assessment – Summary of 24-hour RSP concentrations of concerned ASRs under mitigated scenario in Year 2017

Locations	ASR	24-hour RSP concentrations at various height (μg/m^3) (AQO = 100 μg/m^3 (9))[1]		
		1.5m[2]	5m[2]	10m[2]
Planned Park, Site C2	DARC-32	112 (1)	-	-
Planned Park, Site C2	DARC-33	**113 (10)**	-	-
Planned Park, Site C2	DARC-38	**113 (10)**	-	-
Planned Park, Site C2	DARC-39	**116 (10)**	-	-
Planned Park, Site C2	DARC-40	**128 (10)**	-	-
Block 5, Site E	DARE-06	113 (5)	112 (1)	111 (1)
Planned School, Site E	DARE-27	115 (6)	113 (1)	112 (1)
Planned School, Site E	DARE-28	113 (1)	112 (1)	111 (1)
Planned School, Site E	DARE-29	113 (1)	112 (1)	111 (1)
Planned Park, Site C2	DARC-36	119 (3)	-	-
Planned Park, Site C2	DARC-37	118 (4)	-	-

Note:

[1] Values in ( ) mean the number of exceedances allowed.

[2] Values in ( ) mean the number of exceedance against the AQOs.

[3] Non-compliance of AQO is shown as bolded characters.

Table 4.19: Tier 2 assessment – Summary of 24-hour FSP concentrations of concerned ASRs under mitigated scenario in Year 2017

Locations	**ASR**	**24-hour FSP concentrations at various height (μg/m^3) (AQO = 75 μg/m^3 (9))[1]**		
		1.5m[2]	**5m[2]**	**10m[2]**
Planned Park, Site C2	DARC-30	83 (1)	-	-
Planned Park, Site C2	DARC-31	83 (1)	-	-
Planned Park, Site C2	DARC-32	83 (1)	-	-
Planned Park, Site C2	DARC-33	83 (1)	-	-
Planned Park, Site C2	DARC-38	83 (1)	-	-
Planned Park, Site C2	DARC-39	84 (1)	-	-
Planned Park, Site C2	DARC-40	85 (1)	-	-
Public Open Space, Site E	DARE-01	83 (1)	-	-
Block 5, Site E	DARE-05	83 (1)	83 (1)	83 (1)
Block 5, Site E	DARE-06	83 (1)	83 (1)	83 (1)
Block 6, Site E	DARE-08	83 (1)	83 (1)	83 (1)
Block 8, Site E	DARE-16	83 (1)	83 (1)	83 (1)
Block 9, Site E	DARE-17	83 (1)	83 (1)	83 (1)
Block 11, Site E	DARE-21	83 (1)	83 (1)	83 (1)
Basketball Court, Site E	DARE-22	83 (1)	-	-
Block 10, Site E	DARE-23	83 (1)	83 (1)	83 (1)
Block 10, Site E	DARE-24	83 (1)	83 (1)	83 (1)
Planned School, Site E	DARE-25	83 (1)	83 (1)	83 (1)
Planned School, Site E	DARE-26	83 (1)	83 (1)	83 (1)
Planned School, Site E	DARE-27	84 (1)	83 (1)	83 (1)
Planned School, Site E	DARE-28	83 (1)	83 (1)	83 (1)
Planned School, Site E	DARE-29	83 (1)	83 (1)	83 (1)
Planned School, Site E	DARE-30	83 (1)	83 (1)	83 (1)
Planned Clinic and Community Centre, Site C2	DARC-10	88 (1)	88 (1)	87 (1)
Planned Clinic and Community Centre, Site C2	DARC-11	88 (1)	88 (1)	87 (1)
Planned Clinic and Community Centre, Site C2	DARC-12	88 (1)	88 (1)	87 (1)
Planned School, Site C2	DARC-23	88 (1)	88 (1)	87 (1)
Planned School, Site C2	DARC-24	88 (1)	88 (1)	87 (1)
Planned School, Site C2	DARC-25	88 (1)	88 (1)	87 (1)
Planned School, Site C2	DARC-26	88 (1)	88 (1)	87 (1)
Planned Park, Site C2	DARC-34	88 (1)	-	-
Planned Park, Site C2	DARC-35	88 (1)	-	-
Planned Park, Site C2	DARC-36	88 (1)	-	-
Planned Park, Site C2	DARC-37	88 (1)	-	-

Note:

[1] Values in ( ) mean the number of exceedances allowed.

[2] Values in ( ) mean the number of exceedance against the AQOs.

Short-term Assessment (Tier 3) – Year 2017

4.7.13 Based on the Tier 2 assessment which is a reasonable conservative assessment, 1-hour TSP non-compliance at two ASRs and 24-hour RSP non-compliance at four ASRs are predicted. However, a flatted terrain is assumed for worst case scenario assessment for Tier 1 and Tier 2 assessment. A more focused Tier 3 assessment has been conducted with the consideration of height above datum of emission sources and concerned ASRs. The active area assumption for construction site of the Project and concurrent project remaining the same as Tier 2 assessment.

4.7.14 The cumulative 1-hour TSP and 24-hour RSP concentrations from Tier 3 assessment have been predicted. **Appendix 4.13** shows the assessment results and **Table 4.20** and **Table 4.21** below summarises the cumulative 1-hour TSP and 24-hour RSP impacts (Tier 3) at the concerned ASRs. Results show that, the cumulative 1-hour TSP and 24-hour RSP concentrations would comply with the respective criteria and as such, adverse short-term construction dust impact is not anticipated.

4.7.15 Contours have been presented in **Figure 227724/E/1210** to **Figure 227724/E/1212** for 1-hour TSP and 24-hour RSP concentrations at 1.5m above ground (i.e. the maximum level) to illustrate the short-term dust impact on ASRs.

Table 4.20: Tier 3 assessment – Summary of 1-hour TSP concentrations of concerned ASRs under mitigated scenario in Year 2017

Locations	ASR [1]	1-hour TSP concentrations at various height (μg/m^3) (TM-EIAO Criterion = 500 μg/m^3)						
		1.5m	5m	10m	15m	20m	25m	30m
Planned Park, Site C2	DARC-33	363	-	-	-	-	-	-
	DARC-40	291	-	-	-	-	-	-

Note:

[1] All concerned ASRs for Tier 3 assessment are planned park. There is no ASR above the height higher than 1.5m. Therefore, only results of height at 1.5m are shown in the above table.

Table 4.21: Tier 3 assessment – Summary of 24-hour RSP concentrations of concerned ASRs under mitigated scenario in Year 2017

Locations	ASR [1]	24-hour RSP concentrations at various height (μg/m^3) (AQO = 100 μg/m^3 (9))[2]						
		1.5m[3]	5m	10m	15m	20m	25m	30m
Planned Park, Site C2	DARC-33	112 (5)	-	-	-	-	-	-
	DARC-38	111 (1)	-	-	-	-	-	-
	DARC-39	115 (1)	-	-	-	-	-	-
	DARC-40	125 (3)	-	-	-	-	-	-

Note:

[1] All concerned ASRs for Tier 3 assessment are planned park. There is no ASR above the height higher than 1.5m. Therefore, only results of height at 1.5m are shown in the above table.

[2] Values in ( ) mean the number of exceedances allowed.

[3] Values in ( ) mean the number of exceedance against the AQOs.

<u>Long-term Assessment – Year 2017</u>

4.7.16 The annual RSP and FSP concentrations from long-term assessment have been predicted. **Appendix 4.13** shows the assessment results and **Table 4.22** below summarises the cumulative annual RSP and FSP impacts at the concerned ASRs. In summary, the predicted annual RSP and FSP concentrations at all ASRs would comply with the AQOs, hence, no adverse long-term impact is anticipated. Contour of annual RSP and FSP concentrations at 1.5m above ground is shown in **Figure 227724/E/1231** and **Figure 227724/E/12321** respectively.

Table 4.22: Long term assessment – Summary of Annual RSP and FSP concentration results under mitigated scenario in Year 2017

Pollutant	Averaging time	AQOs (μg/m^3)[l]	Concentration at Various Height (μg/m^3)		
			1.5m	5m	10m
RSP	Annual	50	39 - 43	39 - 42	39 - 41
FSP	Annual	35	28 - 32	28 - 30	28 - 30

4.8 Operational Air Quality Assessment

Assessment Result – Worst Assessment Year (2026)

4.8.1 The maximum cumulative 1-hour, 24-hour and annual NO_2 concentrations; and 24-hour and annual RSP and FSP concentrations at each representative ASRs have been assessed. For 1-hour NO_2, 24-hour RSP, annual RSP, 24-hour FSP and annual FSP, all representative ASRs within the 500m assessment area comply with relevant AQOs and the assessment results are presented in **Table 4.22, Table 4.24** and **Table 4.25,** and detailed in **Appendix 4.14**.

4.8.2 For Annual NO_2, all representative ASRs within the 500m assessment area, except 1.5m of ASMP-34 (Sau Fai House), comply with relevant AQO. For 1.5m of ASMP-34 (Sau Fai House), a marginal exceedance (i.e. 41 μg/m^3) is recorded. However, the ground level of this single aspect building was intentionally designed not for residential purpose, but only for non-sensitive uses such as machinery and transformers plant rooms etc. The assessment result at 1.5m of this ASR is therefore for reference only. The floors occupied by residences are at least 5m above the ground level, and all assessment results at 5m and other higher levels of this ASR comply with the AQOs. Therefore, adverse cumulative air quality impact within and in the vicinity of ARQ during the operational phase is not anticipated. The annual NO_2 assessment results, except 1.5m of ASMP-34 are presented in **Table 4.23** and detailed in **Appendix 4.14**. Photos of ground floor of Sau Fai House are given in **Appendix 4.15**.

Table 4.23: Cumulative maximum 1-hour NO_2 concentrations at maximum level at worst assessment year (2026)

	NO_2 Concentration (μg/m^3)
	1-hour
Cumulative NO_2	229 - 281 (2-6)
AQO Compliance	Yes

Note:

[1] Values in ( ) mean the number of exceedance against the AQO.

[2] The cumulative concentrations include the background concentration from PATH model.

Table 4.24: Cumulative annual NO_2 concentrations at maximum level at worst assessment year (2026)

	NO_2 Concentration (µg/m^3)
	Annual
Cumulative NO_2	18 – 39 (0)
AQO Compliance	Yes

Note:

[1] Values in ( ) mean the number of exceedance against the AQO.

[2] The cumulative concentrations include the background concentration from PATH model.

[3] The result at 1.5m of ASMP-34 (Sau Mei House) is excluded in the table.

[4] A marginal exceedance (i.e. 41 µg/m^3) is recorded at 1.5m of ASMP-34 (Sau Fai House). However, the ground level of this single aspect building was intentionally designed not for residential purpose, but only for non-sensitive uses such as machinery and transformers plant rooms etc. The assessment result at 1.5m of this ASR is therefore for reference only. The floors occupied by residences are at least 5m above the ground level, and all assessment results at 5m and other higher levels of this ASR comply with the AQOs. Therefore, no adverse impact is anticipated.

Table 4.25: Cumulative maximum RSP concentrations at maximum level at worst assessment year (2026)

	RSP Concentration (µg/m^3)	
	24-hour	**Annual**
Cumulative RSP	107 – 115 (1)	39 – 41 (0)
AQO Compliance	Yes	Yes

Note:

[1] Values in ( ) mean the number of exceedance against the AQO.

[2] The cumulative concentrations include the background concentration from PATH model.

Table 4.26: Cumulative maximum FSP concentrations at maximum level at worst assessment year (2026)

	FSP Concentration (µg/m^3)	
	24-hour	**Annual**
Cumulative RSP	80 – 86 (1)	28 – 29 (0)
AQO Compliance	Yes	Yes

Note:

[1] Values in ( ) mean the number of exceedance against the AQO.

[2] The cumulative concentrations include the background concentration from PATH model.

4.8.3 As shown in **Appendix 4.14**, the max concentration of pollutants is found at 1.5m above ground. Contours of 1-hour NO_2, annual NO_2, 24-hour RSP, annual RSP, 24-hour FSP and annual FSP concentrations at 1.5m above the ground are therefore plotted. In addition, contours of annual NO_2 at 5m above the ground is also plotted for justification of environmental acceptability of schedule 2 designated projects (refer to **Section 4.10** for the details).

4.8.4 The contours are shown in **Figure 227724/E/1300** to **Figure 227724/E/1360** as listed below:

(1) **Figure 227724/E/1300** – Contours of Cumulative Max. 1-hour NO_2 Concentration at 1.5m above ground in Year 2026

(2) **Figure 227724/E/1301** – Contours of Cumulative 19th Highest 1-hour NO_2 Concentration at 1.5m above ground in Year 2026

(3) **Figure 227724/E/1320** – Contours of Cumulative Annual-average NO_2 Concentration at 1.5m above ground in Year 2026

(4) **Figure 227724/E/1321** – Contours of Cumulative Annual-average NO_2 Concentration at 5m above ground in Year 2026

(5) **Figure 227724/E/1330** – Contours of Cumulative Max. 24-hour RSP Concentration at 1.5m above ground in Year 2026

(6) **Figure 227724/E/1331** – Contours of Cumulative 10th Highest 24-hour RSP Concentration at 1.5m above ground in Year 2026

(7) **Figure 227724/E/1340** – Contours of Cumulative Annual-average RSP Concentration at 1.5m above ground in Year 2026

(8) **Figure 227724/E/1350** – Contours of Cumulative Max. 24-hour FSP Concentration at 1.5m above ground in Year 2026

(9) **Figure 227724/E/1351** – Contours of Cumulative 10th Highest 24-hour FSP Concentration at 1.5m above ground in Year 2026

(10) **Figure 227724/E/1360** – Contours of Cumulative Annual-average FSP Concentration at 1.5m above ground in Year 2026

Mitigation Measure

4.8.5 Based on the assessment result, adverse cumulative air quality impact within assessment area not anticipated. Therefore, no mitigation measures would be required during the operational phase.

4.9 Residual Impacts

Construction Phase

4.9.1 With the implementation of the recommended mitigation measures and the dust suppression measures stipulated in Air Pollution Control (Construction Dust) Regulation, no adverse residual air quality impact is anticipated during the construction phase.

Operational Phase

4.9.2 No adverse residual air quality impact is anticipated during the operational phase.

4.10 Environmental Acceptability of Schedule 2 Designated Projects

4.10.1 The engineering feasibility study of the proposed ARQ development is a Schedule 3 Designated Project (DP) under the EIAO, whilst there will be two Schedule 2 DPs; i.e. road improvement works and rock cavern developments under the ARQ project. Details of these two Schedule 2 DPs are provided in **Section 1.5** and shown in **Figure 227724/E/0002**.

Road Improvement Works

4.10.2 Three road improvement works were proposed at junction of (J/O) Lin Tak Road and Sau Mau Ping Road, at J/O Clear Water Bay Road and Road L1 of Development of Anderson Road (DAR), as well as at the new merging lane at New Clear Water Bay Road near Shun Lee Tsuen Road. The operation year of these three road improvement works are 2022, 2021 and 2019, respectively.

4.10.3 The vehicular emission is considered as the major source to the ASRs surrounding the road improvement works areas as there is no additional chimney is identified within 500m of road improvement works boundary. In general pollutants concentration of vehicular emission will decrease with both the distance from road network and the height from road surface.

4.10.4 For 1-hour NO_2, 24-hour RSP, annual RSP, 24-hour FSP and annual FSP, all the air sensitive uses are outside the non-compliance zone of the relevant AQOs at 1.5m as shown in **Figure 227724/E/1301, Figure 227724/E/1331, Figure 227724/E/1340, Figure 227724/E/1351** and **Figure 227724/E/1360,** respectively. As mentioned in **Section 4.10.3**, the maximum concentrations of pollutants are found at the ground level. Therefore, non-compliance of relevant AQOs is not anticipated at the ASR at the height above the ground level.

4.10.5 For annual NO_2 concentration, all the air sensitive uses of road improvement works at junction of (J/O) Lin Tak Road and Sau Mau Ping Road and at J/O Clear Water Bay Road and Road L1 of DAR are outside the non-compliance zone of the relevant AQOs at 1.5m as shown in **Figure 227724/E/1320.** For road improvement works at the new merging lane at New Clear Water Bay Road near Shun Lee Tsuen Road, all the air sensitive uses, except Shun Lee Disciplined Services Quarter, are outside the non-compliance zone of the relevant AQOs at 1.5m. Nevertheless, as shown in **Figure 227724/E/1321,** all the air sensitive uses, include Shun Lee Disciplined Services Quarter, are outside the non-compliance zone of the relevant AQOs at 5m. As there are no residential or other air sensitive uses below 5m at the portion of the Shun Lee Disciplined Services Quarter those within the non-compliance zone at 1.5m and all sensitive use above 5m comply with the relevant AQO, therefore, adverse air quality impact of annual NO_2 concentration is also not anticipated.

4.10.6 Nevertheless, the detailed air quality impacts of this Schedule 2 DP will be further investigated in a separate EIA under the EIAO.

Rock Cavern Developments

4.10.7 The proposed cavern developments are located on the hillside of the proposed ARQ Development.

4.10.8 There will be no air pollutant emission sources present in the rock cavern development based on the best available information at this stage (e.g. commercial use such as food and beverage, as well as museum). Therefore, the rock cavern developments are considered as ASRs only.

4.10.9 According to the best available information at this stage, the caverns are proposed for commercial use (e.g. food and beverage) as well as museum. In view of its operational nature, adverse air quality impact is not anticipated. Nevertheless, the air quality impact of this Schedule 2 DP will be further investigated when the future use of the cavern is confirmed, and submitted as separated EIA report in next stage of study.

4.10.10 According to the assessment result as shown in **Appendix 4.14**, the rock cavern near the proposed landscape deck (i.e. ARQC-05 to ARQC-10 are shown in **Figure 227724/E/1030**) would comply with the relevant AQOs of NO_2, RSP and FSP. Therefore, adverse air quality impact at this rock cavern is not anticipated. The locations of these ASRs are shown in **Figure 227724/E/1030**.

4.10.11 According to the **Figure 227724/E/0002**, there is another rock cavern at the eastern side of the rock cavern near the proposed landscape deck. Since this rock cavern is located at higher altitude and further away from the pollutant sources, the pollutants level at this rock cavern would be lower than that at the rock cavern near the proposed landscape deck. Therefore, adverse air quality impact at this rock cavern is not anticipated.

4.10.12 The rock cavern at the northern side of the Quarry Park, is located near the 2 ASRs of Quarry Park (i.e. ARQP-34 and ARQP-37 as shown in **Figure 227724/E/1030**). As shown in **Appendix 4.14**, all these 2 ASRs of Quarry Park comply with relevant AQOs of NO_2, RSP and FSP, therefore, adverse air quality impact at this rock cavern is also not anticipated.

4.10.13 Nevertheless, the detailed air quality impacts of this Schedule 2 DP will be further investigated in a separate EIA under the EIAO.

4.11 Conclusion

Construction Phase

4.11.1 Potential dust impact would be generated from the soil excavation activities, backfilling, site erosion, storage of spoil on site, and transportation of soil during the construction phase. Quantitative fugitive dust assessments have therefore been conducted for the construction of ARQ in accordance with Annex 12, Guidelines for Air Quality Assessment, of the TM-EIAO. The assessment result concluded that watering once per hour with hourly equivalent intensity of no less than 1.75 L/m^2 to on all exposed worksites during working hours (7am – 7pm) will be required to control the fugitive dust impact. With the implementation of recommended mitigation measures, no exceedance of criteria provided by Annex 4, Criteria for Air Quality Assessment, of the TM-EIAO is anticipated during the construction phase.

Operational Phase

4.11.2 Cumulative air quality impact arising from the vehicular emissions from the open roads, tunnel portals and chimney emissions within the assessment area has been assessed according to Annex 12, Guidelines for Air Quality Assessment of the TM-EIAO. The assessment results concluded that all the predicted cumulative 1-hour NO_2, 24-hour and annual RSP and FSP concentrations would comply with the AQOs and Annex 4, Criteria for Air Quality Assessment, of the TM-EIAO during the operational phase.

4.11.3 For annual $NO_{2,\ a}$ marginal exceedance (i.e. 41 $\mu g/m^3$) is recorded at 1.5m of ASMP-34 (Sau Fai House). The ground level of this single aspect building was intentionally designed not for residential purpose, but only for non-sensitive uses such as machinery and transformers plant rooms etc. The assessment result at 1.5m of this ASR is therefore for reference only. The floors occupied by residences are at least 5m above the ground level, and all assessment results at 5m and other higher levels of this ASR comply with the AQOs. Therefore, adverse cumulative air quality impact within and in the vicinity of ARQ during the operational phase is not anticipated.