3 Air Quality

3.1 Legislation, Standards and Guidelines

3.1.1 General

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

- Air Pollution Control Ordinance (APCO) (Cap. 311);
- Air Pollution Control (Construction Dust) Regulation;
- Air Pollution Control (Non-road Machinery) (Emission) Regulation; and
- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499).

3.1.2 Air Pollution Control Ordinance

3.1.2.1 The principal legislation for controlling air pollutants is the APCO (Cap. 311) and its subsidiary regulations, which defines statutory Air Quality Objectives (AQOs).

3.1.2.2 The APCO (Cap.311) provides the power for controlling air pollutants from a variety of stationary and mobile sources and encompasses a number of AQOs. In addition to the APCO, the following overall policy objectives are laid down in Chapter 9 of the Hong Kong Planning Standard and Guidelines (HKPSG) as follows:

- Limit the contamination of the air in Hong Kong, through land use planning and through the enforcement of the APCO to safeguard the health and well-being of the community; and
- Ensure that the AQOs for 7 common air pollutants are met as soon as possible.

3.1.2.3 Currently, the AQOs stipulate limits on concentrations for seven pollutants including sulphur dioxide (SO_2), Respirable Suspended Particulates (RSP), Fine Suspended Particulates (FSP), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), photochemical oxidants, (As Ozone (O_3)) and Lead (Pb). The prevailing AQOs are listed in **Table 3.1** below.

Table 3.1 Hong Kong Air Quality Objectives (AQOs)

Pollutant	Limits on Concentration, µg/m^3 [1] (Number of exceedances allowed per year in brackets)				
	10-min	1-hr	8-hr	24-hr [2]	Annual [2]
Sulphur Dioxide (SO_2)	500 (3)			125 (3)	
Respirable Suspended Particulates (RSP) [3]				100 (9)	50 (0)

Pollutant	Limits on Concentration, µg/m³ [1] (Number of exceedances allowed per year in brackets)				
	10-min	1-hr	8-hr	24-hr [2]	Annual [2]
Fine Suspended Particulates (FSP) [4]				75 (9)	35 (0)
Carbon Monoxide (CO)		30,000 (0)	10,000 (0)		
Nitrogen Dioxide (NO_2)		200 (18)			40 (0)
Ozone (O_3)			160 (9)		
Lead (Pb)					0.5 (0)

Note:
[1] Measured at 293K and 101.325kPa.
[2] Arithmetic mean.
[3] Respirable suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometres or smaller.
[4] Fine suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 2.5 micrometres or smaller.

3.1.3 Air Pollution Control (Control Dust) Regulation

3.1.3.1 The Air Pollution Control (Construction Dust) Regulation specifies processes that require special dust control. The Contractors are required to inform the Environmental Protection Department (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**.**

3.1.4 Air Pollution Control (Non-road mobile Machinery) (Emission) Regulation

3.1.4.1 Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation specifies that all Non-road Mobile Machinery (NRMMs), except those exempted, used in specified activities and locations including construction sites, container terminals and back up facilities, restricted areas of the airport, designated waste disposal facilities and specified processes are required to comply with the prescribed emission standards.

3.1.5 Environmental Impact Assessment Ordinance (EIAO)

Total Suspended Particulate Criteria

3.1.5.1 There is no criterion on Total Suspended Particulate (TSP) under the AQO. In accordance with Annex 4 of TM-EIAO, a limit of 500µg/m³ for 1-hour TSP concentration at any sensitive receivers should be adopted for evaluating air quality impacts.

Odour Criterion

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

3.2 Description of the Environment

3.2.1 Existing Ambient Air Quality Conditions

3.2.1.1 The latest 5 years air quality monitoring data (available up to 2017) of the various air pollutants monitored at the nearest Tai Po air quality monitoring station operated by EPD are shown in **Table 3.2** and have been compared with the AQOs for information.

Table 3.2 Air quality monitoring data (Tai Po Station, 2013 – 2017)

Pollutant	Parameter	Concentrations (µg/m³)						AQOs (µg/m³)
		2013	2014	2015	2016	2017	5-year mean	
SO_2	4th highest 10-minutes	N/A	70	56	37	39	51 [10%]	500 (3)
	4th highest 24-hour	24	15	13	10	9	14 [11%]	125 (3)
NO_2	19th highest 1-hour	159	145	136	112	127	136 [68%]	200 (18)
	Annual	**<u>53</u>**	**<u>45</u>**	37	33	39	**<u>41</u>** [104%]	40
CO	Max. 1-hour	N/M	N/M	N/M	N/M	N/M	N/A [-%]	30,000
	Max. 8-hour	N/M	N/M	N/M	N/M	N/M	N/A [-%]	10,000
O_3	10th highest 8-hour	156	144	157	147	**<u>181</u>**	157 [98%]	160 (9)
RSP	10th highest 24-hour	**<u>102</u>**	92	77	74	82	85 [85%]	100 (9)
	Annual	43	41	36	29	32	36 [72%]	50
FSP	10th highest 24-hour	**<u>80</u>**	63	57	55	55	62 [83%]	75 (9)
	Annual	30	27	23	20	22	24 [70%]	35

Note:

[1] N/M - Not Measured; N/A – Not Available.

[2] Number of exceedance allowed under the AQO is shown in ( ), % of the AQO is shown in [ ]. The 5-year mean is the average of the yearly maximum.

[3] Monitoring results exceeding the AQO are bolded and underlined.

[4] Monitoring data for 10-min SO_2 for Years 2012 and 2013 are not available.

3.2.1.2 The 4th highest 10-minute and the 4th highest daily SO_2 levels were well within the corresponding AQOs.

3.2.1.3 The 19th highest 1-hour NO_2 levels were ranged from 112 to 159µg/m^3, which were within the AQO of 200µg/m^3. A declining trend of 1-hour NO_2 levels can be observed from Year 2013 to Year 2016. Exceedances were found in Year 2013 – Year 2014 annual NO_2 concentrations. However, a downward trend is identified where the annual concentrations had decreased from 53µg/m^3 in 2013 to 33µg/m^3 in 2016.

3.2.1.4 The highest 1-hour and 8-hour CO levels were not measured at Tai Po Station.

3.2.1.5 The highest 8-hour O_3 levels were ranged from 143 to 181µg/m^3, all complying with the AQOs except Year 2017.

3.2.1.6 The 10th highest daily RSP levels had decreased from 102µg/m^3 in 2013 to 74µg/m^3 in 2016, as compared with the AQO of 100µg/m^3. The annual RSP levels also exhibited a downward trend from 43µg/m^3 in 2013 to 29µg/m^3 in 2016, which were all within the AQO of 50µg/m^3.

3.2.1.7 The 10th highest daily FSP levels had decreased from 80µg/m^3 in 2013 to 55µg/m^3 in 2017, as compared with the AQO of 75µg/m^3. The annual FSP levels also exhibited a downward trend from 30µg/m^3 in 2013 to 20µg/m^3 in 2016, which were all within the AQO of 35µg/m^3.

3.2.2 Future Ambient Air Quality Conditions

3.2.2.1 It should be noted that the ambient air quality conditions described in above sections are the historical data in the past 5 years. During the 16th Hong Kong-Guangdong Joint Working Group Meeting on Sustainable Development and Environmental Protection (January 2017), the Hong Kong and Guangdong Governments jointly endorsed a Work Plan and will continue to implement the Pearl River Delta (PRD) Regional Air Quality Management Plan up to year 2020. Key emission reduction measures to be implemented by Hong Kong and Pearl River Delta Economic Zone (PRDEZ) include:

Hong Kong Government

- tightening of vehicle emission standards;
- phasing out highly polluting commercial diesel vehicles;
- retrofitting Euro II and Euro III franchised buses with selective catalytic reduction devices;
- strengthening inspection and maintenance of petrol and liquefied petroleum gas vehicles;
- requiring ocean-going vessels to switch to using low sulphur fuel while at berth;
- tightening the permissible sulphur content level of locally supplied marine diesel;

- controlling emissions from off-road vehicles/equipment;
- further tightening of emission caps on power plants and increasing use of clean energy for electricity generation; and
- controlling Volatile Organic Carbon (VOC) contents of solvents used in printing and construction industry.

Pearl River Delta Economic Zone

- installing desulphurization and denitrification systems at large-scale coal-fired power generating units;
- closing down small-scale power generating units;
- phasing out heavily polluting cement plants as well as iron and steel plants;
- installing vapour recovery systems at petrol filling stations, oil depots and on tanker trucks;
- implementing new pollutant emission standards for boilers as well as specific industries such as cement, furniture manufacturing, printing, shoe-making and surface coating (automobile manufacturing) industries;
- installing denitrification systems at new dry-type cement kilns;
- tightening the emission standards for newly registered petrol vehicles to Guangdong IV standard; and
- progressively supplying diesel at National IV standard and petrol at Guangdong IV standard.

3.2.2.2 In order to predict the future ambient air quality taking into account the measures to improve air quality, PATH-2016 (Pollutants in the Atmosphere and their Transport over Hong Kong), a regional air quality model, has been developed by EPD to simulate air quality over Hong Kong against the PRD as background.

3.2.2.3 The project involves 6 grids in the PATH-2016. The hourly pollutant concentration data predicted by PATH-2016 for year 2020 are provided by EPD and are summarised in the following tables. **Figure 3.1** illustrates the locations of concerned PATH grids for the assessment area.

Table 3.3 Future ambient air quality for concerned PATH grids (Year 2020)

Pollutant	Parameter	Concentrations in various PATH Grids (µg/m^3)						AQOs[1] (µg/m^3)
		41_48	41_49	42_48	42_49	43_48	43_49	
SO_2	4th highest 10-mins [3]	110	110	109	110	108	117	500 (3)
	4th highest 24-hour	23	23	23	23	22	23	125 (3)
NO_2	19th highest 1-hour	65	60	60	56	57	54	200 (18)

Pollutant	Parameter	Concentrations in various PATH Grids (µg/m^3)						AQOs[1] (µg/m^3)
		41_48	41_49	42_48	42_49	43_48	43_49	
	Annual	12	10	10	9	9	9	40
CO	Max. 1-hour	1002	996	1005	997	1010	1003	30,000
	Max. 8-hour	845	844	839	842	834	839	10,000
O_3	10th highest 8-hour	153	153	156	153	156	153	160 (9)
RSP	10th highest 24-hour	74	75	75	74	75	73	100 (9)
	Annual	31	32	32	32	33	31	50
FSP	10th highest 24-hour[2]	55	56	56	55	57	54	75 (9)
	Annual[2]	22	23	23	22	23	22	35

Note:

[1] Values in ( ) indicate number of exceedance allowed under the AQO.

[2] FSP concentrations are estimated in accordance with EPD's "Guidelines on the Estimation of FSP for Air Quality Assessment in Hong Kong".

[3] Values are given as highest 10-minute SO_2 concentrations, which are estimated based on EPD's "Guidelines on the Estimation of 10-minute Average SO_2 Concentration for Air Quality Assessment in Hong Kong".

3.2.2.4 It can be seen from the **Table 3.3** that, with the implementation of the emission reduction measures by both the Hong Kong and Guangdong Governments, future background air quality in Year 2020 would comply with AQO.

3.3 Air Sensitive Receivers

3.3.1.1 With reference to Clause 3.4.4.2 of the EIA Study Brief, the assessment area for air quality impact assessment should be defined by 500m from boundary of the Project and the works of the Project. The assessment area is shown in **Figure 3.2**.

3.3.1.2 In accordance with Annex 12 of the TM-EIAO, Air Sensitive Receivers (ASRs) include 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.

3.3.1.3 However, for other premises which are not stipulated above, including open space, farm land, and recreational uses (e.g. park, playground, basketball court, football field, etc.), reference shall be made to Clause 2.2, Annex 12 of the TM-EIAO, which stated that any other premises or place with which, in terms of duration or number of people affected, has a similar sensitivity to the air pollutants as the abovementioned premises and places are also considered as a sensitive receiver.

3.3.1.4 As far as air quality impact arising from this Project is concerned, air sensitive uses located near the perimeter of the Project site would likely be affected by construction dust impact, and those along the Ting Kok

Road (i.e. the only access route) would likely be affected by the vehicular emission impact associated with induced traffic. To this end, the most affected representative ASRs within 500m from the boundary of the Project and the works of the Project 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 and supplemented by site inspections. They mainly include existing residential premises of around 2-4 storeys, offices/workplaces in Tai Po Industrial Estate (TPIE) etc..

3.3.1.5 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:

- Tai Po OZP Plan No. S/TP/28;

3.3.1.6 According to Tai Po OZP Plan No. S/TP/28, a vacant site located at the north of the Project and in the vicinity to Tycoon Place and Richwood Park is zoned as “Residential (Group C)”. However, there is no available programme confirming the construction period / intake of population. While this land lot is not taken as ASR during the construction phase of the Project, this land lot is taken as ASR during operational phase of the Project.

Provision of Staff Quarters and Overnight Accommodations

3.3.1.7 As discussed in **Section 2**, in order to allow for more flexible uses and development of the Project to suit contemporary circumstances and operational requirements, the provision for staff quarters and overnight accommodations have been duly considered (Scenario 2; Scenario 1 would be the original project development scenario without these facilities).

3.3.1.8 These staff quarters and overnight accommodations are strategically located close to and overlooking onto the east and south seafront instead of Ting Kok Road and the Tai Po Industrial Estate. The separation distances from Ting Kok Road and Tai Po Industrial Estate are about 350 – 780m and 320 – 520m respectively. Besides, all the staff quarters and overnight accommodations are 1-2 storeys only and the upper roof structures are built into the slope and form part of the golf course. Hence, both the staff quarters and overnight accommodations would be substantially screened by the future terrain which would reach a maximum height of about 42mPD. These overnight accommodations would not induce significant additional traffic, nor other air pollutant emissions. For air impact assessment, additional receiver (i.e. PA3) at the staff quarters would be included to represent the Scenario 2. The overnight accommodations would be housed within the ancillary facilities (i.e.PA1), hence no additional receiver would be required for that.

3.3.1.9 The locations of the representative ASRs for construction dust impact assessment and operational air quality impact assessment are illustrated in **Figure 3.2** and summarized in **Table 3.4** below. ASRs in the surroundings of the Project Site have been included in construction phase assessment. Considering the nature of the Project would not constitute to a significant pollution source in the future but only generating a small amount of induced traffic, ASRs located along Ting Kok Road (i.e. the major access route to the Project Site) are selected for operational phase assessment.

Table 3.4 Representative ASRs for air quality assessment

ASR ID	Location	Land use	Number of Storey	Approx. Distance from Project Site (m)	ASRs for Construction Phase	ASRs for Operational Phase
Existing ASRs						
A1	Fortune Garden	Residential	3	35	✓	✓
A2	Casa Marina I	Residential	3	225	✓	✓
A3	Village House at 53 Ting Kok Road	Residential	3	110	✓	✓
A4	Tai Po East Fire Station	Government	4	100	✓	✓
A5	Meyer Aluminum Limited	Industrial	2	25	✓	✗
A6	Watson's Water Centre	Industrial	5	25	✓	✗
A7	Hung Hing Printing Centre	Industrial	2	10	✓	✗
A8	Phoenix Television Coporation	Industrial	3	50	✓	✗
A9	Casa Brava	Residential	3	200	✓	✓
A10	Casa Marina II	Residential	3	430	✓	✓
A11	Tycoon Place	Residential	4	240	✓	✓
A12	Hong Kong Landfill Restoration Group Limited	Office	2	5	✓	✓
A13	EPD Site Office	Government	1	<5	✓	✓
A14	Lai Wah Garden Company Limited	Industrial	1	60	✓	✓
Planned ASRs						
PA1	Proposed Ancillary Facilities with overnight accommodations	Recreation / Office / Residential	3	Within Project Site	✗	✓
PA2	Planned Residential Site	Residential	5	170	✗	✓
PA3	Proposed Staff Quarters	Residential	2	Within Project Site	✗	✓

3.4 Construction Dust Assessment

3.4.1 Assessment Area

3.4.1.1 With reference to Clause 3.4.4.2 of the EIA Study Brief, the assessment area for air quality impact assessment should be defined by a distance of 500m from the boundary of the Project and works of the Project. **Figure 3.2** illustrates the extent of the assessment area for construction dust impact assessment. However, considering the close proximity with TPIE, the assessment has been extended beyond 500m to cover the neighbouring industrial sources (i.e. entire TPIE).

3.4.2 Identification of Pollution Sources and Emission Inventory

Pollution Source associated with the Project

3.4.2.1 The key air pollution sources in association with the Project and in the vicinity that may bear upon the air quality during construction phase include dust emission from the construction activities of the Project.

3.4.2.2 For the potential cumulative dust impact arising from the construction of concurrent projects (see **Section 2.11**), it is observed that the construction period of the “Upgrading works of Sewage Pumping Stations and Sewerage along Ting Kok Road” (i.e. Year 2018 – 2022) would overlap with that of this Project (i.e. Year 2021 – 2023). According to its approved application for the Direct Environmental Permit (EP) (DIR – 258/2017), its air quality assessment has already considered this Project (Shuen Wan Golf Course) as one of the concurrent projects. As stated in the approved Direct EP application, the contractors shall also be required to schedule and coordinate carefully their dusty construction activities (such as excavation and backfilling) to avoid overlap of major dusty construction activities. Hence, overlapping of construction works between the Project and the upgrading works would only be localised in nature and minimal. Nevertheless, it should be noted the construction works involved for the project would be mainly along Ting Kok Road and footprint of the SPS upgrading works would be rather small, such that adverse dust emissions from those site formation or excavation works, or adverse cumulative construction dust impact would be considered unlikely.

3.4.2.3 The tentative commencement year for the site formation works of this Project is Year 2021 with a target completion in Year 2023. A review on the construction methodology and tentative implementation programme has been conducted. Majority of the dust emissions would be associated with the site formation works required within the Project Site area. Other associated works outside the Project Site such as water abstraction point at the exiting channel, sewerage connection and water mains connections at Ting Kok Road, would mostly be conducted by pipe-jacking method and only minimal amount of excavation would be required. Hence, those areas are not considered to have significant dust emissions. The construction dust associated with the Project Site will be generated mainly from the construction works including the following activities:

- Site formation;
- Minor excavation works;
- Backfilling; and
- Wind erosion of open sites.

3.4.2.4 Land transportation would be used to deliver and dispose of the waste generated to the designated disposal outlets. It is anticipated that there will be a maximum of 120 vehicles per day for waste transportation during the construction phase. The tentative transportation routings for the disposal of various types of wastes generated during the construction phase are shown in **Table 3.5**. No barging points and associated conveyor systems will be established at the Project Site.

Table 3.5 Tentative transportation routings for waste disposal during construction phase

Disposal Outlet	Type of Waste	Tentative Transportation Routing
NENT Landfill	Non-inert C&D Materials and General Refuse	Via Ting Kok Road, Fanling Highway, Jockey Club Road, Man Kam To Road, Wo Keng Shan Road
Chemical Waste Treatment Centre (CWTC)	Chemical Waste	Via Ting Kok Road, Tolo Highway, Tai Po Road (Sha Tin), Tsing Sha Highway, Tsing Yi Road

3.4.2.5 On the other hand, import of inert C&D materials would be required for the Project. Land transportation would be used to deliver the materials from Tuen Mun Area 38 Fill Bank to the Project Site. The tentative transportation routing for the import of inert C&D materials is shown in **Table 3.6**.

Table 3.6 Tentative transportation routing for the import of inert C&D materials during construction phase

Fill Material Source	Type of Waste	Tentative Transportation Routing
Tuen Mun Area 38 Fill Bank	Inert C&D Materials	Via Lung Mun Road, Lung Fu Road, Wong Chu Road, Tuen Mun Road, Yuen Long Highway, San Tin Highway, Fanling Highway, Ting Kok Road

<u>Near-Field Pollution Source</u>

3.4.2.6 Particulate emission from the neighbouring roads within 500m assessment area, various Specified Processes (SPs) in the vicinity and industrial emissions within TPIE have also been assessed for cumulative assessment. These road sections including Ting Kok Road, Dai Kwai Street, Dai Cheong Street etc. Details of the industrial, marine and vehicular emissions can be referred to **Section 3.5.4**.

3.4.2.7 Besides, the Project is located at the immediate east of TPIE and at around 520m west of a cement depot cum concrete batching plants at Yu On Street. Furthermore, according to site observation, a marine vessel unloading point operated by the cement depot cum concrete batching plants travels regularly within the 500m assessment area.

Hence, their cumulative impacts of all these sources are considered in this assessment.

Far-Field Pollution Source

3.4.2.8 All major emission sources including public electricity generation, civil aviation, road transport, navigation, industries, other fuel combustion and non-combustion sources covering both HKSAR and PRDEZ are considered. Hourly pollutant concentration data predicted by PATH-2016 for Year 2020 provided by EPD are directly adopted as the background concentration for cumulative assessment**,** more details are given in **Section 3.5.4.**

3.4.3 Key Representative Pollutants

3.4.3.1 According to Section 13.2.4.3 of United States Environmental Protection Agency (USEPA) Compilation of Air Pollution Emission Factors (AP-42), among all aerodynamic particle sizes (i.e. TSP), there are 47.3% of particles with an aerodynamic diameter of <10 μm (i.e. RSP). Hence, TSP and RSP are the most representative pollutants for construction phase assessment. However, upon the effect of the AQO from 1 January 2014, a new criteria pollutant, FSP, has been included in the AQO. As a conservative approach, FSP has also been assessed, notwithstanding that it only constitutes 7.2% of the total particles in fugitive dust. Hence, the 1-hour TSP, 24-hour RSP/ FSP, and annual RSP/ FSP concentrations at each identified ASR have been assessed and compared with the AQO or the requirements of TM-EIAO to determine their compliance.

3.4.3.2 Fuel combustion from the use of Powered Mechanical Equipment (PME) during construction works could be a source of Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Carbon Monoxide (CO). To improve air quality and protect public health, EPD has introduced the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation, which came in effect on 1 June 2015, to regulate emissions from machines and non-road vehicles. Starting from 1 December 2015, only approved or exempted non-road mobile machinery are allowed to be used in construction sites. Hence, with the effect of the Regulation, the emissions from PMEs are considered relatively small as compared with the tailpipe emissions from vehicles. Furthermore, the Project would only involve site reprofiling works where extensive use of Non-road Mobile Machineries (NRMM) are not anticipated. In fact, for most areas within the Project Site, they were once used for receiving waste materials. Hence, the limitation on loading would obstruct any intense construction works within the waste boundary. In this regards, the number of NRMM that would be used would be limited as well (e.g. 1 Nos. of earth auger for piling works, etc.), details of NRMM can be referred to **Section 5**. Hence, emissions from PMEs would be considered relatively small and adverse cumulative impacts would be considered unlikely.

3.4.3.3 In addition, there is also no source of Lead (Pb) and Ozone (O_3) during the construction of the Project. Hence, NO_2, SO_2, CO, Pb and O_3 are therefore not considered as the key pollutants for quantitative assessment for the construction dust assessment.

3.4.4 Assessment Methodology

Dust Emission associated with the Project

3.4.4.1 The prediction of dust emissions is based on typical values and emission factors from USEPA AP-42, 5th Edition. References of the dust emission factors for different dust generating activities are listed in **Table 3.7** below. Details are discussed in the following sections.

Table 3.7 References of dust emission factors for different activities

Construction Site	Activities	Equations and Assumptions	Reference
All construction sites	Heavy construction activities including land clearance, ground excavation, cut and fill operations, construction of the facilities, haul road, etc.	$E_{(TSP)}$ = 1.2 tons/acre/month of activity or = 2.69 Mg/hectare/month of activity $E_{(RSP)} = E_{(TSP)}$ x 0.473 = 1.27 Mg/hectare/month of activity $E_{(FSP)} = E_{(TSP)}$ x 0.072 = 0.19 Mg/hectare/month of activity	USEPA AP42, S.13.2.3.3
	Wind erosion	$E_{(TSP)}$ = 0.85 Mg/hectare/year $E_{(RSP)} = E_{(TSP)}$ x 0.473 = 0.40 Mg/hectare/year $E_{(FSP)} = E_{(TSP)}$ x 0.072 = 0.06 Mg/hectare/year	USEPA AP42, S.11.9, Table 11.9.4

Note:

[1] RSP:TSP and FSP:TSP ratios are referenced from Section 13.2.4.3 of USEPA AP-42.

3.4.4.2 The dust dispersion has been modelled by taking consideration of the actual works area of the Project, in particular the western portion of the Project Site abutting TPIE where a large portion of tree preservation areas are located. No site formation works are anticipated at those preserved areas and hence no dust emissions would be anticipated. However, other smaller or fragmented tree preservation areas are still assumed as works area in the construction dust assessment hence the current assumption could be deemed conservative.

3.4.4.3 Dust emission from construction vehicle movement will generally be limited within the worksites and the emission factor given in AP-42 S.13.2.3.3 has taken this factor into account. Watering facilities will be provided at every designated vehicular exit point. 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.

Determination of Worst Assessment Year

3.4.4.4 Based on the current construction programme, the works area is spilt into 3 stages and the construction period would span across three years (from Year 2021 to Year 2023). Since the construction work fronts would be moving around, affecting different ASRs at different times, all years within the construction period have been assessed. **Appendix 3.1** presents the construction programme. **Appendix 3.2** presents the calculation of dust emission factors and locations of dust source.

Dust Dispersion Modelling Approach

3.4.4.5 Dust impact assessment is undertaken using the EPD approved AMS/EPA Regulatory Model (AERMOD). It is a well-known model designed for computing air dispersion. Modelling parameters including dust emission factors, particles size distributions, surface roughness, etc. are referred to EPD's "Guidelines on Choice of Models and Model Parameters" and USEPA AP-42. The density of dust is assumed to be $2.5 g/cm^3$, with reference to the "Coal Mining Emission Factor Development and Modelling Study" (USEPA-AP42). Construction activities include heavy construction activities (including site clearance, soil formation, etc.) and wind erosion of all active open sites.

3.4.4.6 Particle size distribution is estimated based on S13.2.4.3 of USEPA AP-42. **Table 3.8** presents the particle size distribution of TSP, RSP and FSP adopted in the assessment.

Table 3.8 Particle size distribution assumed in AERMOD

Particle Size (µm)	Average Particle Size (µm)	Particle Size Distribution		
		TSP	RSP	FSP
0 – 2.5	1.25	7%	15%	100%
2.5 – 5	3.75	20%	42%	-
5 – 10	7.5	20%	43%	-
10 – 15	12.5	18%	-	-
15 – 30	22.5	35%	-	-
	Total	**100%**	**100%**	**100%**

3.4.4.7 As the site formation works of this Project will be from Year 2021 to Year 2023, hourly air quality data from PATH-2016 model for Year 2020 is used as the background concentrations for conservative assessment. In addition, hourly meteorological data (including wind direction, wind speed, temperature and mixing height) for Year 2010 extracted from the PATH-2016 model are used. Mixing heights from the PATH-2016 which are lower than the minimum mixing height recorded by the Hong Kong Observatory (HKO) in Year 2010 (i.e. 121m) are capped at 121m. For the treatment of calm hours, the wind speeds are capped at 1m/s for those from PATH-2016 below 1m/s.

3.4.4.8 Although part of the Project site would have restricted working hours (i.e. 9am to 4/5pm), as a conservative assessment, Monday to Sunday (i.e. including public holidays) daytime working hours of 7am to 7pm is assumed to have dust emissions generated from dusty construction activities. During night-time non-working hours (7pm to 7am of the next day), dust emission source would include wind erosion only as construction activities during these hours are ceased.

3.4.4.9 Fugitive dust impacts are modelled for ASR heights at 1.5m, 5m, 10m, 15m, 20m, 30m and 40m above local ground. Both the unmitigated and mitigated scenarios are presented. A 50 x 50m grid is used to generate the pollution contours at the worst hit level for the worst year to present the pollutant dispersion**.**

3.4.4.10 A summary of AERMOD modelling parameters that have been adopted in the construction dust assessment are given in **Table 3.9** below**:**

Table 3.9 Modelling parameters adopted in AERMOD

Parameters	Input
Background Concentration	Hourly RSP concentrations from PATH-2016 (Year 2020)
Meteorological Data	2010 hourly meteorological data adopted in PATH-2016
Anemometer Height	9m (According to EPD's Guidelines on Choice of Models and Model Parameters)
Albedo	0.136 (Within 10km x 10km region from the Project site, landuses comprise of 23.5%, 43%, 9.5% and 24% of Urban, Forest, Grassland and Water areas respectively. Refer to **Appendix 3.3.**)
Bowen ratio	0.506 (Within 10km x 10km region from the Project site, landuses comprise of 23.5%, 43%, 9.5% and 24% of Urban, Forest, Grassland and Water areas respectively. Refer to **Appendix 3.3.**)
Landuse and Surface Roughness	Refer to **Appendix 3.3** for surface characteristic within 1km for each PATH grid
Terrain Effect	With terrain effect[1]
Emission Period	General construction activities during daytime working hours (7 am to 7 pm) Wind erosion during night-time (7pm to 7am of the next day)
Assessment Heights	1.5m, 5m, 10m, 15m, 20m, 30m and 40m

Note:

[1] According to the site formation plan, the construction work fronts would be at various level from 8 – 40mPD level. For example, the work fronts at the southern portion of the Project site near the seafront would reach up to 30 mPD level whereas those near Ting Kok Road would reach up to around 40 mPD level. Local height profile of these dust sources are incorporated into the model.

3.4.4.11 It is understood that construction activities, mainly site reprofiling works, will not be taken place on the entire works area at the same time, but to be undertaken at moving multiple work fronts spread across the works area. The current construction works programme has further subdivided each works area (i.e. Areas 1, 2 and 3) into different sub-areas (e.g. 1a, 1b, 1c, etc.) to reflect the situation. The model has taken into account the proposed schedule of different substages by month as shown in **Appendix 3.1**.

3.4.4.12 A sequential assessment approach covering all construction years has been adopted (i.e. 3 assessment years). The construction of the Project, mainly site reprofiling works, would take place in a general "North to South" sequence from Year 2021 to 2023. It is assumed that entire works area under each subarea (e.g. 1a, 1b, 1c, etc.) within their working months would be active.

3.4.4.13 Since A12 and A13 are the two ASRs located at or less than 5m away from the Project Site, a 3-m high hoarding would be erected along the construction site boundary adjacent to these ASRs so as to minimise the dust impact (See **Figure 3.2a** for the extent of proposed 3-m high hoarding). When the active works areas are positioned where hoarding is erected, dust emission height is increased to 3 meters above ground.

Dust Emission associated with the Operation of Concurrent Sources

3.4.4.14 Approach for prediction of particulate emissions from open road is the same as operational phase assessment as described in **Section 3.5.4**, in which the dispersion model, CALINE4 is used to assess the vehicular emission impact.

3.4.4.15 Vehicular emission burden for RSP and FSP was calculated by EMFAC-HK v3.4 model. As a conservative approach, vehicular emission impacts would adopt the highest emission factor year (Year 2021 in the construction period of Year 2021 - 2023) and the traffic forecast for Year 2023, which is the year with the highest traffic volume within the construction period. Hence, such combination would be considered a conservative approach.

3.4.4.16 Hence, traffic data in Year 2023, which is the final year of construction period, is considered to be conservative as it would be the highest within the construction phase, while the RSP / FSP emission factors for Year 2021 would also be the highest. **Appendix 3.4** presents the hourly RSP and FSP emission factors for each road link.

3.4.4.17 For chimney emissions from various industries, SPs in TPIE and in the vicinity, the prediction approach is the same as the operational air quality assessment as described in **Section 3.5.4**, in which the dispersion model, AERMOD, is used to assess the chimney emission impact**.**

3.4.4.18 Furthermore, a marine vessel operated by the cement depot cum concrete batching plant travels regularly within the 500m assessment area according to site survey. The marine emissions from the identified vessel would be included for cumulative assessment and details can be referred to **Section 3.5.4**.

Far-field Source Contribution (i.e. Future Background Air Quality)

3.4.4.19 Hourly pollutant concentration data predicted by PATH-2016 for Year 2020 provided by EPD are directly adopted as the background concentration**.** More details are given in **Section 3.5.4.**

3.4.4.20 FSP concentrations are not available from PATH model. According to EPD's "Guidelines on the Estimation of PM2.5 for Air Quality Assessment in Hong Kong", the conservative correction as shown in **Table 3.10** are adopted to determine the background FSP concentrations. For hourly background TSP concentrations, it is considered reasonable to assume the hourly RSP concentrations from PATH as the ambient TSP background concentrations, since the particulates of sizes larger than 10µm generated from far-field dust sources would have been largely settled before reaching the ASRs, and hence most of the particulates contributed from far-field sources affecting the ASRs will likely be of less than or equal to 10µm in size (i.e. RSP).

Table 3.10 Conversion factors for RSP / FSP

Daily Concentration (µg/m^3)	Annual Concentration (µg/m^3)
FSP = 0.75 x RSP	FSP = 0.71 x RSP

Prediction of the Cumulative Construction Dust Impact

3.4.4.21 The cumulative construction dust impact is a combination of the emission impacts contributed from the near field and far field sources (i.e. at local scale and background air quality impact from other concurrent and regional sources) on an hourly basis. As three assessment years (Year 2021 – 2023) have been modelled for each ASR, the highest concentrations among the three years are presented.

3.4.4.22 In consideration of the number of exceedance allowance of the daily AQOs (refer to **Table 3.1),** any pollutant concentrations beyond the AQO's allowance limits (i.e. the 10th highest 24-hour RSP/ FSP concentrations) are presented. The predicted annual RSP/ FSP concentrations are also assessed and all predicted levels are then compared with the AQOs. Besides, the 1-hour TSP concentration as stipulated under Annex 4 of TM- EIAO is also determined at each ASR**.**

3.4.5 Assessment Results (Unmitigated)

3.4.5.1 The predicted maximum unmitigated 1-hour TSP concentrations, 10th highest 24-hour and annual RSP / FSP concentrations among Years 2021-2023 are presented in the **Table 3.11** below and detailed in **Appendix 3.5**. Exceedances of the TSP, RSP and/or FSP criteria are predicted at existing ASRs. Mitigation measures are therefore required to reduce the potential air quality impact during construction phase. It should be noted that the predicted concentrations are based on conservative assumptions, such as adopting vehicular emission in Year 2021 but coupling with maximum traffic data in Year 2023**.**

3.4.5.2 Based on the detailed results presented in **Appendix 3.5**, it is observed that the worst affected height is identified at 1.5m above ground for existing ASRs. To this end, contours for the cumulative unmitigated 1-hour TSP concentrations, and 10th highest 24-hour and annual RSP / FSP concentrations the worst affected level (i.e. 1.5m above local ground) are plotted in **Figures 3.3a-3.3o**.

Table 3.11 Unmitigated cumulative TSP, RSP and FSP concentrations at ASRs

ASR ID	Worst Affected Year	Worst Hit Height Above Local Ground (m)	Concentrations (μg/m³)				
			TSP	RSP		FSP	
			Highest 1-hour	10th highest 24-hour	Annual	10th highest 24-hour	Annual
Criteria			**500**	**100**	**50**	**75**	**35**
Existing ASRs							
A1	2021, 2022	1.5, 5.0	**3572**	**143**	**53**	59	27
A2	2022	1.5	**1226**	76	33	56	23
A3	2021, 2022	1.5	**1381**	78	36	57	24
A4	2021	1.5	**2066**	80	37	57	24
A5	2021	1.5, 5.0, 15.0	**2362**	**118**	43	58	26
A6	2021	1.5	**1944**	**120**	47	60	26
A7	2022	1.5	**3600**	**276**	**72**	**76**	30
A8	2023	1.5	**3892**	**253**	**70**	70	30
A9	2021, 2022	1.5	**1266**	78	35	57	24
A10	2021, 2022	1.5, 15.0	**782**	76	33	56	23
A11	2021, 2022	1.5	**994**	76	34	56	23
A12	2021	1.5, 5.0	**4403**	**221**	49	62	26
A13	2021	1.5	**3911**	**147**	43	58	25
A14	2021, 2022	1.5	**1721**	78	36	57	24

Note:
[1] Bold values indicate exceedance of AQO or TM-EIAO.

3.4.5.3 Exceedances in AQO and TM-EIAO are predicted at identified ASRs under unmitigated scenario. Most exceedances are found at 1.5m above local ground which are most likely to be associated with heavy construction activities at the Project Site.

3.4.6 Mitigation Measures

3.4.6.1 In order to reduce the dust emission from the Project and achieve compliances of relevant criteria at ASRs, regular watering under a good site practice should be adopted. In accordance with the "Control of Open Fugitive Dust Sources" (USEPA AP-42) as given in **Appendix 3.6**, watering once per hour on exposed worksites and haul road is proposed to achieve dust removal efficiency of 91.7%. These dust suppression efficiencies are derived based on the average haul road traffic of 15 per hour, average evaporation, etc. (see **Appendix 3.6**). Any potential dust impact and watering mitigation would be subject to the actual site conditions. For example, for a construction activity that produces inherently wet conditions or in cases under rainy weather, the above water application intensity may not be unreservedly applied. While the above watering frequencies are to be followed, the extent of watering may vary depending on actual site conditions. The dust levels would be monitored and managed under an Environmental Monitoring and Audit (EM&A) programme as specified in the EM&A Manual.

3.4.6.2 In addition, the Contractor is also obliged to follow the procedures and requirements given in the Air Pollution Control (Construction Dust) Regulation. It 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.

- Erect a 3-m high hoarding at the northern boundary of the Project Site, extent as shown in **Figure 3.2a**;
- Any 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;
- Any dusty materials remaining after a stockpile is removed should be wetted with water and cleared from the surface of roads;
- A stockpile of dusty material should not be extended beyond the pedestrian barriers, fencing or traffic cones;
- The load of dusty materials on a vehicle leaving a construction site should be covered entirely by impervious sheeting to ensure that the dusty materials do not leak from the vehicle;
- Where practicable, vehicle washing facilities with 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;
- 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 Project 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;
- 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;

- 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;
- 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;
- 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;
- Any skip hoist for material transport should be totally enclosed by impervious sheeting;
- 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 3 sides;
- 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;
- Loading, unloading, transfer, handling or storage of bulk cement or dry PFA should be carried out in a totally enclosed system or facility, and any vent or exhaust should be fitted with an effective fabric filter or equivalent air pollution control system; and
- 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.

3.4.7 Assessment Results (Mitigated)

3.4.7.1 With the implementation of the abovementioned mitigation measures, the maximum mitigated 1-hour TSP concentrations, and 10th highest 24-hour and annual RSP / FSP concentrations are calculated and presented in **Table 3.12** below and detailed in **Appendix 3.7**.

According to the detailed assessment results presented **Appendix 3.7**, the worst construction dust impact on each identified existing ASRs generally occurs at ground level (i.e. 1.5m above ground), which is the closest location to the at-grade construction site.

Table 3.12 Mitigated cumulative TSP, RSP and FSP concentrations at ASRs

ASR ID	Worst Affected Year	Worst Hit Height Above Local Ground (m)	Concentrations (μg/m^3)				
			TSP	RSP		FSP	
			Highest 1-hour	10th highest 24-hour	Annual	10th highest 24-hour	Annual
Criteria			**500**	**100**	**50**	**75**	**35**
Existing ASRs							
A1	2021, 2022	1.5, 10.0	355	80	38	58	24
A2	2021, 2022	1.5	223	75	32	56	23
A3	2021, 2022	1.5	226	75	34	56	24
A4	2021, 2022	1.5, 15.0	233	76	34	57	24
A5	2021, 2022	1.5, 15.0	232	77	35	57	24
A6	2021	1.5, 20.0	259	78	36	58	24
A7	2021, 2022	1.5	371	88	39	58	24
A8	2021, 2023	1.5, 10.0	351	80	38	58	24
A9	2021, 2022	1.5	225	76	34	57	24
A10	2021, 2022	1.5	223	74	32	56	23
A11	2021, 2022	1.5	221	75	33	56	23
A12	2021	1.5, 5.0	439	76	35	57	24
A13	2021, 2022	1.5	356	76	34	57	24
A14	2021, 2022	1.5, 5.0	227	75	34	56	24

3.4.7.2 Higher pollutant concentrations are predicted at ASRs which are closer to the Project which would be more susceptible to dust emissions during construction phase (e.g. A12, A13). Similarly, those which are further away from the Project Site, such as residential areas located uphill (e.g. A9, A10), would be facing a lower pollutant concentrations during construction phase. The highest pollutant concentrations are mostly identified at 1.5m above local ground which is most likely to be caused by heavy construction activities to be occurred at the Project Site where dust emissions are released at local ground level.

3.4.7.3 Results indicate that there are no exceedances of respective criteria predicted at all ASRs.

3.4.7.4 Contours of mitigated 1-hour TSP concentrations, and 10th highest and annual RSP / FSP concentrations at the worst affected level (i.e. 1.5m above ground) are illustrated in **Figures 3.4a-3.4o**. Contours also indicate that there are no exceedances at all ASRs.

3.4.8 Evaluation of Residual Air Quality Impact

3.4.8.1 With the implementation of the mitigation measures as stipulated in the Air Pollution Control (Construction Dust) Regulation, dust control measures, including watering once per hour on exposed worksites and haul road, and good site practices, as well as the 3-m high hoarding proposed at the northern boundary of the Project, the predicted 1-hour TSP, 24-hour and annual RSP / FSP concentrations on all sensitive uses in the vicinity of the construction sites would comply with the respective criteria. Hence, no adverse residual air quality impact during construction phase is anticipated**.**

3.5 Operational Air Quality Impact Assessment

3.5.1 Assessment Area

3.5.1.1 As stated in the **Section 3.3**, the assessment area for operational air quality impact assessment should also be generally defined by a distance of 500m from the boundary of the Project and the works of the Project. However, with regards to the close proximity of a cluster of industrial sources i.e. TPIE, industrial sources beyond 500m assessment area are considered in the assessment. **Figure 3.2** illustrates the extent of assessment area. The three tier source contributions from the Project, near-field and far-field pollution sources should be predicted using local-scale and regional-scale models for cumulative impact assessment**.**

3.5.2 Identification of Pollution Sources and Emission Inventory

Pollution Source associated with the Project

3.5.2.1 The Project itself is not a pollution source and the only air quality impact generated would be the small amount of vehicular emission induced. According to the traffic forecast, there would be an induced traffic of around 120 vehicles during peak hour due to the operation of the Project at Year 2024. This is equivalent to about 10% of that along Ting Kok Road in the same year (i.e. commencement year).

3.5.2.2 The induced traffic would comprise of shuttle buses arranged by the operator and vehicles used by visitors / staff. For the shuttle buses, the operator will procure e-shuttle buses to avoid generation of vehicular emissions. For the vehicles used by visitors and staff, although it is not possible to restrict to the use of electric cars, suitable charging facilities will be provided within and in the vicinity of the car park. This will encourage the visitors / staff to use electric cars to commute to the golf course. Other than the vehicles induced at Ting Kok Road, there would also be a number of golf carts operating within the golf course. In order to avoid additional emissions, the Project Proponent has decided to only procure electrically driven golf cart. This will help avoid any generation of vehicular emissions during operational phase of the Project.

3.5.2.3 Besides induced traffic, the Project has also proposed a new Sewage Pumping Station (SPS) with a capacity of about $500m^3$/day at the southern portion of the Project Site. Based on the current Project layout, the separation distance between the proposed SPS and relatively more sensitive uses (e.g. Ancillary facilities) is around 50m (See **Figure 3.7**). Suitable mitigation measures would be provided to the proposed SPS to minimise the potential nuisance to the nearby identified ASRs (See **Section 3.5.2.15** for details).

Near-Field Pollution Source

3.5.2.4 The key existing air pollution sources within the assessment area that may bear upon the air quality during operational phase comprises the industrial emissions from TPIE and the vicinity, vehicular emission, including the Project induced traffic, from neighbouring roads such as Ting Kok Road, and marine traffic emission from the vessel serving the cement depot cum concrete batching plants at Yu On Road.

3.5.2.5 Nevertheless, TPSTW is located at the immediate west of the Project boundary. Together with a committed Food Waste Pre-treatment Facilities (FWPF) near the STW, potential cumulative odour impact to the future golf course users might be anticipated. In addition, an existing SPS is located at the immediate north of the Project site. The SPS and its associated sewer will be upgraded to increase the service capacity to cater for future developments. Lastly, a new SPS has also been proposed within the Project Site to facilitate the conveyance of sewage generated onsite. Potential odour impact will be further discussed in **Section 3.5.4**.

3.5.2.6 Specifically, the existing and planned near-field sources are described in the following sections below:

A) Industrial Emission

3.5.2.7 Through a number of chimney surveys (conducted in November, December 2017 and January 2018), desktop study, liaison with Hong Kong Science and Technology Park and the operators, existing chimneys within the 500m assessment area and the whole TPIE and nearby areas have been identified. The chimney information, including stack height, gas exhaust velocity, exhaust temperature and the internal diameter of the stack etc. have been gathered / made references from various sources, including SP licenses, approved EIA studies etc., where available. The identified chimneys are summarised in **Appendix 3.11**. **Figure 3.5** illustrates the indicative locations of these sources.

B) Vehicular Emission from Open Road

3.5.2.8 Major air pollution source in the vicinity of the Project during operational phase would be tailpipe emission generated from traffic along open road. Vehicular emissions from the existing road networks, including Ting Kok Road, Dai Kwai Street, Dai Cheong Street etc. that would have cumulative air quality impact on nearby ASRs have also been addressed. **Figure 3.6** illustrates the road networks within 500m assessment area which are considered as near-field sources in the operational air quality assessment.

3.5.2.9 It should be noted that an internal access road is planned under this Project, however, its peak flow would only be about 120 vehicles per hour according to the traffic forecast for Year 2024, while other off-peak hours would have a traffic flow of around 60-90 vehicles per hour. Since the golf-playing area would only operate from 7am to 7pm, the traffic flow at the access road would be much lower during nonoperation hours. Hence, considering this limited traffic flow along the access road, adverse air quality impact to the nearby receivers are considered not likely and it would not be included in the modelling assessment.

C) Marine Emission

3.5.2.10 No major marine channel is located within 500m assessment area. However, according to site observation, a sand barge associated with the operation of a cement depot cum concrete batching plants at Yu On Road travels regularly in the marine waters at the east of the Project site, which falls within the 500m assessment area. **Figure 3.6** illustrates the route of sand barge.

D) Odour Emission

3.5.2.11 Four key odour sources have been identified within 500m assessment area of the Project as below:

- TPSTW;
- The committed FWPF;
- The proposed upgraded SPS at Ting Kok Road; and
- The proposed SPS within Project Site.

3.5.2.12 Locations of the odour sources can be referred to **Figure 3.7**.

3.5.2.13 TPSTW is an existing odour source that adjoins the western Project boundary. According to the latest Environmental Permit (EP) for TPSTW (EP-265/2007/A), the odour removal efficiencies for some deodorisers has further increased from 99% to up to 99.95% to reduce the odour that may be generated throughout the wastewater treatment process.

3.5.2.14 Another future odour source is located at the immediate north of TPSTW which is the committed FWPF that serves for food waste / sewage sludge anaerobic co-digestion. Shuen Wan Leachate Pre-treatment Plant, where the committed FWPF would be located, has no noticeable odour at its periphery according to site visit. Meanwhile, the committed FWPF has been proposed an odour removal efficiency of 98%. Potential cumulative odour impact from the TPSTW and the committed FWPF to the Project are assessed.

3.5.2.15 According to the project profile submitted for the application of Direct EP (DIR-258/2017), a SPS is located at the north of the Project Site. The SPS and its associated sewer would be upgraded from 11,520m^3/day to 21,200m^3/day and the upgrading works is anticipated to be completed in Year 2022. Based on the project profile, it indicated that all facilities and areas with potential odour emission, such as wet wells, inlet chamber and screen chambers, will be housed by a fully enclosed and reinforced concrete structure. The exhaust will be conveyed to the deodourising units with odour removal efficiency of 99.5%. The project profile also indicated that existing SPSs in Hong Kong of even larger pumping capacity (ranging from 5,606 to 36,900

m^3/day) would not have noticeable odour around their boundaries provided 99.5% odour removal efficiency has been implemented. On this basis, it is considered that cumulative odour impact during operational phase is not anticipated.

3.5.2.16 The Project has also proposed a new SPS with a capacity of about 500m^3/day at the southern portion of the Project Site. Based on the current Project layout, the separation distance between the proposed SPS and the relatively more sensitive uses (e.g. Ancillary facilities) is around 50m (See **Figure 3.7**). It is anticipated that with the implementation of appropriate mitigation measures commonly adopted in other existing SPSs in Hong Kong, such as enclosing the odourous facilities, maintaining negative pressure to prevent foul air from escaping the building, and provision of odour removal system (e.g. activated carbon type deodourisation units) at the ventilation exhaust to control odour impacts, potential odour impact from these proposed SPSs at nearby air sensitive uses could be properly controlled.

3.5.2.17 According to the approved project profile mentioned in **Section 3.5.2.14** (i.e. Upgrading of Sewage Pumping Stations and Sewerage along Ting Kok Road (DIR-258/2017)), Ting Kok Road No.5 SPS will be upgraded to an installed capacity of 21,000m^3/day. Having the odourous facilities enclosed and installing at least 99.5% odour removal efficiency at its exhausts, adverse odour impact was considered unlikely even the closest ASR from Ting Kok No.5 SPS is some 10m away. Considering the proposed SPS would only have about 500m^3/day installed capacity and similar mitigation measures would be implemented, the closest ASR, which is separated from the proposed SPS by at least 50m, as well as other sensitive uses are not expected to endure adverse odour impacts due to the proposed SPS.

3.5.2.18 Furthermore, additional site visits have been conducted to some typical SPSs in Hong Kong (including Tai Po Tai Wo Road SPS, Tung Chung Area 56 Temporary SPS and existing Ting Kok Road No.5 SPS). The capacities of these SPSs range from 2,400 – 12,100m^3/day and all deodourisers are equipped with at least 99.5% odour removal efficiency. The shortest separation distances between these SPSs and identified ASRs are of 13 – 29m. The survey was conducted in Oct 2018 with temperature at around 30°C and wind speed <1m/s. No noticeable odour was identified at the periphery of the SPSs, and similar situation is anticipated on the planned ASRs located in close proximity with the proposed SPS under this Project given its capacity would be only around 500m^3/day.

3.5.2.19 By taking the merits of the existing SPS designs, odourous facilities within the proposed SPS would be fully enclosed, its exhaust is also recommended to convey to the deodourising units with odour removal efficiency of at least 99.5% and divert away from the Ancillary facilities. Sufficient separation distance of around 50m between the proposed SPS and Ancillary facilities would also be maintained. Considering the capacity of the proposed SPS would be rather small, the potential odour impact from the proposed SPS could be readily controlled by the above measures and adverse odour impacts to identified ASRs is not anticipated. Cumulative odour impact during operational phase is therefore not anticipated.

Far-Field Pollution Source

3.5.2.20 All major emission sources including public electricity generation, civil aviation, road transport, navigation, industries, other fuel combustion and non-combustion sources covering both HKSAR and PRDEZ are considered. Hourly pollutant concentration data predicted by PATH-2016 for Year 2020 provided by EPD are directly adopted as the background concentration for cumulative assessment**,** more details are given in **Section 3.5.4.**

3.5.3 Key Representative Pollutants

3.5.3.1 As discussed in **Section 3.1**, the APCO (Cap. 311) and its subsidiary regulations define statutory AQOs for 7 common air pollutants including NO_2, SO_2, RSP, FSP, CO, O_3 and lead. According to Appendix B Clause 5 (ii) of the EIA Study Brief, the key / representative air pollution parameters for the Project shall be identified, including the types of pollutants and the averaging time concentration.

3.5.3.2 The Project is to plan for golf course in Tai Po Area. No major polluting emission is anticipated from the operation of the Project, except the very small amount of induced traffic due to the future golf course users on the existing road network. The tailpipe emission would comprise a number of pollutants, including NO_x, RSP, FSP, SO_2, CO, etc. As discussed in the following sections, only the NO_2, RSP and FSP are considered the key air quality pollutant for the Project and the concentrations of the other pollutants are very low and hence are not considered as the key pollutants for the purposes of this air quality assessment. The issue on O_3 which is highly influenced by the regional situation are also discussed.

Nitrogen Dioxide (NO_2)

3.5.3.3 NO_x is known to be one of the pollutants emitted by vehicles. According to the 2016 Hong Kong Emission Inventory Report published by EPD [3-1], which is the latest available information by the time of preparing this report, the dominant source of NO_x generated in HK is the navigation which constitutes about 37% of the total in 2016. Road transport is the third largest NO_x emission group, accounting for about 18% of the total while other combustion including for industrial purposes accounted for 10% of the total (see table below).

Table 3.14 The emission percentage and the amount of NO_x in Hong Kong (2016)

Pollutant Source Categories	NO_x Emission % [1]	NO_x Emission (tonnes) [1]
Public Electricity Generation	29%	25,620
Road Transport	18%	16,200
Navigation	37%	32,900
Civil Aviation	7%	6,060
Other Combustion	10%	8,850
Non-combustion	N/A	N/A
Biomass Burning	<1%	30
Total	**100%**	**89,670**

Note:
[1] Figures extracted from 2016 Hong Kong Emission Inventory Report (https://www.epd.gov.hk/epd/sites/default/files/epd/data/2016_Emission_Inventory_Report_Eng_v1.pdf)

3.5.3.4 Together with VOC and in the presence of O_3 under sunlight, NO_x would be transformed to NO_2. As discussed in **Section 3.2**, the latest 5-year average of annual NO_2 concentrations in Tai Po (i.e. 41 µg/m^3) exceeded the prevailing AQO.

3.5.3.5 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 are assessed.

Respirable Suspended Particulates (RSP) and Fine Suspended Particulates (FSP)

3.5.3.6 RSP refers to suspended particulates with a nominal aerodynamic diameter of 10µm or less. According to the EPD's data, and other research studies (Tian et al., 2011 & Wie-Zhen et al., 2008), road vehicles, particularly diesel vehicles, are one of the sources of RSP in Hong Kong. FSP refers to suspended particulates with a nominal aerodynamic diameter of 2.5µm or less.

3.5.3.7 According to the latest statistics of 2016 Hong Kong Emission Inventory Report[3-1], road transport only accounted 9% and 10% of the total RSP / FSP emissions while navigation accounted for 35% and 40% respectively. As discussed in **Section 3.2**, the latest 5-year average of the annual RSP an FSP concentrations in Tai Po were about 72% and 70% of the respective prevailing AQOs.

Table 3.15 The emission percentage and the amount of RSP in Hong Kong (2016)

Pollutant Source Categories	**RSP**		**FSP**	
	Emission (%)	**Emission (tonnes)**	**Emission (%)**	**Emission (tonnes)**
Public Electricity Generation	13%	610	8%	310
Road Transport	9%	420	10%	380
Navigation	35%	1,640	40%	1,480
Civil Aviation	1%	50	1%	50
Other Combustion	16%	740	19%	690
Non-combustion	19%	890	13%	480
Biomass Burning	8%	370	8%	300
Total	100%	**4,720**	100%	**3,680**

Note:
[1] Figures extracted from 2016 Hong Kong Emission Inventory Report (https://www.epd.gov.hk/epd/sites/default/files/epd/data/2016_Emission_Inventory_Report_Eng_v1.pdf)

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

Sulphur Dioxide (SO_2)

3.5.3.9 According to the latest statistics of 2016 Hong Kong Emission Inventory Report[3-1], the dominant source of SO_2 in Hong Kong is navigation, which constitutes the majority of the emissions (about 49%). Given the Air Pollution Control (Marine Light Diesel) Regulation came in force from 1 April 2014, the sulphur content of the Marine Light Diesel (MLD) is limited to 0.05%. In addition, according to the Legislative Council Brief (file ref: Annex 4 to EP 150/NV/24), the sulphur content of marine petrol has a limit of 0.001%. The introduction of sulphur content limit would therefore help reduce SO_2 emission from navigation in Hong Kong.

3.5.3.10 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 <1% of the total SO_2 (see the following table). The introduction of ultra-low sulphur diesel for vehicle fleet in Year 2000 has also helped reducing the SO_2 emission in Hong Kong.

Table 3.16 The emission percentage and the amount of SO_2 in Hong Kong (2016)

Pollutant Source Categories	SO_2 Emission % [1]	SO_2 Emission (tonnes) [1]
Public Electricity Generation	46%	8,020
Road Transport	<1%	40
Navigation	49%	8,540
Civil Aviation	3%	530
Other Combustion	1%	180
Non-combustion	N/A	N/A
Biomass Burning	<1%	10
Total	**100%**	**17,310**

Note:

[1] Figures extracted from 2016 Hong Kong Emission Inventory Report (https://www.epd.gov.hk/epd/sites/default/files/epd/data/2016_Emission_Inventory_Report_Eng_v1.pdf)

3.5.3.11 Fuel used by various industrial premises within TPIE could contain a certain level of sulphur content and subsequently lead to the emission of SO_2, for which could pose potential impacts to the Project. However, with reference to the 2016 Hong Kong Emission Inventory Report, combustion only contribute to around 1% of the total SO_2 emission in the territory. In addition, under the Air Pollution Control (Fuel Restriction) (Amendment) Regulation (the "Amendment Regulation") amended and enacted on 1 October 2008, only gaseous fuel, solid fuel that does not exceed 1% sulphur content by weight or liquid fuel that does not exceed 0.005% sulphur content by weight and a viscosity of not more than 6 centistokes at 40° C, such as Ultra Low Sulphur Diesel ("ULSD") are permitted to be used in commercial and industrial processes. Hence, SO_2 emissions from industrial combustion activities are expected to be limited.

3.5.3.12 In addition, as discussed in **Section 3.2**, the latest 5-year average of the 4^{th}-highest 10-minute and 24-hour SO_2 concentrations in Tai Po are only 10% and 11% of the respective prevailing AQOs. This clearly indicates that the AQOs for SO_2 could be well achieved with great margin in the study area under the existing settings. Given that the limited marine traffics, road transport and other fuel combustions would only contribute a very small amount of SO_2 at the assessment area and there is still a large margin to the AQOs compared to the other pollutants such as RSP and NO_2, it is appropriate to consider that SO_2 is not the key pollutant for quantitative assessment for the operational phase of the Project.

Ozone (O_3)

3.5.3.13 Unlike other pollutants such as NO_x, 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. According to Sun et al. [3-2, 3-3] the rate of formation of O_3, also known as Ozone Production Efficiency, depends not only on NO_x and VOC levels, but atmospheric oxidation, temperature, radiation, and other meteorological factors in the atmosphere of different regions. The formation of O_3 generally takes several hours to proceed [3-1] and therefore O_3 recorded locally could be attributed to emissions generated from places afar.

3.5.3.14 According to "A Study to Review Hong Kong's Air Quality Objectives" [3-4], due to the abundance of its precursors (VOC and NO_x) from a great variety of sources such as motor vehicles, industries, power plants and consumer products, etc., ozone can be widely formed in the region and can be transported over long distance. The general rising trend of ozone levels in Hong Kong over the past years reflects an aggravation in the photochemical smog problem on a regional scale. All these indicate that local traffic emission is not a dominant controlling factor in O_3 formation.

3.5.3.15 In addition, the EPD's "Air Quality in Hong Kong 2017" report [3-5] stated that NO_x emissions from motor vehicles and chimneys have the potential to react with and remove O_3 in the air, and regions with heavy traffic normally have lower ozone levels than areas with light traffic. It is therefore possible that the Project may contribute to a decrease in O_3 in the immediate area along main roads. O_3 is therefore not considered as a key parameter in this assessment.

Carbon Monoxide (CO)

3.5.3.16 CO is one of the primary pollutants emitted by road transport. According to the latest 2016 Hong Kong Emission Inventory Report published by EPD[3-1], CO emissions from road transport contributed about 53% of total CO emission in 2016 (see the table below).

Table 3.17 The emission percentage and the amount of CO in Hong Kong (2016)

Pollutant Source Categories	CO Emission % [1]	CO Emission (tonnes) [1]
Public Electricity Generation	6%	3,690
Road Transport	53%	31,500
Navigation	23%	13,940
Civil Aviation	7%	3,960

Pollutant Source Categories	CO Emission % [1]	CO Emission (tonnes) [1]
Other Combustion	9%	5,520
Non-combustion	N/A	N/A
Biomass Burning	1%	850
Total	**100%**	**59,450**

Note:
[1] Figures extracted from 2016 Hong Kong Emission Inventory Report (https://www.epd.gov.hk/epd/sites/default/files/epd/data/2016_Emission_Inventory_Report_Eng_v1.pdf)

3.5.3.17 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. Although CO concentrations are not measured at Tai Po Station, the ambient air quality predicted for Year 2020 has demonstrated the future 1-hour and 8-hour averaged CO levels would comply with AQOs with large margins (see **Table 3.3**). Hence, the emission of CO from the induced road transportation is not likely to have major impact on air quality, and hence is not considered as a key parameter for this assessment.

Toxic Air Pollutants (TAPs)

3.5.3.18 There are seven kinds of TAPs routinely monitored in HK, including diesel particulate matters, polychlorinated biphenyls (PCBs), dioxins, polycyclic aromatic hydrocarbons (PAHs), VOCs, carbonyls, and toxic elemental species.

3.5.3.19 SP activities are found within TPIE, where some of them are categorised as aluminium works and zinc galvanising works. According to their respective SP licenses, elemental species (e.g. chromium, chlorides, fluorides, tin, etc) would be emitted during their production processes which could potentially affect the Project during operational phase. However, it should be noted the Project site has long been a golf driving range (i.e. air sensitive use) in the last twenty years, as such, the Air Pollution Control Plans (APCPs) supporting these SP licenses should have already taken into account the air quality impact on Project Site and confirmed that the impact is acceptable. Hence, it should be reasonably considered that the elemental species emissions from metallurgical activities within TPIE would not pose adverse air quality impact to the Project site. Furthermore, the Project itself is not the source of elemental species emissions and no change in the concentration of the elemental species from the existing condition at the Project Site is anticipated. Hence, the emission of elemental species is not considered as a key / representative air pollutants for assessment.

3.5.3.20 Dioxins, carbonyls, PCBs and most toxic elemental species are not considered primary sources of vehicular emissions [3-6,3-7], and hence, these three TAPs are not considered as key / representative air pollutants for the operational air quality assessment.

3.5.3.21 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 [3-8]. It is not considered as a key air pollutant for the operational air quality assessment.

3.5.3.22 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 2017 - "Air Quality in Hong Kong 2017" [3-5], the concentration of PAHs (Benzo[a]pyrene, BaP) at the Tsuen Wan and Central/Western monitoring stations was 0.09 and 0.06 ng/m^3 respectively in 2017 which was still much lower than the guidelines of European Communities of 1ng/m^3.

Table 3. 18 Comparison of TAPs concentration in Hong Kong (2017) and the EU Air Quality Standards

Air Pollutants	**Guidelines / Standards (ng/m^3)**	**Highest Avg Conc at Tsuen Wan station of Hong Kong (ng/m^3)**	**Highest Avg Conc at Central/Western station of Hong Kong (ng/m^3)**	**Compliance**
	EU			**EU**
PAHs (BaP)	1 (Annual Average)[1]	0.09 (Annual Average)[2]	0.06 (Annual Average)[2]	Well Achieved

Note:
[1] Referenced from http://ec.europa.eu/environment/air/quality/standards.htm.
[2] Referenced from http://www.aqhi.gov.hk/api_history/english/report/files/AQR2017e_final.pdf.

3.5.3.23 There are different standards for different VOC compounds. According to the latest EPD study report in 2017 – "Air Quality in Hong Kong 2017" [3-5], benzene, 1-3 butadiene, formaldehyde and perchloroethylene are the VOCs that may have more health concern, and the USEPA also identified benzene and 1-3 butadiene are carcinogenic.

Table 3.19 Comparison of VOCs concentration in Hong Kong (2017) and the EU Air Quality Standards

TAP	**Guidelines / Standards (µg/m^3)**	**Highest Avg Conc at Tsuen Wan station (µg/m^3)**	**Highest Avg Conc at Central/Western station (µg/m^3)**	**Compliance**
Benzene	5 (Annual Average) [1]	1.01	1.21	Well Achieved
1-3 butadiene	2.25 (Running Annual Average) [1]	0.09	0.06	Well Achieved
Formaldehyde [2]	9 (Annual Average) [3]	4.39	-	Well Achieved
Perchloroethylene	40 (Annual Average) [4]	0.43	0.57	Well Achieved

Note:
[1] Referenced from the UK National Air Quality Strategy (NAQS). (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf).
[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 (https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=106).

3.5.3.24 As shown in the above table, the measured VOCs concentration in Hong Kong urban area is far below the UK and US standards. Also, according to 2016 Hong Kong Air Pollutants Emission Inventory, the VOCs level in 2016 was around 65% lower compared to 1997 level due to the EPD progressive improvement of EURO standard vehicles over the past two decades. With reference to the EPD's 2016 Hong Kong Emission Inventory Report[3-1], vehicular emission is also not the primary source of VOCs, accounting for about 18% 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 1.1-2.3% of the overall VOC emissions in Hong Kong are benzene and 1-3 butadiene contributed by vehicular emission.

3.5.3.25 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 are also not specified under the current AQO. Based on above reasons, TAPs are not considered as a key air pollutant for the operational air quality assessment.

Lead (Pb)

3.5.3.26 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 "Air Quality in Hong Kong 2017" report from EPD, the highest annual averaged lead level within Hong Kong was recorded in Kwun Tong, Tung Chung and Tseung Kwan O at 19 ng/m^3. The measured concentration is much lower than the annual AQO of 500 ng/m^3. Therefore, lead is not considered as a key / representative air pollutant for the operational air quality assessment.

Conclusion

3.5.3.27 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 existing HKAQO.

3.5.4 Assessment Methodology

General

3.5.4.1 The area for air quality impact assessment should be generally defined by 500m from the boundary of the Project Site and the works of the Project. However, considering the close proximity with TPIE, the assessment has been extended beyond 500m to cover the neighbouring industrial sources (i.e. entire TPIE).

3.5.4.2 The assessment has evaluated the impacts arising from three classes of emission sources depending on their distance from the project site, including:

(1) Project induced contribution;

(2) Pollutant-emitting activities in the immediate neighbourhood; and

(3) Other contributions from pollution not accounted for by (1) and (2).

3.5.4.3 All sources within TPIE and the 500m assessment area (i.e. (1) and (2)) are considered as near-field source impacts and are predicted using local-scale models. These sources include industrial emissions, vehicular emissions from existing road network and marine emissions.

3.5.4.4 Other far-field pollution source impacts (3) which are beyond 500m from the Project (i.e. background concentration), are predicted using regional scale model – Pollutant in the Atmosphere and the Transport over Hong Kong, PATH. In PATH model, all major emission sources including public electricity generation, civil aviation, road transport, navigation, industries, other fuel combustion and non-combustion sources covering both HKSAR and PRDEZ are considered.

3.5.4.5 The cumulative operational air quality impact is then a combination of the contributions from the near-field and far-field sources.

Determination of Worst Assessment Year

3.5.4.6 According to Appendix B, Clause 5 (iv) of the EIA Study Brief for the Project, the air pollution impacts of future road traffic shall be calculated based on the highest emission strength from road vehicles in the assessment area within the next 15 years upon commissioning of the Project. The selected assessment year should represent the highest emission scenario, given the combination of emission factors and traffic flow for the selected year.

3.5.4.7 Vehicular tailpipe emissions have been calculated by the EMFAC-HK provided by EPD. The EMFAC-HK v.3.4 published in February 2018 has been employed. The emission refers to vehicular emission from road networks within 500m of the site boundary (e.g. Ting Kok Road).

3.5.4.8 Based on the tentative programme, the Project will commence in Year 2024. EMFAC-HK models are carried out for Year 2024 (commissioning year), 2026 (interim year), 2029 (interim year), 2034 (interim year) and 2039 (15 years upon commission) to determine the highest emission and hence the worst assessment year. The traffic forecast data is given **Appendix 3.8**. The methodology, key model assumptions and results (including emission factors) are presented in **Appendix 3.9**.

3.5.4.9 The total NO_x, RSP and FSP emissions from nearby road networks predicted by EMFAC-HK based on the traffic forecast are summarized in the table below. Results indicate that the highest NO_x, RSP and FSP emission scenarios would likely occur in Year 2024 and hence is taken as the worst assessment year for the purpose of this operational air quality assessment. In addition, it can also be seen from **Table 3.20** that, despite the continuous increase in the Vehicle-km Travelled (VKT), a progressive decrease in NO_x, RSP and FSP emissions from vehicle tailpipe is observed, which is anticipated as a result of the implementation of emission reduction measures over motor vehicles by the Hong Kong Government, e.g. introductions of Euro V vehicle emission standards in 2012 and Euro VI tentatively in 2017/2018, phasing out pre-Euro IV diesel commercial vehicles by end 2019, etc. These measures on controlling vehicular emission would progressively reduce roadside air pollution.

Table 3.20 Summary of Total Daily Pollutant Emissions within Assessment Area

Year	Total NO_x Emission (gram/day)	Total RSP Emission (gram/day)	Total FSP Emission (gram/day)	Total Veh-km Travelled (VKT/day)
2024	**33,985**	**1,302**	**1,197**	76,948
2026	31,337	1,240	1,141	77,666
2029	26,352	1,021	949	78,736
2034	19,250	638	588	80,626
2039	18,918	617	569	**82,550**

Note:
[1] Values in bold are the maximum values among the Scenario Years.

<u>Prediction of Vehicular Emission from Open Road</u>

3.5.4.10 The EMFAC-HK calculates the hourly vehicular emission (in tonne) for each road category. The hourly emission rates for each vehicle class (in gram per mile per vehicle) are obtained by dividing the hourly emissions calculated in the EMFAC-HK by the VKT for the respective hour. The calculation of the NO_x, RSP and FSP emission factors for different road groups are given in **Appendix 3.9**.

3.5.4.11 The USEPA approved near field air dispersion model, CALINE4 developed by the California Department of Transport is used to assess vehicular emissions impact from all existing road network.

3.5.4.12 Grid-specific meteorological data for Year 2010 extracted from EPD's PATH model is adopted in CALINE4 model, including relevant temperature, wind speed, direction and mixing height. The stability classes are estimated from PCRAMMET model. The mixing height is capped to between 121m and 1667m as per the real meteorological data. For the treatment of calm hours, the wind speed is capped at 1 m/s for wind speed from PATH which are lower than 1 m/s.

3.5.4.13 The surface roughness height is closely related to the land use characteristics, and the surface roughness is estimated as 10 percent of the average height of physical structures. The assessment area consists of mostly village houses and industrial premises of 2-3 storeys, which normally range from 8-15m in height. However, taking into account the future use of the Project site (as mainly turf grass) and the close proximity to the Tolo Harbour (i.e. sea surface), a surface roughness of 50cm has been adopted to derive the wind standard deviation, which is estimated in accordance with the "Guideline on Air Quality Models (Revised), 1986" and is considered as a reasonably conservative assumption. Summary of wind standard deviation is given in the table below.

Table 3.22 Summary of wind standard deviation for surface roughness

Stability Class	Wind Standard Deviation (roughness = 50cm)
A	28.6
B	28.6
C	22.3
D	15.9
E	9.5
F	4.8

3.5.4.14 RSP and FSP emission rates for Year 2024 are directly adopted as the input for CALINE4 while NO_x emission factors are separated into initial (tailpipe) NO_2 and residual NO_x emission rates as follows:

- Initial NO_2 to NO_x (NO_2/NO_x) ratio for different vehicle and road types, shown in **Appendix 3.9**, have been calculated from EMFAC-HK results;
- Initial NO_2 emission factor for individual vehicle types have been derived from initial NO_2/NO_x ratio, presented in **Appendix 3.9**; and
- Residual NO_x emission factor is determined by subtracting the initial NO_2 emission factor from total NO_x emission factor for individual vehicle types.

3.5.4.15 Initial NO_2, residual NO_x, RSP and FSP emission factors, shown in **Appendix 3.10**, are inputted to CALINE4 models. Modelling parameters for CALINE4 are summarised in **Table 3.23**.

Table 3.23 Model parameters for CALINE4

Parameter	Input
Meteorological Data	Year 2010 MCIP data extracted from PATH model
Mixing Height	Year 2010 MCIP data extracted from PATH model and is capped to between 121m and 1667m as per the real metrological data recoded by Hong Kong Observatory in Year 2010
Stability Class	Estimated from PCRAMMET Model

Parameter	Input
NO_x to NO_2 Ratio	Ozone Limiting Method (initial NO_2/NO_x ratios from 0 to 1 were adopted for the initial NO_2 and residual NO_x models respectively)

Industrial Emissions

3.5.4.16 In light of the close proximity with TPIE, apart from chimneys located within 500m assessment area, those beyond 500m but within TPIE has been included in the assessment. Furthermore, a cement depot cum concrete batching plants is located at the east of the Project site just outside the 500m assessment area. In order to achieve more conservative assessment, it has been included in the assessment for conservative purposes.

3.5.4.17 Amongst all industrial emission activities identified in the vicinity, six of them are classified as SPs. The emission parameters, including emission rates, emission height, exit velocities etc., of these activities are made reference to their latest respective SP licenses.

3.5.4.18 However, most of the chimneys identified within TPIE are not in association with SP and hence their industrial premises would not hold any SP licenses. Liaisons with Hong Kong Science & Technology Parks Corporation (HKSTPC, who manages TPIE) and individual operators have been made to obtain their emission parameters for assessment but most operators had not responded. EPD has also been consulted and EPD replied that such information could not be provided due to the privacy of the individual operators. For those chimneys where the emission parameters were not provided by the operators, physical parameters such as chimney height and diameter were estimated via on-site observation while other physical parameters such as emission rates, were estimated in the section below. In addition, for cement depot cum concrete batching plants at Yu On Street, in accordance with "*A Guidance Note on the Technical Management and Monitoring Requirements for Specified Process – Cement Works (Concrete Batching Plant)*"(BPM 3/2 (16)), emission of particulate matter from fixed emission point of bag filters shall meet the concentration limit of $10mg/m^3$ (design standard) by 1 January 2018 for all plants. Hence, particulate matter emissions from the concrete batching plant are estimated with reference to the BPM 3/2 (16). **Appendix 3.11**. presents the detailed calculations of industrial emissions.

3.5.4.19 Two approaches were considered in the assessment. In the approved EIA Study for Cross Bay Link, Tseung Kwan O (AEIA- 172/2013), it is stated that HKSTPC allows a daily diesel consumption of 52.6 m^3/day for tenants in Tseung Kwan O Industrial Estate (TKOIE) besides Hong Kong Aero Engine Services Ltd. Based on this information, the total fuel consumption for all tenants in TPIE could be predicted and hence the emission rates for various pollutants. The second approach is to adopt the averaged values of all emission points stipulated in the SP licenses assessed in the area. It should be noted that emission from non-SP industries in TPIE, which include some food factories, printing centres, etc. are unlikely noxious or offensive as compared with those from SPs (i.e. major stationary air pollution sources) due to the nature and scale of these industries. Hence, by adopting the averaged emission rates of all SP emission points on non-SP chimneys under the second approach is considered a reasonably conservative.

3.5.4.20 The estimated emission rates of the two approaches can be referred to **Table 3.24.** Since the second approach would lead to a higher pollutant emission rates than the first approach, the averaged emission rates of all SP emission points are adopted for conservative assessment.

Table 3.24 Emission rates predicted with different approaches

Pollutants	Each Chimney[1]		Total Emission from TPIE [3]	
	Approach 1 [4]	Approach 2 [5]	Approach 1 [4]	Approach 2 [5]
NO_x	0.2191 g/s	**0.4598 g/s**[6]	11.83 g/s	24.83 g/s
RSP	0.0110 g/s	**0.0415 g/s** [6]	0.59 g/s	2.24 g/s
FSP	0.0110 g/s [2]	**0.0327 g/s** [6]	0.59 g/s	1.77 g/s

Note:

[1] Exclude those chimneys with SP License.

[2] FSP is not assessed in the EIA Study for Cross Bay Link, Tseung Kwan O (AEIA- AEIAR-172/2013). As a conservative comparison, FSP is assumed to have the same emission as RSP.

[3] Not include the 6 SP licenses in TPIE and near the Project Site.

[4] Based on the approved EIA Study for Cross Bay Link (AEIA- 172/2013).

[5] Averaged values of all SP emission points

[6] Bold and underlined values are adopted for assessments.

3.5.4.21 Besides, a sensitivity test based on "Approach 2" has been further conducted by adopting maximum instead of averaged values of all emission points stipulated in the assessed SP licenses. Details of the sensitivity test can be referred to **Appendix 3.11a**.

3.5.4.22 Potential air quality impact associated with the industrial emissions is assessed by the EPD approved dispersion model, AERMOD. Chimneys are modelled as "Point" source, while haul road and loading / unloading area are modelled as "Area" sources in the model. OLM is adopted for conversion of NO_x to NO_2, using the predicted O_3 and NO_2 levels from PATH-2016 model. The in-stack NO_2:NO_x ratio for the industrial chimneys is assumed to be 10% in accordance with EPD's "*Guidelines on Choice of Models and Model Parameters*".

3.5.4.23 The overall modelling parameters are summarised in **Table 3.25** for ease of reference.

Table 3.25 Modelling Parameters

Parameter	Input
Background Concentration	PATH-2016 Year 2020
Modelling Mode	Urban
Terrain Effect	With terrain effect

Parameter	Input
Population	2,000 (Estimated from PlanD population projection data)
Land use	Specific for each PATH grid Refer to **Appendix 3.3** for surface characteristic parameters (e.g. Albedo, Bowen ratio, grid-specific surface roughness)
Meteorological Data	Year 2010 hourly meteorological data adopted in PATH
Anemometer Height	9m

Marine Emissions

3.5.4.24 Based on site observations, a sand barge would travel regularly via Tolo Harbour to the nearby cement depot cum concrete batching plants for the unloading of materials. It travels along the eastern side of the Project site and eventually reaches the anchoring point just outside the cement depot cum concrete batching plants almost once every two days and the unloading time could range from 2 – 5 hours.

3.5.4.25 As a conservative assessment, the sand barge is assumed to travel across the nearby waterbody once every hour (at the 1st hour of operation till the last hour of operation period), and anchor (hoteling) at the designated spot throughout the operation period (7am to 11pm). Detailed calculations of marine emissions can be referred to **Appendix 3.12**.

3.5.4.26 Emissions from the vessel manoeuvring are modelled as a series of "Point" sources in AERMOD. OLM is adopted for conversion of NO_x to NO_2, using the predicted O_3 and NO_2 levels from PATH model. According to EPD's "Guidelines on Choice of Models and Model Parameters", the industrial NO_2 emission is assumed to be 10% of NO_x. The overall modelling parameters are summarised in **Table 3.22** for ease of reference.

Far-field Source Contribution (i.e. Future Background Air Quality)

3.5.4.27 PATH (Pollutants in the Atmosphere and their Transport over Hongkong) is a regional air quality model developed by EPD to simulate air quality over Hong Kong against the Pearl River Delta (PRD) as background. It simulates wind field, pollutant emissions, transportation and chemical transformation and outputs pollutant concentrations over Hong Kong and the PRD region at a fine grid size of 1km.

3.5.4.28 PATH-2016 model is used to quantify the future background air quality. Far-field emission sources (i.e. all those outside 500m assessment area) including roads, marine, airports, power plants and industries within the Pearl River Delta Economic Zone and Hong Kong were considered in the PATH-2016 model. Details of the PATH-2016 model and related emission inventory can be found in EPD's website.

3.5.4.29 Emission from industrial activities, marine emissions and vehicular emissions are included in the PATH model. As a conservative approach, the hourly pollutant concentration data predicted by PATH for Year 2020 provided by EPD are directly adopted in the calculation of cumulative impact as a conservative assumption.

3.5.4.30 It is understood that FSP concentrations are not available from PATH model. According to EPD's "*Guidelines on the Estimation of FSP for Air Quality Assessment in Hong Kong*", the conservative corrections as shown in the following table are adopted to determine the background FSP concentrations.

Table 3.26 Conversion factors for RSP/FSP

Annual (μg/m^3)	Daily (μg/m^3)
FSP = 0.71 x RSP	FSP = 0.75 x RSP

Prediction of the Cumulative Operational Air Quality Impact

3.5.4.31 The cumulative operational air quality is a combination of the emission impacts contributed from the near field and far field sources (i.e. at local scale and background air quality impact from other concurrent and regional sources).

3.5.4.32 OLM is used for conversion of NO_x to NO_2 based on the O_3 level from PATH directly on an hourly basis. As a conservative approach, the OLM is applied separately to the following groups of emission sources:

- Group A – All open roads
- Group B – All emissions from industrial and marine sources (e.g. chimney emissions from TPIE and marine emissions)

3.5.4.33 In consideration of the number of exceedance allowance of the hourly and daily AQOs (refer to **Table 3.1**), the pollutant concentrations after the AQOs allowance limits (i.e. the 19th highest 1-hour NO_2 concentrations and 10th highest 24-hour RSP/ FSP concentrations) are determined at each ASR at 1.5m, 5m, 10m, 15m, 20m, 30m and 40m above local ground. The annual predicted concentrations are also assessed and all predicted levels are then compared with the AQOs.

Without Project Scenario

3.5.4.34 According to Appendix B Clause 5 (vii) of the Study Brief, the incremental air quality impact arising from the Project shall be calculated. In order to determine the incremental air quality impact from this Project in the assessment Year 2024, an additional assessment has been conducted for the without project scenario in the same year. Under this scenario, same methodologies as mentioned above the traffic forecast for without project have been adopted. EMFAC-HK is used to predicted the vehicular emission under the without project scenario and CALINE4 is adopted to assess the vehicular emission impact. Hourly pollutant concentrations from the PATH model is adopted as the background for the cumulative air quality impact.

Prediction of Odour Emissions

3.5.4.35 Three odour sources have been identified within 500m assessment area. As discussed in **Section 3.5.2**, only the committed FWPF and TPSTW are considered in the quantitative odour assessment.

A) Tai Po Sewage Treatment Works

3.5.4.36 Odour emissions are generated from the sewage treatment process inside the TPSTW, including the inlet works, wastewater treatment, and sludge treatment. The EIA study supporting the expansion works of TPSTW has been approved (AEIAR-081/2004) in Year 2004. Odour sources considered in the approved EIA and their associated emission information therefore have been referenced and directly used in this odour impact assessment.

3.5.4.37 In addition, a VEP application (VEP-434/2014) dated April 2014 has been submitted and approved to vary the design requirements of deodourisation units from those presented in the approved EIA, where the minimum odour removal efficiency has been improved from 99% to 99.95% in the VEP application. As such, the latest available information on the design of deodouriser will be adopted in this odour impact assessment. **Table 3.27** below summaries the odour emission sources and the mitigation measures to be adopted.

Table 3.27 Odour Emission Sources in TPSTW (Ref.: VEP-434/2014)

Stage	Facility	Mitigation Measures	Odour Emission
I / II	Inlet Pumping Station	Cover exposed area with Deodouriser (99% removal)	✓
	Flume Channel and Grid Removal	Cover exposed area	×
	Primary Sedimentation Tank	Cover all weir launders	✓
	Bioreactor	Nil	✓
	Final Sedimentation Tank	Nil	✓
	Sequence Batch Reactor	Nil	✓
	Return Activated Sludge Pumping Station	Cover exposed area	×
	Sludge Digestion Tank	Cover outlet chamber with Deodouriser (99% removal)	✓
	Sludge Gravity Thickener	Cover outlet chamber with Deodouriser (99.95% removal)	✓
	Sludge Consolidation Tank	Cover outlet chamber with Deodouriser (99.95% removal)	✓
	Screening Unit outside Dewatering House	Cover	×
	Sludge Pumping Station	Cover exposed area	×
IV	Inlet Pumping Station	Cover exposed area with Deodouriser (99% removal)	✓
	Grid Removal	Cover exposed area	×
	Screen House	Chemical Dosage to achieve 65% odour reduction	✓

Stage	Facility	Mitigation Measures	Odour Emission
	Primary Sedimentation Tank	Cover all weir launders and Chemical Dosage to achieve 65% odour reduction	✓
	Bioreactor	Nil	✓
	Final Sedimentation Tank	Nil	✓
	Sludge Digestion Tank Chamber	Cover with Deodouriser (99.95% removal)	✓
	Sludge Consolidation Tank	Cover with Deodouriser (99.95% removal)	✓

B) Committed Food Waste Pre-treatment Facilities

3.5.4.38 With reference to the Environmental Review Study for Food Waste Pre-treatment Facilities for Food Waste/ Sewage Sludge Anaerobic Co-Digestion Pilot Trial – Investigation, Design and Construction completed in Year 2016, all the potentially odourous facilities within the committed FWPF will be fully enclosed and negative pressure will be maintained to prevent foul air from escaping. An odour removal system (e.g. activated carbon type deodourisation unit) at the ventilation exhaust will also be provided to control the potential odour impact on nearby ASRs. The required odour removal efficiency of the proposed deodourisation units is estimated to be about 98%. The emission details of the committed FWPF are tabulated in **Table 3.28**.

Table 3.28 Details of odour emission from the committed FWPF

Parameter	Design
Maximum Height of Odour Emission Point	10m above ground
Maximum Odour Emission Point Diameter	0.77m
Minimum Exhaust Velocity	15m/s
Exhaust Temperature	25 °C
Operating Hour	8:00am – 6:00pm
Equivalent Maximum Allowable Odour Emission Limit	20 OU/m^3

3.5.4.39 Odour emissions are modelled as either “Area” or “Point” source in AERMOD. Grid-specific composite meteorological data, including hourly wind speed, wind direction, temperature, relative humidity, mean sea level pressure, cloud fraction and cloud base height, extracted from EPD’s PATH model will be pre-processed by AERMET. The mixing height estimated by AERMET was capped to between 121m and 1667m as per the real meteorological data. For the treatment of calm hours, the wind speed was capped at 1 m/s for wind speed from PATH which are lower than 1 m/s.

3.5.4.40 With reference to the TM-EIAO, the odour criterion is defined as 5 OU units based on an averaging time of 5 seconds. Hence, it is required to convert the predicted odour concentration in 1-hour averaging time from the AERMOD model to 5-second average. Reference is made to the peak-to-mean ratio stated in the “Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales” published by the Department of Environment and Conservation, New South Wales, Australia (NSW Approved Method). In accordance with the NSW Approved Method, the conversion factors for converting 1-hour average to 5-second average concentration are adopted directly as a conservative approach. The conversion factors for different types of source and stability classes are listed in **Table 3.29** below. However, given that the stability class is not included in the AERMOD model, hourly stability class has been estimated from the PCRAMMET model, and the hourly emission rate is multiplied by the conversion factor corresponding to the estimated stability class in order to predict the 5-second average odour concentrations. **Appendix 3.13** refers the odour emission inventories of committed FWPF as well as TPSTW.

Table 3.29 Conversion factors for 1-hour to 5-second averaged odour concentration

Stability Class	Near-Field Conversion Factor		Far-Field Conversion Factor [1]	
	Point (Surface wake-free)	Area	Point (Surface wake-free)	Area
A	12	2.5	4	2.3
B	12	2.5	4	2.3
C	12	2.5	4	2.3
D	25	2.5	7	2.3
E	25	2.3	7	1.9
F	25	2.3	7	1.9

Note: [1] With reference to the NSW Approved Method, far-field conversion factors are adopted as the separation distances between odour sources and the nearest ASRs are greater than 10 times the largest source dimension.

3.5.4.41 The overall modelling parameters are summarised in **Table 3.30** for ease of reference.

Table 3.30 Modelling parameters

Parameter	Input
Background Concentration	No
Modelling Mode	Urban
Terrain Effect	With terrain effect
Population	2,000 (Estimated from PlanD population projection data)
Land use	Specific for each PATH grid Refer to **Appendix 3.3** for surface characteristic parameters (e.g. Albedo, Bowen ratio, grid-specific surface roughness)
Meteorological Data	2010 hourly meteorological data adopted in PATH
Anemometer Height	9m

3.5.4.42 Since the Project would not contribute to any odour emissions in the surrounding, the assessment is aimed to evaluate the potential odour impact on the Project site alone. The cumulative odour impact is a combination of the contributions from TPSTW and the committed FWPF. Maximum 5-second odour concentrations at the Project at 1.5m, 5m and 10m above local ground are determined. Contours of odour concentrations at the worst affected height are also be plotted to illustrate the overall compliance of the criteria.

3.5.5 Assessment Results

Assessment Results (Criteria Pollutants)

3.5.5.1 The 19th highest 1-hour and annual NO_2 concentrations, and 10th highest 24-hour and annual RSP/FSP concentrations predicted under "with Project" scenario are presented in **Table 3.31**. Detailed results are presented in **Appendix 3.14** It can be seen from the table below that all the predicted NO_2/RSP/FSP concentrations are within the respective criteria.

Table 3.31 Cumulative NO_2, RSP and FSP concentrations (with project scenario)

ASR ID	Worst Hit Level (m)	Concentrations (μg/m³)					
		NO_2		RSP		FSP	
		19th High 1-hour Conc.	Annual Conc.	10th High 24-hour Conc.	Annual Conc.	10th High 24-hour Conc.	Annual Conc.
AQO		**200**	**40**	**100**	**50**	**75**	**35**
Existing ASRs							
A1	1.5, 5, 10	78	14	79	36	57	24
A2	1.5, 5	73	12	74	32	56	23
A3	1.5	107	18	75	33	56	24
A4	1.5	93	21	75	34	57	24
A9	1.5	121	20	75	33	57	24
A10	1.5	85	13	74	32	56	23
A11	1.5	70	11	74	33	56	23
A12	1.5, 10	91	17	76	33	57	24
A13	1.5	87	19	76	33	57	24
A14	1.5	103	17	75	33	56	23
Planned ASRs							
PA1	1.5	78	13	76	33	57	23
PA2	1.5	75	12	74	32	56	23
PA3	1.5, 5	76	13	80	35	57	24

3.5.5.2 For the all identified ASRs, all predicted concentrations at identified receivers are complied with AQO criteria.

3.5.5.3 In particular for PA1 and PA3, the 19th high 1-hour and annual NO_2 concentrations are comparatively lower than ASRs located within TPIE. Furthermore, all pollutant concentrations predicted at PA1 and PA3 are of similar levels with the closest residential area and those uphill (i.e. A1, A2, A10). Hence, no adverse air quality impact is anticipated at the Project Site and all other identified ASRs would not be adversely affected due to the operation of the Project.

3.5.5.4 With reference to the worst hit levels at concerned ASRs under operational phase assessment, they are mostly at 1.5m above local ground. Contours are therefore plotted at these levels and presented in **Figures 3.8a-3.8f**. Contour plots indicate that there are no air sensitive uses located within the area of exceedance, and hence air quality impact is not anticipated.

Incremental Air Quality Impact in Future Years

3.5.5.5 Pollutant contributions associated with the Project are generated from its induced traffic. By comparing the assessment results under "with" and "without" project scenarios, Project contribution in future year (i.e. Year 2024) could then be quantified.

3.5.5.6 According to the assessment results (for both with and without Project Scenarios) as summarised in **Tables 3.32**, maximum total changes on NO_2/RSP/FSP at existing and planned ASRs are all less than 1µg/m^3, which are considered relatively small as compared to the AQOs.

Table 3.32 Increments of NO_2, RSP and FSP concentrations due to the Project

ASR ID	Incremental of Concentrations (µg/m^3)					
	NO_2		RSP		FSP	
	19th High 1-hour Conc.	Annual Conc.	10th High 24-hour Conc.	Annual Conc.	10th High 24-hour Conc.	Annual Conc.
AQO	**200**	**40**	**100**	**50**	**75**	**35**
Existing ASRs						
A1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
A2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
A3	0.5	<0.1	<0.1	<0.1	<0.1	<0.1
A4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
A9	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
A10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
A11	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
A12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
A13	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
A14	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Planned ASRs						
PA2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Odour Assessment Results

3.5.5.7 The maximum 5-second odour concentrations are presented in **Table 3.34**. Besides, the odour concentrations at the entire Project Site would comply with 5OU criterion. **Figure 3.9** shows the contours of cumulative 5-second odour concentrations at the Project Site.

Table 3.34 Odour concentrations at Planned ASRs (Project Only)

ASR	Odour Concentrations	Criterion
PA1	<1 OU	5 OU
PA3	<1 OU	

3.5.6 Mitigation Measures

3.5.6.1 All the predicted criteria pollutant concentrations are in compliance with the AQO. Hence, no mitigation measures are required. Nevertheless, 99.5% odour removal efficiency deodouriser should be installed at the proposed SPS to minimise potential odour nuisance.

3.5.7 Evaluation of Residual Air Quality Impact

3.5.7.1 According to the operational air quality assessment result presented in **Section 3.5.5**, it is indicated that no adverse residual air quality impact during the operational phase is anticipated.

3.6 Conclusion

3.6.1 Construction Phase

3.6.1.1 Potential construction dust impact would be generated from site formation works, utility construction and road construction works, etc. during construction phase. Quantitative construction dust impact assessment has been conducted. Results have concluded that there will not be any adverse residual air quality impacts during construction phase given regular watering on all works area (i.e. once per hour during working hours).

3.6.2 Operational Phase

3.6.2.1 Quantitative operational air quality assessment has been conducted taking into account the vehicular emission impacts associated with the Project and nearby existing road network, industrial emissions from TPIE and in the vicinity of the Project Site, marine emissions associated with nearby cement depot cum concrete batching plants. Cumulative impact from far-field source contributions, including territory wide vehicular emission, power plants, marine emission, as well as regional emission from PRD, have also been taken into account. It is concluded that the predicted cumulative air quality impacts on all ASRs would comply with the AQOs during the operational phase, and hence adverse impacts are not anticipated.

3.6.2.2 Quantitative odour assessment has been conducted taking into account contribution from existing (i.e. TPSTW) and committed (i.e. FWPF) odour sources. Adverse odour impact is not anticipated at the Project Site.

3.7 Reference

[3-1] Environmental Protection Department (2016), Hong Kong Air Pollutant Emission Inventory (http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html)

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[3-3] Sun Y., Wang L.L., Wang Y.S. (2010) "In situ measurements of NO, NO_2, NO_y, and O_3 in Dinghushan (112°E, 23°N), China during autumn 2008", Atmospheric Environment 44 (2010), P2079-2088

[3-4] Environmental Protection Department, A Study to Review Hong Kong's Air Quality Objectives (http://www.epd.gov.hk/epd/english/environmentinhk/air/studyrpts/aqor_report.html)

[3-5] Environmental Protection Department (2017), Air Quality in Hong Kong 2015 (http://www.aqhi.gov.hk/api_history/english/report/files/AQR2016e_final.pdf)

[3-6] Environmental Protection Department (2003), Assessment of Toxic Air Pollutant Measurements in Hong Kong (http://www.epd.gov.hk/epd/english/environmentinhk/air/studyrpts/assessment_of_tap_measurements.html)

[3-7] European Monitoring and Evaluation Programme (2005), Sources of Poychlorinated Biphenyls Emissions (http://www.eea.europa.eu/publications/EMEPCORINAIR5/Sources_of_PCB_emissions.pdf/view)

[3-8] Environmental Protection Department (2015), Implementation Schedule of Vehicle Emission Standards in Hong Kong (http://www.epd.gov.hk/epd/sites/default/files/epd/Appendix%20III_HK%20std%20%2802-11-2015%29_EMFAC-HK%20%28V3.1%29.pdf)