3b. AIR QUALITY IMPACT (ARTIFICIAL ISLAND NEAR SKC)

3b.1 Introduction

3b.1.1.1 This section presents the assessment of the potential air quality impacts associated with the construction and operation phases of the IWMF located at the artificial island near SKC. A key environmental issue would be the cumulative aerial emission impacts in the vicinity of the IWMF. Other potential air quality impacts arising from construction dust emissions and odour emissions are also assessed.

3b.2 Environmental Legislation, Policies, Plans, Standards and Criteria

3b.2.1 Introduction

3b.2.1.1 The criteria for evaluating air quality impacts and the guidelines for air quality assessment are laid down in Annex 4 and Annex 12 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), respectively.

3b.2.2 Air Quality Objectives and EIAO-TM

3b.2.2.1 The Air Pollution Control Ordinance (APCO) provides a statutory framework for establishing the Air Quality Objectives (AQOs) and stipulating the anti-pollution requirements for air pollution sources. The AQOs, which must be satisfied, stipulate the maximum allowable concentrations over specific period for a number of criteria pollutants. The relevant AQOs are listed in **Table 3b.1**.

Table 3b.1 Hong Kong Air Quality Objectives

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

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

3b.2.2.2 The EIAO-TM stipulates that the hourly TSP level should not exceed 500 μgm^{-3} (measured at 25°C and one atmosphere) for construction dust impact assessment. Mitigation measures for construction sites are specified in the Air Pollution Control (Construction Dust) Regulation.

3b.2.2.3 In accordance with the EIAO-TM, odour at an air sensitive receiver should not exceed 5 odour units based on an averaging time of 5 seconds for odour prediction assessment.

3b.2.3 Air Pollution Control (Construction Dust) Regulation

3b.2.3.1 Notifiable and regulatory works are under the control of Air Pollution Control (Construction Dust) Regulation. Notifiable works are site formation, reclamation, demolition, foundation and superstructure construction for buildings and road construction. Regulatory works are building renovation, road opening and resurfacing slope stabilisation, and other activities including stockpiling, dusty material handling, excavation, concrete works etc. This Project is expected to include both notifiable works and regulatory works. Contractors and site agents are required to inform the Environmental Protection Department (EPD) on carrying out construction works and to adopt dust reduction measures to reduce dust emission to the acceptable level.

3b.3 Description of the Environment

3b.3.1.1 The artificial island near SKC is to be formed mainly by reclamation at the south-western coast of Shek Kwu Chau, an island located to the southwest of Cheung Chau and to the south of Chi Ma Wan Peninsula, Lantau Island. The artificial island near SKC would cover approximately 10 ha of reclaimed land. Shek Kwu Chau was granted to the Society for the Aid and Rehabilitation of Drug Addicts (SARDA) for use as a rehabilitation centre. There is no other existing or planned residential, commercial or industrial development on the island. A location plan of the IWMF at the artificial island near SKC is given in **Figure 1.2**.

3b.3.1.2 There is currently no EPD-operated air quality monitoring station located in the study area. Historical air quality monitoring data from the nearest station, namely the rooftop Tung Chung Station operated by EPD is taken to examine the historical trend of the air quality condition in the vicinity of the artificial island near SKC study area. **Table 3b.2** summarizes the annual average concentrations of the air pollutants recorded at the monitoring station from Year 2006 to Year 2010.

Table 3b.2 Annual Average Concentrations of Pollutants from Year 2006 to Year 2010 at EPD's Air Quality Monitoring Station (Tung Chung)

Pollutant	Annual Average Concentration ($\mu g/m^3$)				
	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010
RSP	56	54	52	46	45
SO_2	25	23	18	13	12
NO_2	47	46	49	45	44
CO	782	819	860	635	737
O_3	37	40	41	47	44

3b.4 Air Sensitive Receivers

3b.4.1 General

3b.4.1.1 In accordance with the criteria stipulated in the EIAO-TM, air sensitive receivers (ASRs) have been identified for this assessment. Domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping centre, place of public workshop, library, court of law, sports stadium or performing arts centre are classified as ASRs. Existing ASRs within the area of concern have been confirmed through site visits and review of the survey maps.

3b.4.1.2 Any other premises or place with which, in terms of duration or number of people affected, has a similar sensitivity to air pollutants as the aforelisted premises and places are also considered to be a sensitive receiver.

3b.4.1.3 Planned/committed ASRs within the area of concern have been reviewed with reference to relevant Outline Zoning Plans, Outline Development Plans, Layout Plans and other published plans.

3b.4.2 ASRs for Gaseous Pollutants Impact Assessment

3b.4.2.1 Representative ASRs are identified within the potential hot spot areas for the gaseous pollutants impact assessment based on the findings of the PATH (Pollutants in the Atmosphere and the Transport over Hong Kong) model results. The identification process is presented in **Section 3b.7.2**.

3b.4.3 ASRs for Odour Impact Assessment

3b.4.3.1 For odour impact assessment, one ASR is identified within 500m from the boundary of the artificial island near SKC namely Shek Kwu Chau Treatment and Rehabilitation Centre. In order to demonstrate the extent of the potential odour impact from IWMF to the receptor in its vicinity, the nearest ASR of the artificial island near SKC for odour impact, namely the Shek Kwu Chau Treatment and Rehabilitation Centre, is identified for the odour impact assessment. The representative ASRs for air quality impact assessment are shown in **Figure 3b.1** and listed in **Table 3b.3**.

Table 3b.3 Identified Air Sensitive Receiver for the Artificial Island near SKC (Odour Impacts)

ASR	Description	Nature of ASR (1)	Building Height, m	Ground level, mPD	Distance to Project Boundary, m
SKC1	Shek Kwu Chau Treatment and Rehabilitation Centre	G/IC	6	74.1	278

Note:
(1) G/IC –Government / Institution / Community

3b.5 Identification of Pollution Sources

3b.5.1 Construction Phase

3b.5.1.1 The major construction works of the Project would be site formation, construction of facilities, and construction of the access road. The major potential air quality impact during construction phase of the Project would be dust arising from:

- Reclamation works at the artificial island near SKC;
- Excavation and materials handling;
- Filling activities;
- Haul roads; and
- Wind erosion of open sites and stockpiling areas.

3b.5.1.2 The reclamation works at the artificial island near SKC would be mainly marine-based and would involve rocks and soil filling activities which may generate some fugitive dust emissions. However, since the filled area will be compacted shortly after the filling activities, fugitive dust emissions, if any, would be minimal. The construction activities would be undertaken at about +5mPD level. Given the large vertical separation distance of about 70m from the nearby ASR at about +75mPD, with the implementation of practicable dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, adverse construction dust impact during reclamation works at the artificial island near SKC is not expected.

3b.5.1.3 The construction dust generating activities would be those associated with site formation and building construction. Based on the preliminary design, the construction works would generate about 30,545m^3 construction and demolition materials in total, out of which, 3,476m^3 would be required to be disposed offsite. Therefore, extensive excavation and transportation of dusty material would not be required as part of this Project.

3b.5.1.4 With the implementation of practicable dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, adverse construction dust impact at the ASR is not expected during construction of the Project.

3b.5.2 Operation Phase – Gaseous Pollutants

3b.5.2.1 Aerial emissions from the IWMF chimney would be controlled to within the target emission levels, which is presented in **Section 3b.6** of this report. Apart from incineration emission, other emissions associated with the IWMF include emissions from marine vessels related to the operation of the IWMF.

3b.5.2.2 The major nearby pollutant emission source that would contribute to the cumulative air quality impacts at the identified ASRs is the Lamma Island Power Station located at about 12 Km away from the artificial island near SKC.

3b.5.3 Operation Phase – Odour Impacts

3b.5.3.1 Apart from the incineration emission, odour nuisance from the proposed on-site wastewater treatment plant, the waste reception halls, the waste storage area, the mechanical treatment processes of the sorting and recycling plant within the Project site would also be expected during the operation phase of the Project. There is no existing or planned odour emission sources identified in the surrounding area of the artificial island near SKC, cumulative odour impact during the operation phase of the IWMF at the artificial island near SKC is therefore not anticipated.

3b.6 Assessment Methodology

3b.6.1 Construction Phase

3b.6.1.1 The reclamation works at the artificial island near SKC would be mainly marine-based and would involve rocks and soil filling activities which may generate some fugitive dust emissions. However, since the filled area will be compacted shortly after the filling activities, fugitive dust emissions, if any, would be minimal. The construction activities would be undertaken at about +5mPD level. Given the large vertical separation distance of about 70m from the nearby ASR at about +75mPD, with the implementation of practicable dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, adverse construction dust impacts are not expected at the ASRs. Quantitative assessment is therefore considered not necessary.

3b.6.1.2 Audit and monitoring program during the construction phase of this Project has been formulated and is presented in the Environmental Monitoring and Audit Manual prepared under this study.

3b.6.2 Operation Phase - Gaseous Pollutants

<u>Emission Inventory</u>

Major emissions in close proximity to ASRs

3b.6.2.1 An inventory of major emissions in close proximity of less than 500m from the identified ASRs has been prepared based on information presented in relevant approved EIA reports as well as site survey and available records. These include mainly vehicle emissions from major roads and industrial stack emissions. For the purpose of this assessment, it is anticipated that emissions from these major emission sources will contribute to the future cumulative impacts in the assessment area.

3b.6.2.2 The emission inventory is presented in the second half of this sub-section together with the detailed modelling approach.

Chimney Emissions from the IWMF

Incineration Plant

3b.6.2.3 The key air pollutants of concern that are associated with the incineration plant of the IWMF are listed in **Table 3b.4**. The target emission levels of these air pollutants proposed for the incineration plant of the IWMF are listed in **Table 3b.4** and are equivalent to the concentration limits stipulated in "A Guidance Note on the Best Practicable Means for Incinerator (Municipal Waste Incineration) BPM 12/1(08)" published by the EPD except nitrogen oxides. For nitrogen oxides, the target emission levels for the IWMF would be set as half of respective concentration limits stipulated in BPM 12/1 (08), that is, daily average value of 100 mg/m^3 and half-hourly average value of 200 mg/m^3 (expressed as nitrogen dioxide). A table comparing the proposed target emission levels and other relevant overseas standards is shown in **Appendix 3.1**. The target emission limits of the IWMF will meet the stringent emission limits stipulated by the European Commission for waste incineration. The location of the emission is shown in **Figure 3b.2**.

Table 3b.4 Target emission levels

Air Pollutant	Target Emission Levels (mg/m^3) [(a)]	
	Daily	**Half - Hourly**
Particulates [(b)]	10	30
Gaseous and vaporous organic substances, expressed as total organic carbon	10	20
Hydrogen Chloride (HCl)	10	60
Hydrogen Fluoride (HF)	1	4
Sulphur Dioxide (SO_2)	50	200
Carbon Monoxide (CO)	50	100
Nitrogen Oxides (NO_X) as Nitrogen Dioxide (NO_2)	100	200
Mercury	0.05 [(e)]	-
Total Cadmium & Thallium	0.05 [(e)]	-
Total Heavy Metals [(c)]	0.5 [(e)]	-
Dioxins & Furans (in mg I-TEQ m^{-3})	$1x10^{-7}$ [(d)]	-

Notes:
(a) Emission limits are reference to 0^oC and 101.325 kPa, dry and 11% oxygen content conditions.
(b) The particulate emission limit is assumed to be RSP.
(c) Including Sb, As, Pb, Co, Cr, Cu, Mn, V and Ni.
(d) The averaging time is 6 to 8 hours.
(e) Average values over a sampling period of minimum of 30 minutes and maximum of 8 hours.

3b.6.2.4 The incineration plant consists of six incineration process units, each with a design capacity of 600 tonnes of MSW per day. During normal operation, only five incineration process units would be in operation while one incineration process unit would be shut down for regular maintenance. The total treatment capacity will be maintained at 3,000 tpd. The 6 flues connecting to the 6 incineration units are grouped as 2 chimneys (each consists of 3 flues) within one concrete windshield. The 2 chimneys are situated adjacent to each other at about 6m apart. Given the short separation of the 2 chimneys, the plumes emitted from the 2 chimneys would inevitably become a combined plume shortly after discharge. Therefore, for the purpose of the air quality modelling, all the IWMF chimney emissions were modelled as a single point of emission. The stack discharge parameter from the incineration plant is summarized in **Table 3b.5** and the details of the emission data are presented in **Appendix 3.2**.

Table 3b.5 Operation parameters of the Incineration Plant

Oxygen concentration of flue gas	6.1%
% moisture in flue gas	20.4%
Temperature of the flue gas	413K
Flow rate of flue gas	694,200Nm^3/hr
Exit velocity	15m/s
Total stack cross-sectional area	19.4m^2
Stack height	150m above ground

Marine Emissions associated with the IWMF

3b.6.2.5 The MSW collected at Island East Transfer Station (IETS), Island West Transfer Station (IWTS) & West Kowloon Transfer Station (WKTS) will be delivered to the IWMF using marine transportation. The marine vessels operation information and vessels emissions stated in the approved WENT Landfill Extensions EIA Report have been adopted for this assessment. By-products would be generated from the operation of the IWMF and will be containerized in containers and then transported by marine vessels to the berth at the WENT Landfill.

3b.6.2.6 The artificial island near SKC is only accessible by marine transport. Shuttle ferries between Cheung Chau and SKC for the staffs and visitors would be operated as necessary. The ferry frequency and detailed emission calculation are shown in **Appendix 3.3**. A summary of the inventory for marine emissions is summarised in **Appendix 3.4**.

<u>Modelling Approach</u>

General

3b.6.2.7 The assessment has been carried out in three stages as follows:

- Stage 1 – Terrain and building wake effects test for the selected stack height of the IWMF using wind tunnel model;
- Stage 2 – Identification of potential hot spot areas using PATH model; and
- Stage 3 – Cumulative air quality assessment for identified potential hot spot areas using PATH and Gaussian models (i.e. CALINE4 and ISCST3).

<u>Stage 1 – Terrain and building wake effects test for the selected stack height of IWMF using wind tunnel model</u>

3b.6.2.8 The purpose of the Stage 1 assessment is to determine and to verify that the selected stack height for the IWMF would not result in adverse terrain and building wake effects at the artificial island near SKC. Visualization of plume behaviour for various wind directions and speeds has been conducted to provide a qualitative understanding of the effect of the structures on the dispersion. This is to verify that the plume from the IWMF stack will not hit critical ASRs.

3b.6.2.9 Wind tunnel tests were conducted for various wind directions and wind speeds. These tests will define the wind directions where building and terrain wake effects are the most significant. Further wind tunnel tests were then conducted at the critical wind direction to determine the maximum concentration for the selected stack height at critical ASRs to verify that the selected stack height for the IWMF would not result in exceptionally high concentration at critical ASRs due to adverse terrain and building wake effects.

3b.6.2.10 The detailed technical aspects on conducting the wind tunnel tests are presented in **S3b.6.2.14** to **S3b.6.2.17**.

Stage 2 – Identification of the potential hot spot area by using PATH model

3b.6.2.11 The purpose of the Stage 2 assessment is to examine the cumulative air quality impacts at a territory-wide scale by using PATH model. Based on the predictions of the PATH model, potential hot spot areas and critical air pollutants of concern are identified for the detailed assessment by using both the PATH and the Gaussian models in Stage 3. The detailed modelling approach for PATH model is presented in **S3b.6.2.18** to **S3b.6.2.42**.

Stage 3 – Cumulative air quality assessment for identified potential hot spot areas using PATH and Gaussian models (i.e. CALINE4 and ISCST3)

3b.6.2.12 The purpose of the Stage 3 assessment is to examine the cumulative air quality impacts at the hot spot areas identified in the Stage 2 assessment. ISCST3 model and PATH model will be used to assess the chimney emission impact from the IWMF on the ASRs. CALINE4 model were used to simulate line sources including open road emissions within 500m of the ASRs. ISCST3 model was used to simulate other point, area and volume sources emissions within 500m of the ASRs.

3b.6.2.13 The future background concentrations for air pollutants are predicted by the PATH model. The PATH model output is added to the sum of the CALINE4 and ISCST3 model results sequentially on an hour-to-hour basis to derive the short-term and long-term cumulative impacts at the ASRs. The highest pollutant concentration predicted at an ASR amongst the 8760 hours (a year) is taken as the worst predicted hourly pollutant concentration for that ASR. The maximum 24-hour average pollutant concentration at an ASR is the highest predicted daily average concentration amongst the 365 days. The annual average pollutant concentration at an ASR is the average of 8760 hourly concentrations. The detailed modelling approach for CALINE4, ISCST3 and PATH models are presented in **S3b.6.2.43 to S3b.6.2.48**. A summary of the industry chimneys and vehicular emissions for CALINE4 and ISCST3 model are summarized in **Appendices 3.4** and **3.8**, respectively.

Physical Model - Wind Tunnel (for Stage 1 assessment)

3b.6.2.14 Wind tunnel simulations have been conducted such that concentration estimates under neutral, stable, and unstable conditions can be obtained for the IWMF site for the wind directions and wind speeds important to air pollution encountered in Hong Kong. Since wind tunnel simulations of stable and unstable conditions have a high degree of uncertainty due to Richardson number and Reynolds number scaling issues, all wind tunnel simulations have been conducted under neutral conditions.

3b.6.2.15 First, the concentration as a function of wind speed and wind direction is defined in the wind tunnel at all receptor locations of interest. Next this functional relation is used to estimate the hourly concentration levels at all receptors by applying a theoretical correction factor to the wind-tunnel predictions to account for plume buoyancy effects. Since the wind tunnel simulations are conducted under neutral stratification, a theoretical correction factor[1] to the wind-tunnel predictions have been applied to account for plume buoyancy and atmospheric stability effects under stable and unstable conditions.

3b.6.2.16 A scale model of the test site and surrounding to obtain concentration measurements out to 5 km has been constructed. A 1:1000 scale model of the IWMF and surrounding structures and terrain was also constructed. The model included all significant structures (i.e. structures whose critical dimension, lesser of height or width, exceeds 1/20th of the distance from the source) within a 1700 m radius of the center of the IWMF.

3b.6.2.17 Roughness elements, for positioning upwind and downwind of the turntable, have been constructed to represent the upwind roughness configuration. Flow conditioning devices, consisting of a 2-dimensional trip and spires, have been placed upwind of the model to aid in the development of the boundary layer. Stack was constructed of aluminium, plexiglass or brass tubes and have been supplied with a helium–hydrocarbon (or nitrogen-hydrocarbon) mixture of the appropriate density. Measures have been taken to ensure that the flow is fully turbulent upon exit. Precision gas flow meters have been used to monitor and regulate the discharge velocity. Receptors have been installed downwind of the stack for each wind direction evaluated.

Numerical Model – PATH (for Stage 2 & 3 assessment)

3b.6.2.18 PATH model was used to quantify the background air quality during operation phase of the Project. The commissioning time of the IWMF will be around in Year 2018 with maximum capacity build up in the commencement year. The emission sources including those in Pearl River Delta Economic Zone, roads, airport, power plants and industries within Hong Kong are all considered in the PATH model. The emission inventories for the PATH model are established based on the confirmed information and reasonable conservative assumptions. The details of the emission inventories are discussed as below. A summary of emission inventory is given in **Appendix 3.5**.

(a) Emissions within Pearl River Delta Economic Zone (PRDEZ)

3b.6.2.19 The Study of Air Quality in the Pearl River Delta Region conducted in Year 2000 had recommended various mitigation strategies to control and improve the regional air quality problems. In December 2003, the governments of Hong Kong Special Administrative Region (HKSAR) and Guangdong jointly drew up the Pearl River Delta Regional Air Quality Management Plan, with a view to meeting the emission reduction targets recommended in the Study of Air Quality in the Pearl River Delta Region. The Pearl River Delta Air Quality Management and Monitoring Special Panel have also been set up under the Hong Kong/Guangdong Joint Working Group on Sustainable Development and Environmental Protection to follow-up on the tasks under the Management Plan.

3b.6.2.20 A Mid-term Review Study on Pearl River Delta Regional Air Quality Management Plan was commissioned by EPD of HKSAR Government and the Guangdong Environmental Protection Bureau (GPEPB) in November 2006 to update the regional pollutant emission for 2003 and 2010 Control Scenario, as well as to review the effect of control measures committed by the governments.

3b.6.2.21 In addition, the Guangdong Province government also prepared the 珠江三角洲環境保護規劃 in June 2006 and PRC national plans (such as 深圳市城市總體規劃(1996-2010)) which also outlined the plan to control and reduce their emission up to 2020. With implementation of these measures, the resulted Year 2020 PRDEZ emission data are significantly lower than Year 2010 PRDEZ emission data from the Mid-term Review Study.

(1) Ronald L. Peterson, Ph.D., CCM, "Validation of method for direct use of wind tunnel modeling for regulatory modeling for modeling applications"

3b.6.2.22 In accordance with the Final Report for Review of Air Quality Objectives and Development of a Long Term Air Quality Strategy for Hong Kong Feasibility Study (AQO Review Report), Year 2015, 2020 and post-2020 emission inventories are developed based on the above emission data. Year 2015 inventory, which is estimated based on the interpolation from the emission inventory for Year 2010 from the Mid-Term Review and the Year 2020 inventory compiled from 珠江三角洲環境保護規劃, is the highest emission inventory among three scenarios. As stated above, the operation of the IWMF is expected to build up to the maximum capacity in the commencement Year. Therefore, Year 2015 emission inventory as presented in the AQO Review Report is considered a reasonable assumption for the PATH model.

(b) Emissions from Hong Kong International Airport

3b.6.2.23 The emissions from the operation activities at the Chek Lap Kok Airport are also considered in the PATH model. There are 6 key groups of emission sources, including aircraft movements, ground support equipment (GSE), auxiliary power units (APUs), engine run-up facility, fuel tanks and aircraft maintenance.

3b.6.2.24 In accordance with the Hong Kong - Zhuhai - Macao Bridge Hong Kong Boundary Crossing Facilities (HZMB-BCF) EIA Report, the emission inventory for aircraft movements were estimated based on the full operation capacity of the airport by Year 2020. The emission from GSE and APUs would be capped from 2020 onwards. The emissions from engine run-up facility and fuel tanks were also estimated based on the conservative assumptions. Therefore, as a conservative approach, Year 2020 emission inventories for the operation activities at the Hong Kong International Airport are used in the PATH model for this study.

(c) Emissions from Power Stations within HKSAR

3b.6.2.25 In accordance with the Administration's response to the follow-up actions arising from the "Subcommittee on Second Technical Memorandum for Allocation of Emission Allowances in Respect of Specified Licences" (Ref: CB(1)410/10-11(02)), the emission allowances for Year 2015 to be allocated to the respective power stations listed in **Table 3b.6** are used in PATH model for this study.

Table 3b.6 Allocated Emission Allowances for Year 2015

Power Stations	Allocated Emission Allowances (in Tonnes)		
	SO_2	**NOx**	RSP
Lamma Power Station and Lamma Power Station Extension	6,780	10,020	300
Black Point Power Station	1,440	4,140	110
Castle Peak Power Station	4,260	13,390	420
Penny's Bay Gas Turbine Power Station	2	2	1

(d) Industrial Sources / Biogenic Sources within HKSAR

3b.6.2.26 According to the prediction in the Study of Air Quality in the Pearl River Delta Region, there will be no significant increase in the biogenic emission in Hong Kong from Year 2000 to Year 2015 due to insignificant change in land use nature. This assumption is taken to remain valid for this assessment.

3b.6.2.27 The emissions from other industrial sources have also been considered in the PATH model. As the IWMF is expected to be operated in full capacity in Year 2015, estimation has been made by projecting from the emission level for 2010 in the Mid-Term Review to the emission level for Year 2015.

3b.6.2.28 Other specific emission sources have been updated based on their respective best available information. The specific industrial emission sources within HKSAR including Ecopark, Sludge Treatment Facilities, Green Island Cement Facilities, Existing WENT Landfill and its Extensions, Shiu Wing Steel Mill and Black Point Gas Supply Project are also considered in the PATH model and their emissions are based on the full capacity of their operation. Their emissions inventories are make reference to the respective approved EIA reports and their Specified Process Licence.

(e) Marine Emissions within HKSAR

3b.6.2.29 The emissions from marine vessels within HKSAR have also been considered by making reference to the AQO Review Report. With reference to the AQO Review Report, the marine traffic in Year 2030 should be higher than Year 2015. The adoption of the emission at Year 2030 is considered as conservative approach. The projected marine emission at Year 2030 is shown in **Appendix 3.6**.

3b.6.2.30 With regards to the potential emissions from the container terminals in the Kwai Tsing area, it is understood from the container terminal operators' press releases and other public documents that the operators have converted or planned to convert most of their diesel rubber-tyre gantry cranes (RTGC) to either electric or hybrid RTGC by 2010. With reference to the press releases from Modern Terminals Limited, it is expected to reduce the fuel consumption per each converted RTGC by nearly 40% after 2009. For the Hongkong International Terminals (HIT), they have a plan to convert 70% of RTGC to electric RTGC by 2010. In addition, the emissions of the proposed CT10, making reference to the Study on Hong Kong Port – Master Plan 2020 – Final Strategic Environmental Assessment – Part 2 (Port 2020 Study), have also been included in the model. The emission inventories for the marine vessels within HKSAR adopted in the PATH model are based on these assumptions.

(f) Vehicular Emissions within HKSAR

3b.6.2.31 EMFAC-HK model is adopted to estimate the vehicle emission rates and inventories of exhaust oxides of nitrogen and particulate matter. EMFAC-HK model have been conducted for 3 assessment years (Year 2015, 2020 & 2030) for each of the 18 HKSAR districts covered in the PATH model. The assessment years selected for the Project are in-line with the implementation years of different phases of air pollution control measures as presented in the AQO Review Study.

3b.6.2.32 The required traffic data for Years 2015, 2020 & 2030 was predicted by the 2006-based Base District Traffic Model (BDTM) traffic model. The 2006-based BDTM traffic model is recently developed by the Transport Department (TD) with the latest planning data and transport network. For part of the North Lantau area, an area-specific traffic impact assessment had been conducted and the predicted total traffic flow of some major roads in the North Lantau area for Year 2031 were presented in the HZMB-BCF EIA Report. A comparison of the total traffic flows for those major roads in North Lantau area as presented in the BDTM model and the HZMB-BCF EIA indicates that the traffic flows presented in the HZMB-BCF EIA are higher. For the sake of conservative assessment, the higher traffic flows data for those major roads as presented in the HZMB-BCF EIA for Year 2031 had been used to estimate the traffic flow for those major roads for different assessment years in the IWMF EIA. This approach would result in conservative estimates of vehicle emissions from those major roads in North Lantau for different assessment years to a different degree. The traffic data produced by the traffic model is in the form of 24-hour traffic flow with VMT, speed fraction and number of trips in 16 types of vehicle for 3 assessment years. The methodology to produce the abovementioned data has been agreed by the TD. For each district, the results of relevant core traffic counting station(s) reported in TD's Traffic Census were used to represent the general traffic pattern and vehicular grouping within the whole district. This methodology would have some limitations in representing the detailed traffic composition and traffic pattern on individual roads, yet given that the total traffic volume within the district would still be maintained, the small spatial variations of the total vehicle emissions are considered minimal and acceptable for this territory-wide study.

3b.6.2.33 For the purpose of PATH modelling, the estimated total vehicle emission for each district would be distributed over the road network surrogate in the respective district. For each district, EMFAC-HK model have been conducted for all roads covered by the traffic model as a whole. There are no separate EMFAC-HK model runs for different road types as different road types are currently not represented in the PATH model.

3b.6.2.34 However, for those districts identified with hot spot areas for the Project (namely Kwai Tsing District and Islands District), separate EMFAC-HK model runs for different road types (classified by post speed) as shown in the **Table 3b.7** below have been conducted to produce vehicle emission factors for different road types to be examined in the hot spots assessment. This is useful in representing the variation of vehicle emissions for different road types with different vehicle travel speeds in a local context.

Table 3b.7 Different road types for the hot spot areas

District	Road Types Exist
Kwai Tsing	1. Local Road (post speed 50kph) 2. Trunk Road (post speed 70-80kph) • Kwai Chung Road 3. Expressway (post speed >100kph) • Tsing Kwai Highway
Islands (i.e Lantau)	1. Local Road (post speed 50kph) 2. Trunk Road (post speed 70-80kph) • Airport Island 3. Expressway (post speed >100kph) • North Lantau Highway • Hong Kong-Zhuhai-Macau Bridge

3b.6.2.35 The vehicle population data (at the end Year 2008) published by EPD have been used for future assessment years in the EMFAC-HK model and TD has no objection on the use of published vehicle population data for EMFAC-HK model. For the hourly temperature and relative humidity profile, given the small variations of temperature and relative humidity profile between each district, the information provided by the Hong Kong Observatory (HKO) as recorded at the Hong Kong Observatory meteorological station (at Tsim Sha Tsui) have been adopted for all the EMFAC-HK model input. The key assumptions (including vehicle population, technology fractions, hourly temperature and relative humidity) for the EMFAC-HK model are shown in **Appendix 3.7**.

3b.6.2.36 The EMFAC-HK model cannot estimate the SO_2 emission and its emission factors for different vehicle types. With reference to the Guideline on Modelling Vehicle Emissions published by EPD, the calculation of the SO_2 emission and its emission factors is conducted in accordance with USEPA PART 5 programme. The equation is shown below:

$$ESO_2[g/km] = 1.96 \times (Sf/100) \times (Df \times 1000) \times (Ef/100)$$

Where

1.96 = factor to account for fraction emitted (0.98) (based on the assumption that 98% of the sulphur in fuel is emitted as SO_2 in accordance with USEPA PART5 program) and weight ratio of SO_2 to S (2.0)

Sf = fuel sulphur content (weight percent) = 0.005%

Df = density of fuel (0.745kg/L for gasoline and 0.832kg/L for diesel fuel)

Ef = vehicle fuel efficiency (L / 100km)

3b.6.2.37 The Efs for different types of vehicle are extracted from the Electrical and Mechanical Services Department (EMSD) Primary Indicator Values and listed in **Table 3b.8**. The calculated emission rate for SO_2 for different types of vehicles are summarized in **Table 3b.9**.

Table 3b.8 Fuel Efficiency

Vehicle Type	Gross Vehicle Weight (tonnes)	Fuel Efficiency (L per 100km) [1]
Heavy Goods Vehicles	24.01 – 38	61.1
Light Goods Vehicles (Diesel)	<2.5	10.2
Light Goods Vehicles (Diesel)	2.51-4	12.2
Light Goods Vehicles (Diesel)	4.01-5.5	18.6
Light Goods Vehicles (Petrol)	--	14.8
Private Car	Assume all engine size >3000cc	17.9

Note:
(1) Fuel efficiency data are extracted from EMSD's websites in early 2011. It is noted that the fuel efficiency data are subsequently updated in October 2011. The updated data show slight to moderate improvement of fuel efficiency for different vehicle types (about 3% to 24% reduction in fuel consumption). Therefore, the estimated vehicle SO_2 emission rates adopted in this EIA would be on the conservative side based on the updated fuel efficiency data.

Table 3b.9 Emission rate for SO_2 for different types of vehicles

Vehicle Types	Sf	Df	Ef	ESO_2 (g/km)
Petrol PC &LGV (Petrol)	0.005	0.745	17.9	0.0131
Diesel PC&LGV <2.5t	0.005	0.832	17.9	0.0146
Diesel LGV 2.5-3.5t	0.005	0.832	12.2	0.0099
Public Light Buses	0.005	0.832	18.6	0.0152
Diesel LGV >3.5t	0.005	0.832	18.6	0.0152
HGV<15t	0.005	0.832	61.1	0.0498
HGV>15t	0.005	0.832	61.1	0.0498
Double Deck Franchised Buses	0.005	0.832	61.1	0.0498
Motor Cycles (Petrol)	0.005	0.745	17.9	0.0131
Taxi	0.005	0.745	17.9	0.0131
Private Light Buses <3.5t	0.005	0.832	12.2	0.0099
Private Light Buses >3.5t	0.005	0.832	18.6	0.0152
Non-franchised Buses <6.4t	0.005	0.832	61.1	0.0498
Non-franchised Buses 6.4-15t	0.005	0.832	61.1	0.0498
Non-franchised Buses >15t	0.005	0.832	61.1	0.0498
Single Deck Franchised Buses	0.005	0.832	61.1	0.0498

3b.6.2.38 The worst emission year for vehicle emission have been taken as the year among the 3 assessment years with the highest total vehicle emissions from all 18 districts within HKSAR. The vehicle emission for this worst emission year (i.e. Year 2015) of major pollutants of NO_x and PM10 has been adopted in the PATH model. The calculated vehicle emissions for the entire territory of Hong Kong for different assessment years are summarized in **Table 3b.10**. A summary of vehicle emissions are shown in **Appendix 3.8**.

Table 3b.10 Total vehicle emission for different assessment years for the entire territory

Assessment Year	Tonnes per Year		
	SO_2	NO_x	PM10
Year 2015	202	7,953	545
Year 2020	226	6,633	361
Year 2030	232	4,961	259

Note:
In addition to the total vehicle emissions presented in the above table (and also in Appendix 3.8), the vehicle emission burden from TMWB Project (with tentative commencement at Year 2016) as extracted from the TMCLKL-EIA Report was also considered in the PATH emission inventory for cumulative impact assessment as presented in Appendix 3.5.

(g) Other Emission Sources

3b.6.2.39 The emissions from other emission sources (e.g. non-road mobile sources, VOC containing sources etc) within HKSAR have also been considered by making reference to 2030 emission inventory (without implementation measure) as mentioned in the AQO Review Report. Year 2030 emission inventory is expected to be higher than in Year 2015 as there is a positive growth factor in the forecast data.

(h) Non-criteria Pollutants

3b.6.2.40 Apart from the criteria air pollutants listed under AQO, there are some other toxic air pollutants that would be generated from the combustion process of the IWMF. These potential non-criteria air pollutants are listed as follows:

- Gaseous and vaporous organic substances, expressed as total organic carbon
- Hydrogen Chloride (HCl)
- Hydrogen Fluoride (HF)
- Mercury
- Cadmium
- Thallium
- Other heavy metals
- Dioxins & Furans

3b.6.2.41 These toxic air pollutants (except total organic carbon) have been simulated as unreactive particulates (PM2.5 or finer) under PATH. A unit of a particular (Tracer A) species of unreactive particulate was set to be emitted from the IWMF stack.

3b.6.2.42 The health risk effect (acute or chronic exposure) of non-criteria air pollutants from the IWMF was then estimated with the predicted concentration of Tracer A at individual ASR. The cumulative impact of non-criteria air pollutants from various nearby air pollution sources have been estimated from the combined dispersion effect and overall concentration of Tracer A plus other Tracers at individual ASR.

Numerical Model – CALINE4 (for Stage 3 assessment)

3b.6.2.43 For each hot spot, the traffic data of the road network covered by each hot spot area for Year 2015, 2020 & 2030 have been predicted by the BDTM model which is developed by TD. The methodology on the preparation of required traffic data have been agreed by the TD.

3b.6.2.44 The worst emission year for vehicle emission have been taken as the year among the 3 assessment years with the highest total vehicle emissions from the district where the hot spot locate. The vehicle emission for this worst emission year has been adopted in the local dispersion model(s) for that particular hot spot in the cumulative impact assessment.

3b.6.2.45 The calculated vehicle emissions for each hot spot area for different assessment years are summarized in **Table 3b.11**.

Table 3b.11 Total vehicle emission for different assessment years for each hot spot area

Hot Spot Areas	Parameter	Tonnes per Year		
		2015	2020	2030
Kwai Tsing	NOx	528.1	403.5	294.5
	RSP	43.3	26.2	18.5
North Lantau (1)	NOx	828.1(2)	562.4	426.3
	RSP	47.5(2)	23.9	18.3
South Lantau	NOx	8.5	3.5	2.5
	RSP	0.9	0.3	0.2

Note:
(1) The North Lantau hot spot area covers not only part of the Island District but also part of the Tsuen Wan District
(2) The tentative commencement date of the HZMB-BCF & TMCLKL Projects would be at Year 2016. For conservative analysis, the traffic flow at Year 2016 for the abovementioned project was considered in the assessment.

3b.6.2.46 The dispersion modelling has been conducted based on the meteorological data extracted from the PATH model. Ozone Limiting Method (OLM) was adopted for conversion of NO_x to NO_2 based on the predicted O_3 level from PATH. A tailpipe emission NO_2/NO_x ratio of 7.5% based on the EPD's "Guidelines on Choice of Models and Model Parameters" has been assumed. The NO_2/NO_X conversion was calculated as follows:

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

where

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

Numerical Model – ISCST3 (for Stage 3 assessment)

3b.6.2.47 The ISCST3 model assesses both criteria and non-criteria air pollutants concentrations at the ASRs. The impacts due to the IWMF and associated marine emission, other industrial chimneys and portal emissions within 500m of the ASRs have been predicted using the ISCST3 model. For the purpose of air quality modelling, the study area is classified as "Rural" in accordance with EPD's Guideline on Assessing the 'TOTAL' Air Quality Impacts and therefore "Rural" mode has been adopted in the model run. For other hot spot areas, depending on the land uses where the ASRs locate, the dispersion mode have been set to "Urban" or "Rural" accordingly. The emission inventory of industry chimneys emissions are summarized in **Appendix 3.4**.

3b.6.2.48 The dispersion modelling have been conducted based on the meteorological data extracted from the PATH model. Ozone Limiting Method (OLM) was adopted for conversion of NO_x to NO_2 based on the predicted O_3 level from PATH. The NO_2/NO_X conversion was calculated as follows:

$$[NO_2]_{pred} = 0.1 \times [NO_X]_{pred} + MIN \{0.9 \times [NO_X]_{pred}, \text{ or } (46/48) \times [O_3]_{bkgd}\}$$

where

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

3b.6.3 Operation Phase – Odour Impacts

3b.6.3.1 Odour nuisance may arise from the operation of the on-site wastewater treatment plant, the waste reception halls, the waste storage area and the mechanical treatment plant of the Project. The wastewater treatment plant, the waste reception halls and the waste storage areas would be fully enclosed and the odorous air in this facility would be extracted and used for combustion air of incineration to remove the odorous compounds. For the mechanical plant, they would be equipped with deodorizing units or odour filtration system. The odour removal efficiency of the deodorizing units would be 95%. Besides, the wastewater treatment plant, waste reception halls, waste storage area and the mechanical treatment plant would also be operated under a negative pressure to prevent odour leaking to the outdoor environment, adverse odour impact on nearby ASRs would not be expected.

3b.6.3.2 As the odour characteristics from the IWMF are similar to the MSW disposed at the tipping face at the landfill. The odour emission rate of the MSW was made reference to the approved EIA Report for North East New Territories (NENT) Landfill Extension for this assessment. The detailed emission rate and stack parameters adopted in the assessment are shown in **Appendix 3.9**.

3b.6.3.3 Air quality impacts of odour, mainly those residual odour emissions from the deodorizing units, on ASRs have been modelled with the ISCST3 model. MM5 hourly meteorological data were employed for the model run.

3b.6.3.4 The modelled hourly odour concentrations at the ASRs was converted to 5-second average odour concentration by the methodology proposed by Duffee et al.([2]) and Keddie([3]). In addition, Turner([4]) has identified that the Pasquill-Gifford vertical dispersion parameter used in the ISCST3 model is around 3 to 10 minutes. As a conservative assumption, the hourly average estimated by ISCST3 model is assumed as 15 minutes average, and the conversion factors for the predicted 1-hour averaged concentration of odour at the receivers would be adjusted to 5-second averaging time by the values shown in **Table 3b.12**.

Table 3b.12 Conversion Factors to 5 second Average Concentration

Pasquill Stability Class	Conversion Factor		
	15 min to 3 min	3 min to 5 sec	Overall
A	2.23	10	22.3
B	2.23	10	22.3
C	1.7	5	8.5
D	1.38	5	6.9
E	1.31	5	6.55
F	1.31	5	6.55

(2) Richard A. Duffee, Martha A. O"Brien and Ned Ostojic (1991). *Odor Modeling – Why and How, Recent Developments and Current Practices in Odor Regulation, Controls and Technology*, Air & Waste Management Association.
(3) Keddie, A. W. C (1980). *Dispersion of Odours, Odour Control – A Concise Guide*, Warren Spring Laboratory.
(4) Turner, D. (1994). *Workbook of Atmosphere Dispersion Estimates*, 2nd Edition, Lewis Publishers.

3b.6.3.5 With the installation of the proper deodorization units, the odour emissions from the IWMF would be limited and hence the potential odour impacts would likely be confined to the immediate vicinity of the IWMF site and the contribution of the IWMF odour emission on the cumulative odour impact to nearby ASRs would likely be minimal.

3b.7 Prediction and Evaluation of Environmental Impacts

3b.7.1 Construction Phase

3b.7.1.1 Construction activities at the IWMF will involve site formation works, superstructure works and installation of associated utilities facilities. Extensive excavation works is not expected. All the above activities are not expected to generate significant amount of construction dust.

3b.7.1.2 Control measures stipulated in the Air Pollution Control (Construction Dust) Regulation of Air Pollution Control Ordinance (APCO) should be implemented to ensure that construction impacts are controlled within the relevant standards described above. An environmental audit programme for construction phase has been devised to verify the effectiveness of the control measures so as to ensure proper construction dust control. With proper implementation of dust control measures, significant construction dust impacts at ASRs during the construction phase of the Project is not anticipated.

3b.7.2 Operation Phase - Gaseous Pollutants

Stage 1 – Terrain and building wake effects test for the selected stack height of the IWMF using wind tunnel model

3b.7.2.1 Wind tunnel test has been conducted for the selected stack height of the IWMF. The results confirmed that the proposed stack height would not result in exceptionally high concentration at critical ASRs due to adverse terrain or building wake effects. The physical model test report is shown in **Appendix 3.10**.

Stage 2 – Identification of the potential hot spot area by using PATH model

3b.7.2.2 The purpose of the Stage 2 assessment is to examine the cumulative air quality impacts at a territory-wide scale by using PATH model. Plots of the predicated cumulative air pollutant concentrations of NO_2, SO_2, RSP and CO in 1.5km x 1.5km grid cells with vertical level from 0 to 175m are extracted from PATH model and shown in **Appendix 3.11**.

3b.7.2.3 Besides, in order to examine the air quality impacts associated with the stack emissions of the IWMF alone, the differences between the PATH modelling results for two scenarios namely with and without IWMF stack emission were calculated on a hour by hour basis for one of the key air pollutant namely NO_2. The worst-case hourly, worst-case daily, and the annual contribution of the IWMF stack emission on the cumulative NO_2 concentrations over the Hong Kong territory were calculated and presented in the form of concentration plots in **Appendix 3.11**. Tables listing the worst-case hourly, worst-case daily, and the annual contribution of the IWMF stack emission on cumulative NO_2 concentrations at hot spot areas are also presented in **Appendix 3.11**.

3b.7.2.4 Based on the predictions from the PATH model, higher IWMF contributions are identified at ASR locations at Shek Kwu Chau, Cheung Chau, South Lantau Island and part of North Lantau Island areas whereas localised high cumulative concentrations of NO_2 and RSP are predicted at North Lantau Island and Kwai Tsing areas. These areas are considered as potential hot spot areas for further examination under the Stage 3 assessment.

3b.7.2.5 For SO_2, the predicted 1-hr average, daily average and annual average SO_2 concentration at territory-wide scale are all less than 63% of the respective AQO. In view of the relatively low predicted concentrations and the adoption of low-sulphur and ultra-low-sulphur fuel under the existing government policy, SO_2 would not be a critical air pollutant of concern. For CO, the predicted 1-hr average and 8-hr average concentration at territory-wide scale are relatively small (about 20% of the respective AQO) in quantity compared with the respective AQO. For ozone, the IWMF project itself will not generate ozone. The formation of ozone involves a complex interaction between a large number of chemical substances such as NOx and VOC when meteorological conditions (e.g. sunlight, temperature) "favour" such interaction. Therefore, ozone is not directly generated by the project. The ozone formation by photochemical reaction would take several hours and anticipated that ozone recorded in HKSAR would be attributed to VOC and NOx emissions generated from place afar. The NOx generated from the project would quickly react with the ozone in the background to form NO_2. The predicted NO_2 concentration would be presented in this EIA report. Therefore, only NO_2 and RSP are covered under the Stage 3 assessment.

3b.7.2.6 The representative ASRs within the hot spot areas listed in **Section 3b.7.2.4** are identified and tabulated in **Table 3b.13**. The locations of the ASRs are shown in **Figure 3b.1**.

Table 3b.13 Identified Air Sensitive Receivers for the Artificial Island near SKC (Gaseous Pollutants)

ASR	Description	Nature of ASR (1)	Building Height, m	Ground level, mPD	Distance to Project Boundary, m
SKC1	Shek Kwu Chau Treatment and Rehabilitation Centre	G/IC	6	74.1	278
SL1	Cheung Sha	R	9	34.8	5557
SL2	Tong Fuk	R	9	14.0	7113
SL3	Sea Ranch	R	12	24.0	3001
CC1	Ying Sin Leung Care Village	R	6	16.0	3605
CC2	Round Table 3rd Village	R	6	40.0	4039
CC3	Nga Ning Court - Leung Chak House	R	12	45.9	4504
CC4	Horizon Villa	R	9	15.0	5023
TC1	Caribbean Coast Block 1	CDA	141	7.5	11428
TC2	Caribbean Coast Block 16	CDA	153	6.8	11245
TC3	Ling Liang Church Sau Tak primary School	G/IC	21	6.4	11196
TC4	Yu Tung Court - Hor Tung House	R	108	9.3	10890
TC5	Tung Chung Crescent Block 9	R	129	11.1	11275
TC6	Yat Tung Estate - Hong Yat House	R	105	9.7	10498
AP1	Chek Lap Kok Fire Station	C	9	7.5	12646
AP2	Gate Gourmet Catering Building	C	30	6.7	13116
AP3	DHL Central Asia Hub	C	30	5.4	13124
AP4	Regal Airport Hotel	C	90	5.3	14584
AP5	SkyCity Nine Eagles Golf Course	C	-	6.2	14264

ASR	Description	Nature of ASR (1)	Building Height, m	Ground level, mPD	Distance to Project Boundary, m
AP6	SkyCity Nine Eagles Golf Course	C	-	6.2	14057
AP7	SkyCity Nine Eagles Golf Course	C	-	6.2	14319
AP8	Terminal 2 Sky Plaza	G/IC	25	6.4	14213
SLW1	Sha Lo Wan House No.1	R	9	5.0	13421
SLW2	Tin Hau Temple at Sha Lo Wan	R	9	4.9	13404
SLW3	Tin Sum	R	9	5.7	12242
KT1	Block 6, Lai King Estate	R	42	40.1	22376
KT2	Block 7, Lai King Estate	R	66	40.1	22306
KT3	Lai King Home	R	12	40	22301
KT4	Hong Chi Winifred Mary Cheung Morninghope School	G/IC	6	38.5	22359
KT5	Lai Hong House, Ching Lai Court	R	135	25	22249
KT6	Princess Margaret Hospital	G/IC	30	38.9	22388
KT7	Lai Chi Kok Park Stage III	G/IC	-	7.6	22380
KT8	Hoi Yin House, Hoi Lai Estate	R	108	5.9	22563

Notes:
(1) R – Residential; G/IC – Government / Institution / Community; CDA - Comprehensive Development Area

Stage 3 – Cumulative air quality assessment for identified potential hot spot areas using PATH and Gaussian models (i.e. CALINE4 and ISCST3)

3b.7.2.7 The predicted cumulative NO_2 and RSP concentrations at the representative ASRs within the identified hot spot areas using PATH and Gaussian models are summarized in **Appendix 3.12**. The hourly and/or daily and annual average contour plots for NO_2 and RSP at 1.5m above ground are presented in **Figures 3b.3 to 3b.7**. From the contour plots, exceedances of the hourly NO_2 of 300µg/m^3 are predicted in Airport Island at 1.5m above ground. However, no existing or planned ASR is identified within these predicted exceedance areas. The modelling results indicated that the predicted cumulative concentrations of NO_2 and RSP at all representative ASRs would comply with the respective AQO.

3b.7.2.8 The other potential air pollutants (individual chemicals) covered in Annex 1 of EPD's "A Guidance Note on the Best Practicable Means for Incinerator (Municipal Waste Incineration) BPM 12/1(08)" are identified as non-criteria air pollutants. The predicted short-term and long-term concentrations of these non-criteria air pollutants and their health impacts are assessed in **Section 9b** of this EIA Report.

3b.7.3 Operation Phase – Odour Impacts

3b.7.3.1 Odour level at the nearest representative ASR for odour impact, namely Shek Kwu Chau Treatment and Rehabilitation Centre, is predicted and the assessment result is shown in **Table 3b.14**. The modelling results indicated that the predicted odour impact at the nearest ASR for odour impact would be well below EIAO-TM's odour criteria of 5 OU based on an averaging time of 5 seconds. The predicted odour level of 0.04 OU at the nearest ASR due to IWMF emissions is well below 1 OU, i.e. not detectable by most of the population. Odour impacts from the Project is therefore not expected.

Table 3b.14 Predicted Odour Levels at the ASR

ASR	Description	Odour Level (5 seconds average) (OU) at 1.5m above ground
SKC1	Shek Kwu Chau Treatment and Rehabilitation Centre	0.04

3b.8 Mitigation Measures

3b.8.1 Construction Phase

3b.8.1.1 To ensure compliance with the guideline level and AQO at the ASRs, the Air Pollution Control (Construction Dust) Regulation should be implemented and good site practices should be incorporated in the contract clauses to minimize construction dust impact. A number of practicable measures are listed below:-

- Use of regular watering, with complete coverage, to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather.
- Use of frequent watering for particularly dusty construction areas and areas close to ASRs.
- Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering should be applied to aggregate fines.
- Open stockpiles should be avoided or covered. Where possible, prevent placing dusty material storage piles near ASRs.
- Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.
- Establishment and use of vehicle wheel and body washing facilities at the exit points of the site.
- Provision of wind shield and dust extraction units or similar dust mitigation measures at the loading points, and use of water sprinklers at the loading area where dust generation is likely during the loading process of loose material, particularly in dry seasons/ periods.
- Imposition of speed controls for vehicles on unpaved site roads. Ten kilometres per hour is the recommended limit.
- Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs.
- Instigation of an environmental auditing program to monitor the construction process in order to enforce controls and modify method of work if dusty conditions arise.

3b.8.2 Operation Phase

3b.8.2.1 Air pollution control and stack monitoring system will be installed for the IWMF to ensure that the emissions from the IWMF stacks will meet the proposed target emission limits that is more stringent than those stipulated in Hong Kong and the European Commission for waste incineration. According to the assessment results, all the representative ASRs would comply with the AQO limit and thus no further mitigation measure would be required.

3b.8.2.2 To ensure the compliance of odour criteria at the sensitive receptors in the vicinity of the IWMF, all the potential odour emissions associated with the operation of the IWMF namely those from wastewater treatment plant, the waste reception halls, the waste storage area, the mechanical treatment plant should be collected and destroyed by the incineration process or ventilated to deodorizer before discharge to the atmosphere.

3b.9 Residual Environmental Impact

3b.9.1 Construction Phase

3b.9.1.1 With the implementation of the mitigation measures as stipulated in the Air Pollution Control (Construction Dust) Regulation, and with the adoption of good site practices and audit, no adverse residual dust impact is expected.

3b.9.2 Operation Phase

3b.9.2.1 With the implementation of practicable air pollution control and stack monitoring system for the IWMF, emissions from the IWMF stacks will meet the proposed target emission limits that is more stringent than those stipulated in Hong Kong and the European Commission for waste incineration and no adverse residual air quality impact due to IWMF stack emission is expected.

3b.9.2.2 With the implementation of recommended odour mitigation measures, no adverse residual odour impact would be expected at the nearby ASRs.

3b.10 Environmental Monitoring and Audit Requirements

3b.10.1 Construction Phase

3b.10.1.1 With the implementation of practicable dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, adverse construction dust impact is not expected during construction of the Project. Yet, regular site environmental audits during the construction phase of the Project as specified in the EM&A Manual should be conducted to ensure that the recommended dust suppression measures are implemented properly.

3b.10.2 Operation Phase

3b.10.2.1 During the operation of the IWMF, the potential sources of air quality impacts would be the air emissions from the stacks of incineration process and the odour nuisance from the the waste reception halls, the waste storage area, the mechanical treatment plant. Air pollution control and stack monitoring system will be installed for the IWMF to ensure that the emissions from the IWMF stack will meet the stringent target emission limits and all the potential odour emissions associated with the operation of the IWMF will be collected and destroyed by the incineration process or ventilated to deodorizer before discharge to the atmosphere. Monitoring of air quality parameters of concern due to stack emissions has to be conducted in accordance with the requirements similar to those stipulated in the "A Guidance Note on the Best Practicable Means for Incinerator (Municipal Waste Incineration) BPM 12/1(08)". Besides, odour monitoring should be carried out by odour patrol to demonstrate the effectiveness of the proposed odour mitigation measures and to ensure the odour impact can be minimized to meet the air pollution control requirements.

3b.11 Conclusion

3b.11.1 Construction Phase

3b.11.1.1 Air quality impacts from the construction works for the Project would mainly be related to construction dust from excavation, materials handling, filling activities and wind erosion. With the implementation of mitigation measures specified in the Air Pollution Control (Construction Dust) Regulation, dust impact on air sensitive receivers would be minimal.

3b.11.2 Operation Phase

3b.11.2.1 During the operation of the IWMF, the potential sources of air quality impacts would be the air emissions from the stacks of incineration process and the odour nuisance from the waste reception halls, the waste storage area and the mechanical treatment plant.

3b.11.2.2 Air pollution control and stack monitoring system will be installed for the IWMF to ensure that the emissions from the IWMF stacks will meet proposed target emission limits that is more stringent than those stipulated in Hong Kong and the European Commission for waste incineration. Besides, all the potential odour emissions associated with the operation of the IWMF will be collected and destroyed by the incineration process or ventilated to deodorizer before discharge to the atmosphere.

3b.11.2.3 With the implementation of practicable air pollution control, the cumulative air quality impact assessment results shows that all the air sensitive receivers in the vicinity of the Project site would comply with the Air Quality Objectives (AQOs).

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