Appendix 12.1 – Documentation of Key Assessment Assumptions, Limitation of Assessment Methodologies and related Agreement(s) with the Director

1 Introduction

The following sections provide a summary of the key assessment methodologies, assumptions, limitations and prior agreements with relevant Government Departments where applicable, that was adopted in the preparation of the EIA report.

2 Air Quality Impact

2.1 Summary of Assessment Methodology

The assessment of construction phase and operation phase air quality impact from the Project has followed the criteria for evaluating air quality impacts include the following:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499.S16), EIAO-TM, Annexes 4 and 12;
- Air Pollution Control Ordinance (APCO) (Cap. 311) and the Air Quality Objectives (AQO);
- Air Pollution Control (Construction Dust) Regulation;
- Control of Air Pollution in Car Parks (ProPECC PN 2/96);
- Practice Note on Control of Air Pollution in Vehicle Tunnels, and;
- Guidance Note on the Best Practicable Means for Cement Works (Concrete Batching Plant) BPM 3/2

Air quality impact assessment was carried out for all areas within 500m from the proposed WKCD development boundary.

Construction Phase

All identified sources of potential air quality impacts were assessed. The need for mitigation measures to reduce any identified adverse impacts in air quality to acceptable levels was determined.

The key air pollutant of concern from the construction activities is total suspended particulate (TSP). During construction, the major activities that would generate construction dust emissions include the following:

- Excavation activities;
- Foundation works;
- Concrete batching plant and barging points (assumed to be handed over from the XRL project to WKCD);
- Site Formation, and;
- Movement of mobile plant and vehicles on haul roads.

Construction dust was modelled using the Fugitive Dust Model (FDM). The hourly, daily and annual average TSP concentration at representative discrete ASRs were predicted using a Tiered approach. The emission rates for different construction activities considered were based on the USEPA AP42.

The average TSP concentration of 68.4 $\mu g/m^3$, is adopted as the representative background TSP level of the assessment area for construction phase air quality assessment purpose.

Operation Phase

Sources of potential air quality impacts in operation phase were identified and their impact significance was determined.

During the operation phase, air quality impacts on the ASRs due to vehicular emissions were assessed from:

- Existing and proposed open roads outside the WKCD area but within the 500 m assessment area;
- Proposed underpasses/landscape decks along the Austin Road West and Lin Cheung Road and the associated top openings under the Road Works at West Kowloon project, which is within the 500 m assessment area;
- Portal of the existing Western Harbour Crossing (WHC) which is in the vicinity of the WKCD site, and;
- Ventilation exhausts and portals serving the planned underground roads within the WKCD area.

EMFAC-HKV2.5.1 was adopted to calculate the fleet average emission factors for 2015, 2020, 2025 and 2030 based on the diurnal traffic forecast for such years in order to identify the worst case year when the total road traffic emission is the highest. The West Kowloon Reclamation Traffic Model (WKRTM) was used to provide the traffic predictions for the EIA by converting the WKRTM traffic flows into 24 hours traffic data. WKRTM was developed under the TD 54/2008 WKRDTS, which has been properly calibrated and validated under the TD54/2008 Study and had been fine-tuned and adopted for XRL WKT project for MTRC and accepted by TD. WKRTM has been further updated to incorporate the updated trip volumes under the latest WKCD Development Schedule & Phasing. The updated model was used to provide the traffic predictions for the WKCD Project to ensure compatibility with the Government's and MTRC's studies.

Portal emissions were modelled in accordance with "*Permanent International Association of Road Congress Report" (PIARC, 1991)*.

Existing marine activities within the 500 m assessment area, which include:

- Fast ferry traffic movements, based on scheduled sailings, of up to 170 daily movements (ferry going to is one movement, ferry leaving is a second movement) at the China Ferry Terminal;
- Tugs associated with Derrick lighter barge movements in the NYMTTS;
- Derrick lighter barges operating at the New Yau Ma Tei Public Cargo Working Area (NYPCWA), and;
- Ocean Cruise Ship berthing at the Ocean Terminal.

The cumulative air pollutant concentrations from marine and traffic sources at ASRs were predicted using CALINE4 and ISCST3 model. The predicted values from the CALINE4 and ISCST3 are added together with the background pollutant concentrations.

Background pollutant concentrations extracted from PATH (2015) were used. Background pollutant concentrations extracted from PATH (2020) were used for those planned ASRs that will be in operation from 2020 onwards

The Ozone Limiting Method (OLM) as described in *EPD's Guidelines on Choice of Models and Model Parameters* has been adopted to estimate the conversion of NO_x to NO_2 from both marine and vehicular emissions.

The NYMTTS is located adjacent to the north of the WKCD site. Odour emissions from NYMTTS were measured and then modelled using ISCST3. The predicted 1-hour average concentrations of odour at the receivers were converted to 5-second averaging time in accordance with the method adopted in the Kai Tak Development Study.

2.2 Key Assessment Assumptions Adopted in this EIA Study

Assumptions on construction methods have also been made as the actual construction would be subject to any change made at the detailed design stage.

Appendix 12.1 – Documentation of Key Assessment Assumptions, Limitation of Assessment Methodologies and related Agreement(s) with the Director

Construction Phase

The locations of assumed dust sources are given in **Figures 3.3a** to **3.3k** of the EIA report. The key dust emission factors adopted in FDM are summarised in **Table 1** below.

The number of working days for a month and number of working hours per day of the project are anticipated to be 26 days and 12 hours respectively.

For the mitigated scenario, the active construction areas have ground watering applied once per hour or 12 times per day. This gives rise to dust suppression of 91.7%, as estimated in **Appendix 3.8** of the EIA report. The unmitigated scenario does not employ any watering for dust suppression.

For the concrete batching plant, it is assumed that the plant will be handed over from the XRL project to the WKCD Project, and therefore the emissions from the plant will be the same as those given in the approved EIA for XRL. All assumptions and calculations are extracted from the Specified Process (SP) License issued to the XRL for the concrete batching plant. The concrete batching plant and haul roads within the site are modelled as having operation hours of 12 hours per day, that is, from 7:00 am to 7:00 pm.

No stockpile is modelled as excavated material is anticipated to be transported out of the site immediately after generation. Barging points are assumed to be handed over from the XRL project to the WKCD Project, and therefore the emissions from the plant will be the same as those given in the approved EIA for XRL.

The emission inventory and calculation of emission factors for the construction activities are detailed in **Appendices 3.1 to 3.3** of the EIA report**.**

Table 1: Key Dust Emission Factors Adopted in the Assessment

Activities	Emission Factors	Reference
Heavy construction activities including all above ground and open construction works, excavation and slope cutting works	2.69 Mg/hectare/month	Section 13.2.3.3 AP-42, 5th Edition
Wind erosion from heavy construction	0.85 Mg/hectare/year	Table 11.9-4 AP-42, 5th Edition
Paved haul road within concrete batching plant	Emission Factor = $k \times (sL)^{0.91} \times (W)^{1.02}$ g/VKT where k is particle size multiplier * sL is road surface silt loading W is average truck weight	Section 13.2.1 AP-42, 5th Edition (Jan 2011 edition)

* The particle size distribution was made reference to Section 13.2.1(Table 13.2.1-1) of the USEPA Compilation of Air Pollution Emission Factors (AP-42), 5th Edition (Jan 2011 edition).

The background pollutant values adopted for this assessment are derived based on EPD's *Guideline on Assessing Total Air Quality Impacts*. TSP background level of 68.4 μg/m^3, is adopted as the representative background TSP level of the assessment area for construction phase air quality assessment purpose

Cumulative concurrent projects that may contribute to construction dust impacts were identified and assessed as follows.

Table 2: Summary of concurrent projects during construction phase

Project	Construction Period	Possible Cumulative Impact	Included in Cumulative Impact Assessment
Hong Kong Section of the Guangzhou – Shenzhen – Hong Kong Express Rail Link (XRL)	Jan 2010 – 2015	Dust emissions from construction of the West Kowloon Terminus and operation of the concrete batching plant and barging points	Yes

Road Works at West Kowloon	2011 – 2014	According to the EIA, major dusty construction activities and excavation works are to be completed by March 2012. Minor dust emissions may arise from the remaining road works and movement of mobile plant and vehicles	No
Road Improvement Works in West Kowloon Reclamation Development – Phase I	Late 2013 / early 2014 – end 2015	Dust emissions from the roadworks construction and movement of mobile plant and vehicles	Yes
Central Kowloon Route	2015 – end 2020	Dust emissions from construction works.	Yes

Operation Phase

Open Road Emissions

For all the planned and existing roads within the 500 m assessment area including those planned underpass roads within WKCD site and the proposed CKR, the EMFAC-HK V2.5.1 model (I and M), which is the latest version at the time of preparing this report, has been used to determine the fleet average emission factors.

The Burden mode, used for calculating area-specific emission factors, has been selected in the model. Under this mode, the total emissions of pollutants such as RSP and NO_x were computed for each type of vehicle class based on temperature, relative humidity, speed corrected emission factors and vehicle activity. Hourly output was selected.

To provide the traffic predictions for the EIA, the WKRTM traffic flows were converted into 24 hours traffic data (16-vehicle classes) by the following steps:

- conversion of model PV/GV/Preload traffic flows from pcu unit into vehicle unit;
- split of PV/GV/Preload traffic flows into 16-vehicle classes based on surveyed vehicle compositions and the vehicle licensed number obtained from EPD; and,
- derivation of traffic flows outside AM/PM peak hours based on the ATC data.

The WKRTM was developed in years 2016, 2021, 2026 and 2031. The traffic impact assessment was conducted in the design years 2020 and 2031 for WKCD Phase 1 and Full/Phase 2 development. As the design years (i.e. 2015, 2020, 2025 and 2030) required for EIA input are slightly different from the developed WKRTM, the method of linear interpolation of traffic forecasts from WKRTM was adopted to provide traffic forecasts for EIA purpose. For year 2015 traffic forecasts required for EIA, it was directly extracted from WKRTM (year 2016) and assumed to be the same as year 2016 traffic flows for conservative approach.

The predicted traffic flows have taken into account the development of the four concurrent projects, namely: Road Works at West Kowloon; Road Improvement Works in West Kowloon Reclamation; the Hong Kong Section of the XRL, and; Central Kowloon Route (CKR).

The whole sets of diurnal traffic forecast results for the various road links within the assessment area for 2015, 2020, 2025 and 2030 are in **Appendix 3.10**. TD has no objection in principle to the traffic data. The daily forecasted traffic flows along the main roads including Western Harbour Crossing, Austin Road West and Canton Road (i.e. at the three sides of WKCD) are highlighted below for reference:

Location / Year	Two-way Daily Forecasted Traffic Flows (vehs/day)			
	2015	**2020**	**2025**	**2030**
Western Harbour Crossing	107,000	115,000	123,000	129,000
Austin Road West	29,000	35,000	40,000	42,000

Canton Road	33,000	38,000	44,000	45,000

Remark: All number round up to the nearest thousand.

The emission standards, according to the latest implementation programme (as of November 2012) have been adopted in EMFAC-HK V2.5.1 model for vehicles registered in Hong Kong. In this model, the latest European Union (EU) emission standard, Euro VI, for all vehicle classes can be applied, with the exception of motorcycles which do not have applicable new EU emission standards.

The road links for assessment have been grouped into five types. Emission factors for the following five road types have been calculated:

- Road Type 1 - Expressway (Design speed limit: 100kph);
- Road Type 2 - Trunk Road (Design speed limit: 80kph);
- Road Type 3 - Trunk Road (Design speed limit: 50kph);
- Road Type 4 - Local Roads (Design speed limit: 50kph), and;
- Road Type 5 - Trunk Road (Design speed limit: 70kph).

The five road types are characterised by continuous and interrupted flow with different design speed limits. It is assumed that there is continuous traffic flow in Expressway and Trunk Roads (Road Types 1, 2, 3 & 5), whereas there is interrupted flow in Local Roads (Road Type 4). The road type classification of individual road links in the assessment area are as shown in **Figures 3.5.1a** to **3.5.1y.** Road Type 5 is associated with the CKR and will not be present in 2015 or 2020, but will be present in 2025 and 2030, as CKR is anticipated to be in operation in 2021.

Vehicles operating on open roads have been categorised into 16 vehicle classes according to the *Guideline on Modelling Vehicle Emission – Appendix I* for EMFAC-HK V2.5.1.

Vehicle classes are grouped with different exhaust technology indexes and technology fractions. Each technology group represent a distinct emission control technologies. The EMFAC-HK V2.5.1 model has a set of default exhaust technology fractions which best represents the scheduled implementation of new vehicle emission standards as of November 2012. As there is no update to the planned emission control measures since the release of the guideline in November 2012, the default exhaust technology fractions are considered to be applicable in this assessment.

According to the *Guideline on Modelling Vehicle Emissions,* the vehicle population forecast function in EMFAC-HKV2.5.1 used 2010 as the base year. Natural replacement of vehicles and a set of annual growth rates and survival rates for different vehicles are assumed for 2011 to 2040. In particular, vehicles including private cars, motorcycles, and goods vehicles are assumed to grow by a varying percentage (from 0% - 2.5% annual) during the period whereas the number of franchised buses, public light buses and taxis are assumed to have no growth.

There have been some minor policy change from April 2012 to November 2012. The changes include moving two diesel taxis (TAXI) to the private car (PC) category and moving 4 LPG Private light buses (PV4) to the PV5 category. These changes, however, are considered to be insignificant and therefore have been excluded from the assessment. The default populations from the April 2012 population information have been adopted for the model years (2015, 2020, 2025, and 2030). The vehicle age distributions, in the base year 2010, are presented in **Appendix 3.11** for reference.

The use of electric vehicles (EVs), which do not have tailpipe emissions, has been promoted by the government in the recent years. As a conservative approach, this assessment does not take into account the presence of EVs and any programme on the promotion of EVs.

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Default values and compositions have been adopted with reference to in the EMFAC-HKV2.5.1 Guideline.

For each vehicle class, the Vehicle Kilometres Travelled (VKT) of individual hours is calculated by multiplying the hourly number of vehicles with the length of the corresponding road link (in kilometres). Diurnal (24-hour) traffic pattern has been provided by Traffic Consultant. The lengths of individual road links of the connecting road are given in **Appendix 3.12**. The 24-hour VKT values for all vehicle classes in each of the model years 2015, 2020, 2025 and 2030 together with a graphical plot, are provided in **Appendix 3.13**.

The daily trips were used to estimate the cold start emissions of the petrol and LPG vehicles only, as is prescribed by the model. Therefore, trips for vehicles other than petrol or LPG type vehicles would be assumed to be zero. Different road types have different number of trips as follows.

Zero trips are assumed in Expressway and Trunk Roads since there will be no cold start under normal circumstances. For Local Roads, the number of trips in the assessment area, $Trip_{\text{within assessment area}}$, has been estimated as:

$$Trip_{\text{within assessment area}} = (Trip_{\text{within HK}}/VKT_{\text{within HK}}) \times VKT_{\text{within assessment area}}$$

$Trip_{\text{within HK}}$ is the default data of EMFAC-HKV2.5.1 model. $VKT_{\text{within HK}}$ is the VKT of local roads in Hong Kong, which is estimated based on the default VKT data of EMFAC-HKV2.5.1 model and the relevant data as published in the *Annual Traffic Census 2010* by TD. Details of the trip estimation are as shown in **Appendix 3.14**. According to the Mobile Source Group of EPD, the default VKT and trips in the model are based on EPD's estimated data for Hong Kong. $VKT_{\text{within assessment area}}$ is calculated as mentioned above. The trips in each year are provided in **Appendix 3.13**.

While the number of trips is dependent on vehicle population, no project-specific vehicle population data can be identified for the assessment area according to the Traffic Consultants. However, project-specific VKT has been estimated based on the traffic forecast in the assessment area. Moreover, it can be argued that VKT is related to vehicle population in such a way that a higher vehicle population would generally result in a higher VKT. As a result, it has been proposed to estimate the number of trips in the assessment area on the basis of the project-specific VKT and the assumption that the number of trips per VKT in the assessment area would be similar to the number of trips per VKT in Hong Kong. It is considered that this proposed approach is based on best available data and reasonable assumption. This approach for estimating the number of trips together with the results of estimation has been submitted to TD for review. TD has no objection in principle to the method

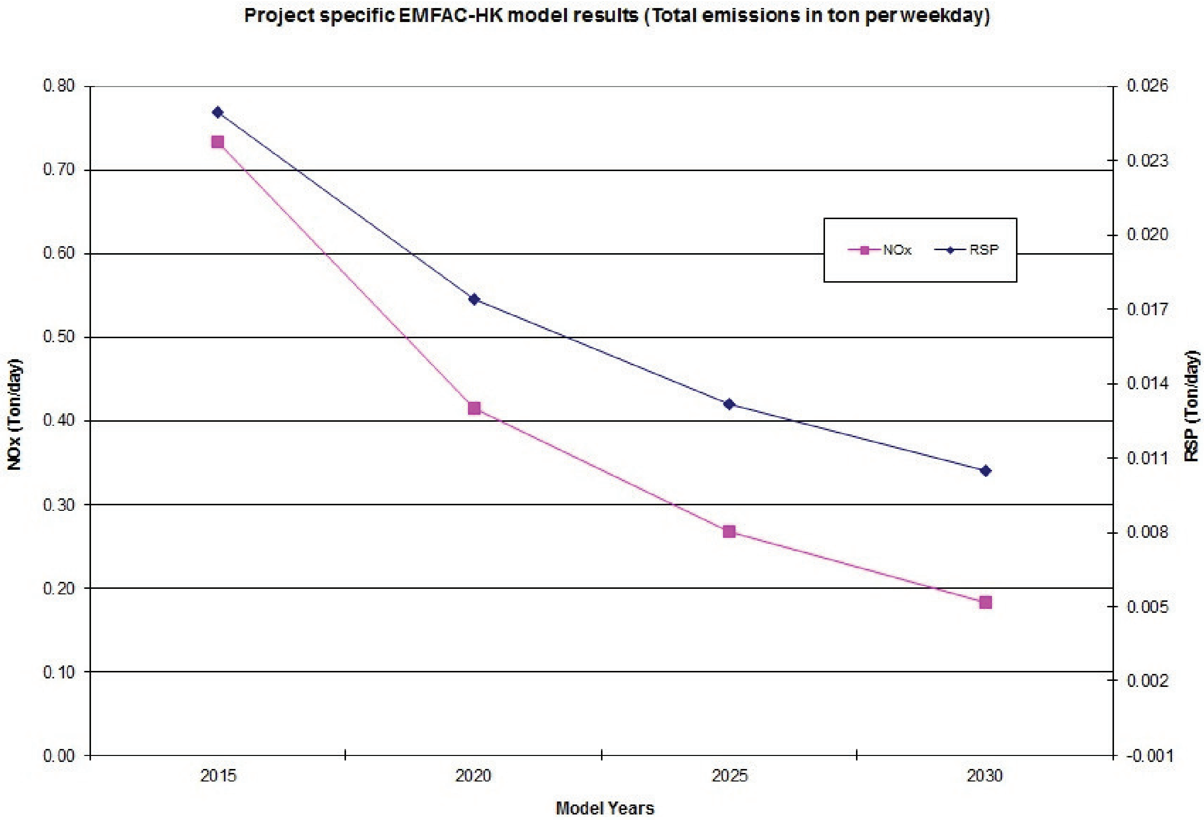
Annual and monthly hourly average ambient temperature and relative humidity obtained from the meteorological data as extracted from the 2010 HKO's King's Park meteorology station (with at least 90% valid data) have been adopted. The 24-hour variations of the annual averages of temperature and relative humidity are presented graphically in **Appendix 3.15**.

The 24-hour speed fractions for different road types and individual vehicle classes are provided by the Traffic Consultant, and are calculated based on the 24-hour traffic flow in each model year and the volume/capacity ratio of different road types. For each vehicle class, the VKT of each road link was grouped into sub-groups with speed bins of 8 km/h (0 - 8 km/h, 8 - 16 km/h, 16 - 24 km/h, etc.). The speed fraction of each sub-group was derived by the summation of the total VKT of road link within this sub-group divided by the total VKT of all road links. The estimated speed fractions provided by the Traffic Consultant are given in **Appendix 3.16**.

The maximum speed for Heavy Goods Vehicles, Franchised Buses and Non-franchised Buses has been restricted to 70 km/h and for Public Light Buses to 80 km/h.

To determine the emissions with 15 years after commencement of the Project, emission rates were modelled for years 2015, 2020, 2025 and 2030. Upon modelling with EMFAC-HKV2.5.1, the emissions for each vehicle class at different hours are then divided by the corresponding VKT to obtain 24-hr emission factors in grams/vehicle-kilometre (g/veh-km). The calculations of emission factors for each model year are shown in **Appendix 3.17**. By comparing the total emissions in different model years as shown in **Graph 1**, year 2015 represents the worst case scenario where the total emission is the highest among all model years.

Graph 1: Comparison of RSP and NOx EMFAC results for 2015, 2020, 2025 and 2030



The emission factors of this worst case year 2015 have been used for the prediction of air quality impacts due to vehicular emissions in order to arrive at conservative impact assessment results.

Although the planned commencement year of operation of the Project has been updated from 2015 to 2017, use of the emission factors in 2015 represents conservative emissions for the assessment. This is because the total traffic emission in year 2017 is anticipated to be lower than that in year 2015 as illustrated in **Graph 1**.

Based on the worst case emission factors and the 24-hour traffic flow in 2015, the composite fleet emission factors have been calculated for the road links within the assessment area, as detailed in **Appendix 3.23**., which were input to the CALINE4 model to predict the air quality impact from open road emissions. By adopting the traffic forecast in 2020, the composite fleet emission factors have also been calculated for the road links, as detailed in **Appendix 3.24**, for input to CALINE4 These emission factors have been used to refine the NO_2 modelling results for those planned ASRs that will be in operation from 2020 onwards.

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Ventilation Exhausts/Portals Serving WKCD Basement

The basement will be ventilated through stacks; however the proportion released through stacks and through the portals cannot be determined until a comprehensive ventilation study is carried out during the detailed design phase. Two scenarios were therefore considered for the ventilation of the WKCD basement:

- Scenario I – 100% of the vehicle emissions generated within the basement is ventilated through a series of stack exhausts and 0% through the basement entry and exit points. The exhausts are assumed to be attached to buildings within the WKCD and were modelled as 6 m tall point sources with an exit air velocity of 2.0 m/s. The stack diameter was dependant on the ventilation area.
- Scenario II – 100% of the vehicle emissions generated within the basement is ventilated through the basement entry and exit points and 0% through a series of stack exhausts. It has been broadly assumed that the emissions would be evenly distributed among the three entry/exit points to approximate this scenario. Therefore, one third of the total basement emissions were assumed to be emitted from the western portal near the western tunnel, one third through the eastern portal onto Austin Road West and one third through the northern portal onto Austin Road West.

The basement entry and exit point are not treated as a standard portal as the traffic does not exit directly from the portal, that is the vehicles come to a T-intersection at the entry and exit point for Location A and C as shown in **Figure 3.6**. The entry and exit points are modelled as volume sources based on the dimensions of the opening.

A single stack is used at approximately the horizontal centre of the proposed louvre area to allow the greatest flexibility in the final stack location.

The Practice Note ADM-2 recommends MTR ventilation exhausts shall be located not closer than 5 m to any opening such as an openable or fixed window, doorway, building ventilation system intake or exhaust and the like in any building irrespective of whether such vent shaft is freestanding or is accommodated in a building. This basis has been used to adopt a minimum stack height of 6 m.

Underpasses/landscape decks along the Austin Road West and Lin Cheung Road and the associated top openings

Portals and similar openings are modelled as volume sources according to the Permanent International of Road Congresses (PIARC) *XIXth World Road Congress Report*. Using the recommended guideline the following situations were considered:

- Scenario 1 - 10% of tunnel emissions released through short top openings, the remainder released through the tunnel portal;
- Scenario 2 - 20% of tunnel emissions released through short top openings, the remainder released through the tunnel portal;
- Scenario 3 - 30% of tunnel emissions released through short top openings, the remainder released through the tunnel portal, and;
- Scenario 4 - Maximum emissions according to PIARC recommendations (which are dependant on top opening lengths – 66% of emissions through top opening if the length is 50m and 100% through top opening if the length is 100m), the remainder of emissions which are not released through the top opening are released through the tunnel portal.

By adopting the traffic forecast in the worst case year of 2015, the emission rates for Scenarios 1 to 4, with 100% of the WKCD basement emission through its portals (Scenario II) are given in **Appendix 3.18a – Appendix 3.18d** whereas the emission rates for Scenarios 1 to 4, with 100% of the WKCD basement emissions through its stack exhausts (Scenario I) are given in **Appendix 3.18e – Appendix 3.18h**. All scenarios were modelled to determine the worst case effects.

By adopting the traffic forecast in 2020, the emission rates for the combination of Scenario I and Scenario 1 are also estimated, as presented in **Appendix 3.19**. Based on the comparison of the modeling results for all eight combinations of Scenarios I & II with Scenarios 1-4 for the worst case year of 2015, the results for different combinations differ by quite a small amount (less than 2%) and yet the combination of Scenario I with Scenario 1 tends to give relatively more conservative results. Therefore, this combination has been used to estimate the emission rates for year 2020, which are then used to refine the NO_2 modelling results for those planned ASRs that will be in operation from 2020 onwards (see **Section 3.6.2**).

EMFAC-HKV2.5.1 model results and the traffic modelling data from the Traffic Consultants were used to generate the inputs for use in ISCST3.

Existing WHC Portal

The portal emissions are modelled according to EPD's *Guidelines on Choice of Models and Model Parameters*, which recommends portals and similar openings are modelled as volume sources according to the PIARC *XIXth World Road Congress Report*. Details of the assumptions are in **Appendix 3.18a – Appendix 3.18h** and **Appendix 3.19**.

New Yau Ma Tei Public Cargo Working Area (NYPCWA)

The estimated emission rates are summarised in **Table 3** below and details of the estimation are given in **Appendix 3.25** of the EIA report.

Table 3: Estimated Emission Rates of Barges at NYPCWA

Pollutant	Vessel type	Estimated Emission Rates
NOx	Barge	0.0799 g/s for each barge
	Tug	2.30×10^{-6} $g/m^2.s$ for each tug
RSP	Barge	0.0022 g/s for each barge
	Tug	8.81×10^{-8} $g/m^2.s$ for each tug
SO2	Barge	0.0136 g/s for each barge
	Tug	6.07×10^{-7} $g/m^2.s$ for each tug

China Ferry Terminal

The estimated emission rates are summarised in **Table 4** below and details of the estimation are given in **Appendix 3.25** of the EIA report.

Table 4: Estimated Emission Rates of Fast Ferries at China Ferry Terminal

Pollutant	Mode	Estimated Emission Rates
NOx	Berth	0.12 g/s for each ferry*
	China Ferry - Transit	8.84×10^{-6} $g/m^2.s$ for each ferry
	Macau Ferry - Transit	1.01×10^{-5} $g/m^2.s$ for each ferry
RSP	Berth	0.004 g/s for each ferry*
	China Ferry - Transit	2.79×10^{-7} $g/m^2.s$ for each ferry
	Macau Ferry - Transit	3.21×10^{-7} $g/m^2.s$ for each ferry
SO_2	Berth	0.026 g/s for each ferry*
	China Ferry - Transit	1.88×10^{-6} $g/m^2.s$ for each ferry
	Macau Ferry - Transit	2.15×10^{-6} $g/m^2.s$ for each ferry

*Assumed to last for 30 minutes during each hour of operation

Ocean Terminal

Based on a visual survey and information on the Star Pisces website the height of the stacks was assumed to be 50 metres. The estimated emission rates are summarised in **Table 5** below and details of the estimation are given in **Appendix 3.25** of the EIA report. No emissions for vessels sailing to and from the terminal were estimated or modelled as this is considered to be adequately covered by the PATH model and is outside the 500 m assessment area.

Table 5: Estimated Emission Rates of Cruise Ships at Ocean Terminal

Pollutant	Vessel	Estimated Emission Rates (g/s)
NOx	Day-time ship	12.97
	24-hour ship	14.55
RSP	Day-time ship	1.88
	24-hour ship	1.97
SO_2	Day-time ship	7.62
	24-hour ship	7.62

Odour

The odour impacts on WKCD from the NYMTTS and the surrounding sea water within the 500 m assessment area are modelled and assessed under the following three scenarios:

- Background odour scenario
- Current odour scenario
- Mitigated odour scenarios A and B

Background Odour Scenario

Under this scenario, all the grids of NYMTTS are assumed to be generating sea water odour. This is considered as the background sea water odour levels even if there were no malodour emissions from the entire NYMTTS, representing the lowest possible odour levels at WKCD.

Current Odour Scenario

Under this scenario, all the grid cells of NYMTTS were modelled using the OER estimated based on the odour source monitoring and review results (see **Appendix 3.26c** of the EIA report). This represents the potential current odour impacts on WKCD due to both odour emissions from NYMTTS and sea water odour emissions from the surrounding marine environment.

Mitigated Odour Scenarios A and B

Two mitigated scenarios have been adopted:

Mitigated Scenario A: The amount of effluent discharges or organic matters entering the NYMTTS via both Box Culverts would be reduced. Four assumed ratios of reduction in organic matters to reduction in water-bound odour emissions, i.e., 1:1, 1:0.75, 1:0.5 and 1:0.25, have been modelled.

Mitigated Scenario B: The amount of effluent discharges or organic matters entering the NYMTTS via the Cherry St Box Culvert would be reduced. Four assumed ratios of reduction in organic matters to reduction in water-bound odour emissions, i.e., 1:1, 1:0.75, 1:0.5 and 1:0.25.

2.3 Limitations of Assessment Methodologies / Assumptions

FDM, ISCST3 and CALINE4 used in the EIA are all Gaussian based dispersion models, which have limited ability to predict dispersion in the following situations:[1]

- Causality effects

  Gaussian plume models assume pollutant material is transported in a straight line instantly (like a beam of light) to receptors that may be several hours or more in transport time away from the source. The model takes no account for the fact that the wind may only be blowing at 1 m/s and will have only travelled 3.6 km in the first hour. This means that Gaussian models cannot account for causality effects, where the plume may meander across the terrain as the wind speed or direction changes. This effect is not considered to be significant for the WKCD site as the site is small.

- Low wind speeds

  Gaussian-plume models ‘break down’ during low wind speed or calm conditions due to the inverse speed dependence of the steady state plume equation. These models usually set a minimum wind speed of 0.5 m/s or 1.0 m/s and ignore or overwrite data below this limit.

- Straight-line trajectories

  Gaussian models will typically overestimate terrain impingement effects during stable conditions because they do not account for turning or rising wind caused by the terrain itself. This effect is not considered to be important for WKCD as the site and surrounding terrain is flat.

- Spatially uniform meteorological conditions

  Gaussian models assume that the atmosphere is uniform across the entire modelling domain, and that transport and dispersion conditions exist unchanged long enough for the material to reach the receptor even if this is several kilometres away. In the atmosphere, truly uniform conditions rarely occur. As the WKCD site and surrounding assessment area is sufficiently small with no significant terrain features, uniform meteorological conditions are considered appropriate.

- No memory of previous hour’s emissions

  In calculating each hour’s ground-level concentrations, Gaussian models have no memory of the contaminants released during the previous hours. This limitation is especially important for the proper simulation of morning inversion break-up, fumigation and diurnal recycling of pollutants.

Odours from different sources can undergo various phenomena, one of which is masking, whereby the presence of one odour can disguise, or mask, the presence of a second. Different odorants may also interact. This can cause interactive or ‘synergistic’ effects, such that the sum of the odorants may be either greater than or less than the intensity of the odour components. In practice, odours from significantly different sources and with different characters are usually neither additive nor synergistic, but instead one source tends to dominate, or mask, the presence of the other.

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[1] *Good Practice Guide for Atmospheric Dispersion Modelling.* Ministry for the Environment, New Zealand (June 2004)

Dispersion models assume a conservation of mass of contaminants, that is the odour intensity of a mixture of two different odorous sources are considered to be additive. Odour modelling is not able to predict synergistic or masking effects, and to that effect, modelling a pleasant and offensive odour source in parallel would produce one overall 'odour' intensity, which would not be representative of, the different hedonic tones of the individual odours, the relative decrease in intensity of the individual odours or the potential for one odour to mask the other.

Sea-water has a neutral tone and is generally considered to be non-offensive, and is assumed to be masked by the presence of H_2S, however as Annex 4 of the EIAO-TM does not allow for a differentiation between the types of odours, the emissions for all grids have been modelled in parallel.

2.4 Prior Agreements with the Director or other Authorities

The methodology adopted for the traffic forecast used in the EMFAC-HK modelling has been agreed by TD (Letters dated 3 April 2012, Ref.: PR 120/195/02 and dated 2 July 2013, Ref.: TD PR-182/232/2). Approval for the Fleet Average Emission Factors, detailed calculations of the air pollutant emission rates for input to the modelling and the specific modelling details, and use of the Ozone Limiting Method (OLM) or Discrete Parcel Method (DPM) or other method is required. An email from EPD (dated 15 May 2013) has advised that the detail of the air quality modelling is agreed

3 Noise Impact

3.1 Summary of Assessment Methodology

The assessment of construction phase and operation phase noise impact from the Project has followed the criteria of the following technical memoranda (TM) and/or legislations:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499)
- Noise Control Ordinance (NCO)
- TM on Environmental Impact Assessment Process (EIAO-TM)
- TM on Noise from Construction Work other than Percussive Piling (GW-TM)
- TM on Noise from Construction Work in Designated Areas (DA-TM)
- TM for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM).

Noise impact assessment was carried out for all areas within 300m from the proposed WKCD development boundary. The first layer of both existing and planned noise sensitive receivers was selected for assessment.

Construction Phase

Assessment approach to the noise impact is in line with the Guidance Note titled "Preparation of Construction Noise Impact Assessment under the Environmental Impact Assessment Ordinance" (GN 9/2010).

In addition, the assessment of construction noise impact was based on standard acoustic principles, and the guidelines given in GW-TM issued under the NCO where appropriate. Where no sound power level (SWL) could be found in the relevant TM, reference was made to BS 5228 Part 1:2009 or noise emission levels measured for PME used in previous projects in Hong Kong.

For the cumulative noise impact during construction phase, concurrent projects outside of the 300m study area and unavailable information during the writing of this report were not taken into account.

Operation Phase

Road traffic Noise

Road traffic noise levels at the representative assessment points was calculated based on the peak hour traffic flow within a 15 years period upon commencement of operation of the Project. Traffic noise was predicted using the model "RoadNoise". The model has fully incorporated the procedures and methodology documented in "Calculation of Road Traffic Noise (CRTN)" (1988) published by the U.K. Department of Transport.

The planned noise sensitive use facades within WKCD may have potential road traffic noise impact from major roads surrounding WKCD. As the PM peak hour traffic flows of those dominant surrounding road links are higher than that during the AM peak hour, the PM peak hour traffic flow was adopted in the assessment. In addition, the potential noise road traffic noise impact from the proposed flyover to existing sensitive receivers was also assessed. Where exceedance of the relevant road traffic noise criteria was predicted, direct noise mitigation measures were considered. In case the proposed direct noise mitigation measures could not be implemented due to site constraints and other uncertainties, indirect noise mitigation measures have also been considered.

Other than the existing road sections paved with low noise surfacing, the extent of low noise road surfacing, barriers and semi-enclosures proposed in the Road Works at West Kowloon project have also been considered in the unmitigated scenario of the road traffic noise impact assessment.

Fixed Plant Noise

In the absence of any detailed information and noise specification for the proposed fixed plant, the maximum permissible noise emission levels at the shaft/ exhaust openings was determined for future detailed design of the fixed plant. This was determined by adopting standard acoustics principles.

For those fixed plant noise sources falling within the view angle of the NSR but with no direct line of sight to the opening, a 5 dB(A) attenuation would be applied. For the case where the NSR has with no direct line of sight to the source/opening which is located on the other side of the building or completely blocked by other building(s), a 10 dB(A) attenuation would be applied. If the noise sources do not fall within the view angle of the representative NSR under assessment, it is assumed that these noise sources are insignificant to that NSR. However, these noise sources are still taken into account in the assessment for conservative approach but a 10 dB(A) attenuation would be applied.

For those existing fixed plant noise sources, the design information were made reference to the relevant approved EIA Reports or obtained from the relevant authorities. Site visits and noise measures were carried out to determine the locations of the fixed sources and regarding sound power levels where information was not available. The noise impact from these sources would then be assessed with the use of the same methodology as stated above for the planned sources.

Open Air Entertainment Activities Noise

The potential noise impact from the open air entertainment activities at the NSR was assessed quantitatively with reference to noise measurement results of a former outdoor event held in WKCD and determined by adopting standard acoustics principles.

Ground-borne Rail Noise

Three underground railways were identified for ground-borne noise assessment, namely Express Rail Link (XRL), Kowloon Southern Link (KSL) and Airport Express and Tung Chung Line (AEL/TCL).

The XRL EIA Report (AEIAR-143/2009) was made reference to as the railway is under construction during the preparation of this EIA study and no measurements could be conducted.

Vibration level from the rail pass-by was measured at various locations to determine the likely vibration and to establish the worst case scenario from KSL and AEL/TCL. All measurements were taken at the foundations of selected buildings either near the rail alignments or with direct coupling to the railway tunnels. The measurements were also conducted during PM peak hours of a normal weekday when the loading of the train shall be at the high side to predict the worst case scenario. Additionally, it was ensured that no construction works of XRL was in progress during the time of measurements.

Operational train noise was predicted in accordance with the methodology detailed in the US Federal Transit Administration Guidance Manual on Transit Noise and Vibration Impact Assessment.

Helicopter Noise

Noise measurement was carried out at the location of the proposed outdoor theatre to the west of the Project site to determine the potential helicopter noise impact. To avoid potential influence from construction works of XRL, during the noise measurement, it was ensured that no construction works would be in progress in the vicinity.

A noise measurement was conducted for recording different types of helicopter events (to Macao and from Macao) at the monitoring location to capture the instantaneous level (L_{max}) when the helicopter is located at the nearest position to the measurement point. The event L_{max} obtained was then compared with the criteria for helicopter noise stated in EIAO-TM to identify the potential helicopter noise impact.

Marine Traffic Noise

Noise measurements were carried out at the site boundary close to the China Harbour Ferry Terminal of the site during morning peak hours to capture the worst case scenario based on the ferry schedule.

To avoid the influence from the potential construction noise of the Express Rail Link West Kowloon Terminus, the marine traffic noise monitoring were carried out on Sunday and confirmation from MTRCL was sought to ensure no construction works would be in progress during the noise measurement period.

Noise measurement for about 60 minutes has been carried out during the morning peak hours of ferry schedule at each monitoring location to capture the instantaneous level (L_{max}) when the vessel is located at the nearest position to the measurement point. The L_{eq} (60min) of the marine traffic noise impact of each event is then derived by knowing the number of events during the peak 60 minutes period. Summation of the L_{eq} (60min) of all different events will then give the overall marine traffic noise impact level. Appropriate distance and façade corrections would be taken into account for the assessment of the noise impact at the planned NSRs if necessary. Background noise levels at NSRs have been adopted for identifying potential nuisance raised by marine traffic.

3.2 Key Assessment Assumptions Adopted in this EIA Study

Construction Phase

The assumption of all PME items required for a particular construction activity would be located at the notional or probable source position where the activity is to be performed was adopted when assessing the potential construction noise impact. The planned NSRs included for construction noise impact assessment are selected by assuming the construction programme and phasing of development is strictly followed. In addition, cumulative SWL of PME was assumed to be used for each location within the Project site.

Operation Phase

In the course of road traffic noise impact assessment, it was assumed that the higher PM peak hour traffic flow will lead to the worst case scenario of traffic noise. The proposed mitigation measures in the Road Works in West Kowloon EIA Report was assumed to be adopted in future scenarios as recommended and was taken into account of during road traffic noise impact assessment. The latest available information on the planned sensitive receiver in Site D was adopted for road traffic noise impact assessment. The potential noise level in which the planned sensitive receiver would be exposed of is subject to further assessment upon completion of detailed design.

The noise level of planned fixed noise sources was referenced from relevant EIA studies or the best available information from the project proponent(s). It was assumed that the noise levels presented in those EIA reports would be the maximum allowable Sound Power Level (SWL). The worst case condition that all intake/exhaust fans are operated at each ventilation building was adopted for assessment.

Noise from open air entertainment activities was assumed to be similar to the levels of a former music festival held in WKCD.

For railway ground-borne noise impact assessment, the train frequency of Airport Expressway Rail Link (AEL) and Tung Chung Line (TCL) is based on the latest information provided by MTRCL. The frequency of West Rail - Kowloon Southern Link (WR-KSL) is based on the latest Environmental Permit (EP-438/2012/A) of SCL project. The trackform information of KSL was referenced to the approved KSL EIA report. The potential vibration from the operation of Express Rail Link (XRL) could not be measured as it is still under construction during the course of this EIA Study. For the ground-borne noise monitoring, peak railway frequency and double pass event has been considered in the assessment to shown the worst case scenario. In order to predict the worst scenario, the measurements were carried out during the PM peak hours of normal weekday when the loads of the train are at their peak. Attention was paid to ensure that no construction works of XRL would be on-going during the measurements. Sufficient data has been collected to cover different loading and wheel/rail condition so as to show the worst case scenarios at each monitoring location.

For the helicopter noise assessment, it is assumed that the flight path, flight schedule and helicopter type would be similar in the future upon operation of the outdoor performance venues of WKCD.

For the marine noise assessment, it is assumed that the vessel path, schedule of ferry services and vessel type would be similar in the future upon population intake of the noise sensitive uses portion in WKCD. The potential marine traffic noise impact due to the operation of the other mobilized, non-schedules vessels and future vessels using leisure piers of WKCD is assumed insignificant.

3.3 Limitations of Assessment Methodologies / Assumptions

Construction Phase

The prediction of construction noise impact was based on the methodology described in the GW-TM under the NCO. There would be limitations of the methodology such as the accuracy of the predictive base data for future (e.g. plant inventory for proposed construction works). Quantitative uncertainties in this assessment of impacts should be considered when drawing conclusions form the assessment.

In carrying out the assessment, realistic worse case assumptions have been made in order to provide a conservative assessment of noise impacts. The construction noise impact was assessed based on conservative estimates for the types and quantities of plant and construction methods.

Operation Phase

There would be some limitations of methodology such as the accuracy of the predictive base data for future (e.g. traffic flow forecast). Besides, traffic noise levels are predicted based on free flow condition. Traffic congestion and hence reduced traffic speed are not taken into account in the noise model. Quantitative uncertainties in the assessment of impacts should be considered when drawing conclusions from the assessment.

The fans and damper arrangement at each ventilation building may be refined in detailed design. The correction of directivity was excluded in the assessment.

For the potential impact from outdoor performance venues, the sound system and the roof design (if any) would be refined in the later detailed design stage. The correction of directivity was excluded in the assessment.

As the detailed design of the structural and foundation has not yet finalised, the potential ground-borne noise impact from the rail operation was predicted according to the best available information during the time of the EIA Study. The operation mode (train frequency, train type) of the WR-KSL, XRL and AEL/TCL may be subject to change in the future.

For the helicopter noise assessment, the measurement taken may not include the most noisy type of helicopter. The schedule of flights may be subjected to change upon the completion of the WKCD or other developments in the area. On the other hand, the models of the helicopter used by commercial may change as well in the future which may give different Lmax levels.

For the marine noise assessment, the schedule of ferry services may be subjected to change upon the completion of the WKCD or other developments in the area.

3.4 Prior Agreements with the Director or other Authorities

The methodology adopted for the traffic forecast used in the traffic noise modelling has been agreed by TD (Letters dated 14 May 2013, Ref.: TD PR/182-232/2 and dated 2 July 2013, Ref.: TD PR-182/232/2).

4 Water Quality Impact

4.1 Summary of Assessment Methodology

The assessment of construction phase and operation phase water quality impact from the Project has followed the criteria for evaluating water quality impacts include the following:

- Water Pollution Control Ordinance (WPCO) Cap. 358;
- Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS);

- Water Supplies Department (WSD) Water Quality Criteria;
- Practice Note for Professional Persons on Construction Site Drainage (ProPECC Note PN 1/94); and
- Applicable standard on total residual chlorine (TRC).

Water quality impact assessment was carried out for the Victoria Harbour, Western Buffer and Eastern Buffer Water Control Zones (WCZs) and all areas within 500m from the proposed WKCD development boundary.

Key water sensitive receivers that may potentially be affected by the proposed WKCD development were identified. These included Typhoon Shelter, WSD Flushing Water Intakes, Cooling Water Intakes and Fish Culture Zones.

Construction Phase

All identified sources of potential water quality impacts in were then evaluated and their impact significance was determined. The need for mitigation measures to reduce any identified adverse impacts in water quality to acceptable levels was determined.

Operation Phase

Sources of potential water quality impacts in operation phase were identified and their impact significance was determined.

Computer models were utilised to predict concerned water quality parameters and any exceedance of criteria in the marine environment as necessary. In particular, the thermal discharge and the associated chlorine product from district cooling water system (DCWS) and independent cooling systems for the Freespace and the MPV/EC & Hotel were modelled using Delft3D model suite.

In the study, the basis for modelling of the harbour waters was the existing, validated Western Harbour Model developed by Deltares. This model covers the relevant part of the Hong Kong waters, including the Pearl Estuary and the Dangan (Lema) Channel. A locally refined domain in the project area was inserted to obtain the higher resolution by means of a technique called “Domain Decomposition” in the model to obtain a resolution between 100m and 200m in the project area. The grid mesh was modified to generate higher resolution (about 40 m x 50 m) in the vicinity of West Kowloon.

To simulate the thermal plume dispersion in the marine environment, the Excess Temperature Model in Delft3D-FLOW model would be employed. The model simulates the evaporation process (i.e. the heat transfer from water surface to the atmosphere at the sea/air surface). The total heat flux is proportional to the excess temperature at the surface while the rate of heat transfer depends on the temperature difference and wind speed.

The water quality model Delft3D-WAQ in the Delft3D model suite would then be employed to simulate the surplus temperature directly resulting from the discharge of seawater from the DCWS and the independent cooling systems for the Freespace and the MPV/EC & Hotel. A time history temperature elevation at each intake locations can be obtained from the model output.

The discharge of residual chlorine would be represented by a decayable tracer in the WAQ model. As the WAQ model was coupled to the FLOW model with a “communication file” between the two models, diffusion and dispersion of the chlorine would be based on the flow determined in the hydrodynamic model.

Each simulation covered a complete spring-neap tidal cycle (approximately 15 days).

The need for mitigation measures to reduce any identified adverse impacts in water quality to acceptable levels was determined.

4.2 Key Assessment Assumptions Adopted in this EIA Study

Construction Phase

The locations of marine features including landing steps, optional piers, optional floating “art” pontoon and viewing platform for the proposed WKCD development shown in **Figure 5.3** of the EIA report were tentative. Assumptions on construction methods have also been made as the actual construction would be subject to any change made at the detailed design stage.

Cooling water discharges/outfalls

Construction of cooling water discharges/outfalls to the south and west of the proposed WKCD development would involve minor seawall modification. In general, the construction sequence is that a temporary cofferdam in the form of sheet-pile wall outside the cooling water discharge/outfall would be constructed prior to the construction of the cooling water discharge/outfall. Excavation of fill material from the existing seawall above the existing seabed would be carried out. The outfall pipe would be positioned in temporary open cuts in the existing seawall well above the existing seabed. Once the outfall pipe have been installed and checked for alignment, the seawall would be reinstated by backfilling to match the existing condition.

Dredging operation would not be anticipated and dredging of marine sediment would not be required for the construction of cooling water discharges/outfalls. Nevertheless, this might still results in small amount of suspended solids released from the surface of the seawall. Silt curtain should be deployed to completely enclose the seawall modification for construction of the cooling water discharges/outfalls.

Landing steps

Construction of landing steps at the south and south west of the proposed WKCD development would also involve minor seawall modification. In general, the landing steps are anticipated to be founded on piles. The pile foundation would be fixed into the seabed either by driving or drilling. Part of the rockfill of the seawall where the landing steps are located would be removed. Precast steps would be installed to form the landing steps. The seawall would be reinstated by backfill with rocks and gravels to match the existing condition.

The proposed landing steps are designed for public amenity purpose and as an integrated part of the waterfront promenade and WKCD landscaped space. They would not be designed to serve any marine traffic. Formation of basins for marine access is therefore not anticipated. No dredging of marine sediment would be required.

Dredging operation would not be anticipated for the construction of landing steps. Nevertheless, this might still results in small amount of suspended solids released from the surface of the seawall. Silt curtain would be deployed to completely enclose the seawall modification and construction of the landing steps.

Optional piers

Installation of marine piles would be required for the optional piers. The piling arrangement of the optional pier was tentative only. Detailed design of the optional piers would be available at the detailed design stage.

In general, the footing of the piles would mainly be in place on the seabed adjacent to the under-water seawall. In order to support the deck of the pier and provide sufficient space for visitors for boarding, there are a total of about 26 piles (each with a diameter of about 0.7m diameter) to form an array with at least about 2m gap between each pile. The pier deck has its length of about 50m and width of about 6 to 7m.The installation of the piles would include driving the piles mainly into the seabed adjacent to the under-water seawall. Part of the rockfill of the seawall where part of the optional piers are located would be removed. Socked H-piles are installed by inserting H-piles into pre-bored holes sunk into bedrock and subsequently grouting the holes with cementitious materials. A temporary casing passing through the soil layer would be provided in the pre-boring process to prevent collapse of the seabed and sediment from falling into the pre-bored hole.

Conventional drilling system should be employed to drill through all materials above the rock head level. The seawall would be reinstated by backfill with rocks and gravels to match the existing condition. Excavation of marine sediment is therefore not expected. As the optional piers are proposed for visitors or leisure activities, installation of piles with large diameters are not necessary. Formation of basins for marine access was also not anticipated as the water depth to the south and west of the proposed WKCD development would be at least 7m.

No dredging of marine sediment was expected. Nevertheless, this might still results in small amount of suspended solids released from the surface of the seabed. Silt curtain would be deployed to completely enclose the pile installation works.

<u>Barging point</u>

Barging point facilities of the Hong Kong Section of Guangzhou - Shenzhen - Hong Kong Express Rail Link project at the West Kowloon seafront would be used for handling of spoil generated from excavation works for the proposed WKCD development.

Operation Phase

<u>Thermal Discharge</u>

In accordance with the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS)*, effluent discharge from the proposed cooling water systems of WKCD would not be allowed in any typhoon shelter, or within 100m of any seawater intake point including the seawater intake points of the DCWS and the independent cooling system for the Freespace and MPV/EC & Hotel.

In the proposed setup, there are two intake points and three outfalls for the proposed DCWS, Freespace and the MPV/EC & Hotel in WKCD development. The existing intake and pump cells at WKCD were assumed to be utilized as the intakes for DCWS and Freespace. The outfall location for the proposed DCWS was assumed to locate at the seawall at about 160m east of the WKCD intake while the outfall for the independent cooling system serving the Freespace will be located at about 100m west of existing MTRC Kowloon Station outfall and is at least 300m away from the closest seawater intake point. For the independent cooling system for the MPV/EC & Hotel, since the design for the intake and outfall was not available, the locations were assumed based on the 100m minimum separation from any seawater intake point requirement. Modelling would be conducted to confirm the suitability of the outfall locations and determine the potential recirculation impact.

The layout plan of the intakes and outfalls are shown in the figure in **Appendix 5.1** of the EIA report. Due to the existing site constraints including the location of the existing seawater and cooling water intakes, the outfall of the proposed WKCD DCWS was limited to the location shown.

Since the intakes of the cooling water system would be located at around -3.15 mPD, the temperature elevations near the mid-depth of the water column were taken from the model.

Appendix 12.1 – Documentation of Key Assessment Assumptions, Limitation of Assessment Methodologies and related Agreement(s) with the Director

The total cooling load demand was estimated based on the cooling load from the proposed communal facilities, residential buildings, hotels, offices and other facilities. A total of less than 20,000 Tons of refrigeration (TR) cooling load was estimated for the full development of WKCD and another less than 300 TR cooling load was required for the independent cooling system serving the Freespace. On the other hand, the cooling load for the MPV/EC & Hotel was predicted to be less than 6,300 TR.

To allow for full capacity of the existing pump cells, a maximum cooling load of 26,000 TR for the DCWS while based on the design cooling load of the Freespace and MPV/EC & Hotel, 1,000 TR and 8,000 TR respectively as the worst case assessment scenario for the Freespace and MPV/EC & Hotel were simulated.

The design excess temperature at the proposed outfalls of the DCWS and independent cooling system was assumed to be 5℃.

A recirculation factor was be added to the temperatures at the intakes to address the potential short circuit issue due to recirculation of water with elevated temperature. The intake temperatures would be multiplied by a factor of (1/(1-E/k), where E is the maximum of the mean temperature elevations predicted at the intakes and k is the excess temperature of cooling system (i.e. 5℃).

The parameters to be adopted for the thermal plume model are summarized in **Table 6** below.

Table 6: Summary of Parameters for Thermal Plume Model (Delft3D-FLOW)

Delft3D-FLOW Excess Temperature Model Parameters		
Temperature of spent cooling water (℃)*	5℃ above ambient temperature	Dry Season Wet Season
Flow rate (worst case for 26,000 TR, 1,000 TR and 8,000 TR for DCWS, Freespace and the MPV/EC & Hotel respectively) (l/s)**	5,500 l/s, 212 l/s and 1,692 l/s	Dry Season Wet Season
Wind Speed (m/s)	5 m/s	Dry Season (north-east direction) and Wet Season (south-east direction)
Ambient Water Temperature (℃)***	23℃	Dry Season
	30℃	Wet Season

Note:
* It is conservatively assumed that the spent cooling water discharge have an excess temperature of 5℃ with reference to the background seawater temperature.
** The sea water flow rate is estimated from the following equation: Q = H/(ρcΔT); where
Q is the sea water flow rate (m^3/s); H is the heat rejection (kW) which is estimated as the cooling load multiplied with the heat rejection rate of 120% to 130%; ρ is the density of sea water (kg/m^3); c is the specific heat capacity of sea water (kJ/kg/K); and ΔT is the temperature difference between sea water intake and discharge (K).
The cooling load is 26,000TR (or 91,442 kW) and the temperature difference is 5K for the DCWS. It should be noted that the cooling load of 26,000 TR is a rough estimate based on a heat rejection rate of 120%. It can be estimated from the above that the sea water flow rate is around 5.3 m3/s or 5,300 L/s (to be conservative in the model, a sea water flow rate of 5.500 m3/s or 5,500 L/s would be simulated). Similarly, a sea water flow rate of 212 L/s and 1,692 L/s will be adopted for simulation for the 1,000 TR and 8,000 TR cooling load for the independent cooling systems of the Freespace and the MPV/EC & Hotel respectively.
*** The ambient water temperature follows the original setting of the Western Harbour Model developed by Deltares.

The diurnal pattern of the cooling load demand for the proposed WKCD DCWS and the independent cooling systems for the FreeSpace and the MPV/EC & Hotel were included in the analysis. **Table 7** below showed the estimated diurnal pattern of the cooling water discharge for the proposed WKCD development. As the temperature difference for inflow and outflow of the seawater cooling system is set to 5K and only the flow rate will vary with time. The flow rate input into the thermal model at any time of a day follows this formula:

Flow Rate at Hr T = 5,500 l/s x (% full cooling load at Hr T shown in **Table 7** below)

On the other hand, the flow of the proposed seawater cooling system of XRL follows its own diurnal pattern as mentioned in Section 11.57 of the XRL EIA Report. The hourly diurnal flow of XRL seawater cooling system adopted in XRL EIA Report was input into the model for this project.

Table 7: Diurnal pattern of cooling water discharge for proposed WKCD DCWS and the independent cooling systems

Hours	% of full cooling load for the proposed DCWS*	% of full cooling load for Freespace^	% of full cooling load for MPV/EC & Hotel^
00:00 – 02:00	62	70	71
02:00 – 04:00	51	40	55
04:00 – 06:00	51	40	52
06:00 – 08:00	58	50	58
08:00 – 10:00	62	50	62
10:00 – 12:00	71	60	70
12:00 – 14:00	74	65	74
14:00 – 16:00	78	75	79
16:00 – 18:00	84	85	82
18:00 – 20:00	84	100	88
20:00 – 22:00	79	100	87
22:00 – 00:00	74	100	88

Note: *The %full cooling load at different times of the day are estimated by summing up the anticipated cooling demand of recreational, residential, commercial, hotel, retails uses at different times of the day in WKCD. Full cooling load demand was not predicted to happen as the cooling requirement varies for different types of buildings at different hours of the day.
^The design cooling load profile for CACF is adopted for the Freespace; whilst a composite pattern derived from design cooling load profile for CACF, hotel, office, retail, dinning and entertainment is adopted for the MPV/EC & Hotel.

The existing and proposed seawater cooling systems near the proposed WKCD development have been considered. From the approved EIA Report for Express Rail Link (XRL) (EIAO Register No.: AEIAR-143/2009), the locations, flow rates and the typical diurnal flow pattern for the XRL intake and outfall were referenced. Information on other private systems was sought from property operators. Assumptions on the flow rates were made from the available information where appropriate. The cooling water discharge of the proposed WKCD development and other systems would be modelled to assess the cumulative impact.

Residual Chlorine

The water quality model Delft3D-WAQ in the Delft3D model suite was employed for assessing the residual chlorine discharged from the cooling water. It was assumed that other anti-fouling chemical agent (e.g. C-treat-6) would not be used at the proposed DCWS. With confirmation on the engineering design, a residual chlorine concentration of 0.2 mg/L has been adopted for the proposed WKCD development.

Following the approved XRL EIA Report, the T90 factor (time to decay by 90%) adopted in the approved XRL EIA Report for the project *Tai Po Sewage Treatment Works Stage V* (EIAO Register No.: AEIAR-081/2004) is the most conservative value among the past EIA studies. Therefore the chlorine decay value (T90 = 8289s) used under these two studies would be adopted. Conversion of the unit to suit the parameter in the WAQ model was done and the calculated decay rate was 24/d. Summary of parameters to be used in the Delft3D-WAQ model is presented in **Table 8** below.

Moreover, due to the high decay rate of chlorine in marine waters, the ambient chlorine level was assumed to be negligible. As no background chlorine would be included in the water quality model, only the elevation of residual chlorine was evaluated.

Table 8: Summary of Parameters for Modelling of Residual Chlorine (Delft3D-WAQ)

Particle Track Model Parameters		
Vertical Dispersion Coefficient (m^2/s)*	5×10^{-3}	Dry Season
	1×10^{-5}	Wet Season
Residual Chlorine of seawater cooling discharge (mg/L)	0.2	Dry Season Wet Season

Particle Track Model Parameters		
Decay rate (/d)	24	Dry Season Wet Season
Flow Rate (m^3/s)	Equivalent to flow rates in the thermal model	Dry Season Wet Season

Note:
*Values presented are commonly adopted and in line in the XRL EIA.

The impacts from other existing seawater cooling systems near the proposed WKCD development were included in the model to assess the cumulative impact, similar to the thermal plume modelling.

Optional sewage pumping station

Potential water quality impact associated with the optional sewage pumping station include occasional overflow of sewage effluent during storm event under normal operation and emergency sewage effluent discharge as a consequence of pump failure or interruption of power supply.

To minimize the occurrence of such effluent discharge in case of overflow or emergency discharge, it was assumed that standby pumps and dual power supply would be provided.

4.3 Limitations of Assessment Methodologies / Assumptions

For construction phase water quality impact assessment, the study has based largely on the current preliminary design and construction method for marine features such as landing steps, optional piers, optional floating “art” pontoon and viewing platform for the proposed WKCD development.

It should be noted that dredging of marine sediment during the construction phase should be prohibited as this would deviate from the assumption of the assessment. Further assessment has to be undertaken in such case.

For operation phase water quality impact assessment, the modelling of thermal discharge and chlorine was based on the tentative locations of the intakes and outfalls shown in **Appendix 5.1** of the EIA report. From the assessment, the DCWS outfall was found to be the largest source of the impact in terms of thermal discharge and release of chlorine. It is therefore important that the location of DCWS in the detailed design does not largely differ from this assessment.

Since the grid mesh was modified to obtain higher resolution (about 40 m x 50 m) in the vicinity of West Kowloon, the modelling is considered to be applicable if the proposed location for the DCWS outfall is within 10 – 20m range.

For other proposed intakes and outfalls for Freespace and MPV/EC & Hotel, it is anticipated that their locations will be adjusted in detailed design stage. In the case that their locations are not changed significantly (i.e. outfall of independent cooling system for Freespace remains at southern side of the WKCD headland and the intake and outfall of MPV/EC & Hotel remain at western side of WKCD headland), it is estimated that the change of modelled seawater temperature at most of the WSRs would be minimal. This is because the cooling load for Freespace and MPV/EC & Hotel was much smaller than the DCWS while their outfalls are located at seafront area with much larger tidal current flows.

4.4 Prior Agreements with the Director or other Authorities

Appendix 12.1 – Documentation of Key Assessment Assumptions, Limitation of Assessment Methodologies and related Agreement(s) with the Director

A methodology paper was submitted to EPD for agreement on the hydrodynamic and water quality modelling requirements under Appendix D1-1 of the EIA Study Brief. A reply letter from EPD (dated 24 July 2012, Ref.: EP2/K20/S3/19) has advised that the detail of the water quality modelling is agreed.

5 Sewerage and Sewage Treatment Implications

5.1 Summary of Assessment Methodology

Based on the Review of West Kowloon and Tsuen Wan Sewerage Master Plans – Feasibility Study (WK&TW SMP Review), the trunk sewers in West Kowloon sewerage catchment have the sufficient capacity to cater for the sewage generated from the development of WKCD. Therefore, the Sewerage Impact Assessment (SIA) focused on the local impact and sewerage arrangements required for the proposed WKCD development. The SIA and sewerage design focused on the ultimate scenarios.

The sewerage impact arising from WKCD was identified by making comparison between the generated flow and capacity of existing sewerage network. Both hand calculation method and hydraulic modelling method (using InfoWork) were adopted to assess the sewerage impact and for the proposed sewerage works design.

5.2 Key Assessment Assumptions Adopted in this EIA Study

Sewage Flow Estimation and Population Projection

The sewage flow projections of the WKCD development and other developments in the vicinity of the WKCD and the design of new sewerage system followed the following manuals and guidelines:

- Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0 (Report No.: EPD/TP1/05) (GESF) published by EPD;
- Wastewater Engineering Treatment and Reuse published by Metcalf & Eddy; and
- Sewerage Manual published by DSD.

The population of the WKCD development was based on the latest development schedule of the Development Plan. The sewerage flows from the existing or proposed developments in the vicinity of the WKCD were estimated based on the population data in "WK&TW SMP Review Technical Note No. 3 (TN3) – Population and Land Uses" or by making reference to SIA Reports of the Express Rail Link (XRL) project.

Baseline Sewerage Condition

The existing sewerage record plans were obtained from DSD for the SIA. According to the SIA reports of the Express Rail Link (XRL) project, some of sewers in the vicinity of the WKCD would be upgraded. The sewerage upgrading works proposed works under XRL project was also combined with the existing sewerage records to form a baseline sewerage networks for the sewerage assessment.

Hydraulic Modelling

Boundary conditions (maximum water level and maximum sewage inflows from existing or planned developments) of hydraulic model were obtained from EPD. A local hydraulic model was built for the sewerage assessment.

5.3 Limitations of Assessment Methodologies / Assumptions

The population date used in the SIA will be updated regularly to reflect the planned developments and change in land use, hence the estimated sewage flow may vary from time to time.

5.4 Prior Agreements with the Director or other Authorities

As discussed between DSD and WKCDA, the maintenance responsibilities for the proposed sewerage system, include gravity sewers, raising mains and pumping facilities, will be discussed and agreed in the detailed design stage. A reply letter from EPD (dated 10 April 2012, Ref.: EP1/K20/WKR-OT/185 Pt. 3) has advised that both EPD and DSD has no adverse comment on this arrangement.

6 Waste Management Implications

6.1 Summary of Assessment Methodology

The criteria for assessing waste management implications are outlined in Annex 7 of the EIAO-TM. The methods for assessing potential waste management impacts during construction and operation phases of the Project follow those presented in Annex 15 of the EIAO-TM and include the following:

- Identify the quantity, quality and timing of waste arising as a result of the construction and operation activities of the Project.
- Assessment of potential impacts from the management of solid waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and public transport.
- Assessment of impacts on the capacity of waste collection, transfer and disposal facilities.

6.2 Key Assessment Assumptions Adopted in this EIA Study

The total amount of C&D materials to be generated from excavation work for the WKCD basement is estimated based on the total area and depth of excavation required at each basement zone. No marine sediment would be excavated for the Project. This finding is based on the ground investigation works carried out for the WKCD Project for part of its site as well as a review of previous reports available from the Geotechnical Engineering Office and relevant approved EIA reports, specifically the past site investigation records for previous projects within or near the proposed WKCD Project area, including the West Kowloon Reclamation, MTRC Kowloon Station, Kowloon Southern Link (KSL) and Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) projects etc.

The quantity of C&D material to be generated from construction of superstructures and substructures has been estimated by applying the generation rate of $0.1m^3$ per m^2 of gross floor area (GFA), which is based on the Reduction of Construction Waste Final Report published by the Hong Kong Polytechnic University and Hong Kong Construction Association.

6.3 Limitations of Assessment Methodologies / Assumptions

At the time of preparation of the EIA, ground investigations have yet to be completed for the entire Project site. Upon completion of all ground investigation work, a C&D Materials Management Plan (C&DMMP) will be submitted to the Public Fill Committee to request for allocation of space for disposal of the C&D materials of the Project.

6.4 Prior Agreements with the Director or other Authorities

A letter was sent to the Public Fill Committee of CEDD confirming that they had no comment on the preliminary C&DMMP (letter dated 2 May 2013, Ref.: KMY/SHC/TM/EC/CL255962/07.02/L0363) .

7 Land Contamination

7.1 Summary of Assessment Methodology

The assessment methodology comprised of undertaking a desktop study to review current and historical land uses (from aerial photos, site records and previous studies), acquisition of information related to potential land contamination from relevant Government Departments, and conducting site surveys to identify existing land uses.

7.2 Key Assessment Assumptions Adopted in this EIA Study

The desktop study has identified the existing Tsim Sha Tsui (TST) Fire Station as a potential contaminative land use within the Project area, however, it was understood at the time of preparation that the TST Fire Station will unlikely be relocated before 2020. Hence it was recommended that further site visit and site investigation/laboratory chemical analysis will be conducted after land acquisition but prior to demolition of the two underground tanks and associated pipes.

Other than the TST Fire Station area, the land contamination potential of the WKCD Project area is considered as low because the area has no previous indication of industrial activities and site inspection has identified no major land contaminative uses within the area.

7.3 Limitations of Assessment Methodologies / Assumptions

The assessment is based on desktop studies, which is limited by the presence and availability of records/reports, while the site survey is limited by the visibility of potentially contaminative land uses.

The Contamination Assessment Plan (CAP) is based on EPD's Guidance Note for Contaminated Land Assessment and Remediation, and the Practice Guide for Investigation and Remediation of Contaminated Land.

7.4 Prior Agreements with the Director or other Authorities

In accordance with Section 3.1 of Annex 19 of the EIAO-TM, the CAP (letter dated 13 February 2012, Ref.: EP1/K20/WKR-OT/185 Pt.2) and subsequently the Land Contamination section of the EIA report was submitted to EPD (letter dated 20 March 2012, Ref.: EP1/K20/WKR-OT/185 Pt.2), and has no adverse comment on the CAP.

8 Ecological Impact (Terrestrial)

8.1 Summary of Assessment Methodology

The Study Area for impact assessment of terrestrial ecology covers all the areas within 500m from the Project site boundary and the areas likely to be affected by the Project. The study was firstly conducted by a literature review and supplemented by on site ecological baseline surveys where it is found necessary. A literature review was performed to investigate the existing condition within the Study Area and identify habitats or species with conservation concern. However, previous literature for this area is limited, therefore ecological Baseline Surveys (Habitat, vegetation and fauna surveys) were carried out for 4 months (between July and December 2011) covering both wet and dry seasons within the ecological Study area.

8.2 Key Assessment Assumptions Adopted in this EIA Study

No specific assessment assumptions are required for the ecological impact assessment.

8.3 Limitations of Assessment Methodologies / Assumptions

Some parts of the study area are construction sites which are not accessible for conducting ecological baseline surveys. However, since these areas have been highly disturbed, no implication in the credibility of ecological impact assessment is anticipated and these areas can be reasonably expected as of low ecological value.

8.4 Prior Agreements with the Director or other Authorities

No specific prior agreements with relevant Government Departments are required to be sought for the ecological impact assessment.

9 Landscape and Visual Impact

9.1 Summary of Assessment Methodology

The LVIA follows the criteria stated in the *Annexes 10 and 18 of the Technical Memorandum to the Environmental Impact Assessment Ordinance (EIAO)*, the *EIAO Guidance Note No. 8/2010 – Preparation of Landscape and Visual Impact Assessment and* the report of *Landscape Value Mapping of Hong Kong* for evaluating and assessing the landscape and visual impacts associated with the proposed WKCD development.

The Landscape Impact Assessment Methodology comprised the following:

1. Identification of Key Landscape Elements and Landscape Character Areas (LCAs) within the Assessment Area;
2. Assessment of the Sensitivity of the Landscape Resources (LRs) and Landscape Character Areas (LCAs);
3. Identification of Potential Sources and Type of Impacts;
4. Assessment of the Magnitude of Landscape Impacts;
5. Identification of Potential Landscape Mitigation Measures;
6. Prediction of the Significance of Landscape Impacts Before and After the Implementation of the Mitigation Measures; and
7. Residual Impacts Assessment.

The Visual Impact Assessment Methodology comprised the following:

1. Identification of Visual Resources and Visually Sensitive Receivers (VSRs) within the Visual Envelope;
2. Assessment of Sensitivity of Visually Sensitive Receivers (VSRs);
3. Identification of Potential Sources of Visual Impacts;
4. Assessment of Potential Magnitude of Visual Impacts;
5. Determination of the Visual Impacts of Both of the Construction and Operation Phases before Implementation of Mitigation Measures;
6. Examination of Alternative Design(s) and Construction Methods;
7. Recommendation of Mitigation Measures to Minimize Adverse Visual Impacts;
8. Residual Impacts Assessment; and
9. Assessment of Cumulative Impacts.

9.2 Key Assessment Assumptions Adopted in this EIA Study

At the time of preparation of the LVIA, the Development Plan for the WKCD has been approved, but specific details on various aspects of the development, such as the form and appearance of buildings, and other features of the WKCD development such as proposed piers, 'art' pontoon, and wind turbines are unconfirmed. Hence the LVIA, in particular the visual impact associated with the Project, is based on the full build out scenario that assumes all proposed facilities are implemented, and the photomontages have incorporated the optional piers, 'art' pontoon and wind turbines as well as the main built features of the WKCD development so as to present the worst-case scenario for visual impact assessment.

9.3 Limitations of Assessment Methodologies / Assumptions

To meet the requirements of the TM of the EIAO, more than 40 VSRs within the Visual Envelope are identified for adequately assessing the visual impacts derived by the proposed WKCD development. However, only viewpoints which can represent the worst-case scenarios from the most sensitive VSRs, and those which are representative in terms of the location are selected for preparing photomontages.

Since detailed design of the proposed WKCD development has yet to commence, many of the design concepts for the proposed facilities and buildings, such as the location and design of proposed roof top gardens/terrace gardens, green roof and solar panels, is yet to be confirmed. At this stage, general facades and massing of the buildings and marine structures is used to illustrate the overall appearance of the proposed WKCD development in the photomontages presented in the LVIA. Wind turbines may also be adopted along the waterfront promenade, and these have been included in the photomontages to illustrate their appearance in relation to the proposed WKCD development, however the provision of such wind turbines are subject to changes during detailed design stage. The design details for the Park are also subject to a Park study and further refinements. All marine facilities such as the 'art' pontoon and the piers are subject to the Protection of the Harbour Ordinance and agreement with Harborfront Committee.

9.4 Prior Agreements with the Director or other Authorities

No specific prior agreements with relevant Government Departments are required to be sought for the LVIA. Nevertheless, the viewpoints for generating photomontages were verbally agreed with Planning Department prior to commencement of the LVIA.