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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

CHAI WAN GOVERNMENT COMPLEX AND VEHICLE DEPOT

COMMERCIAL-IN-CONFIDENCE

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1. INTRODUCTION

1.1. BACKGROUND

1.1.1. This Project is to construct and operate a vehicle depot-cum-office building (hereinafter referred to as the "proposed Project") for the Hong Kong Police Force (HKPF), the Food and Environmental Hygiene Department (FEHD), the Electrical and Mechanical Services Department (EMSD) and the Government Laboratory (GL), who are also responsible for the operation of the proposed Project upon completion of construction works. The Project Proponent for this project is the HKPF. Allied Environmental Consultants Limited (AEC) was appointed as the environmental consultant to undertake the Environmental Impact Assessment (EIA) study for the proposed Project.

1.2. THE ASSIGNMENT

1.2.1. As mentioned in *Section 1.1*, the proposed Project is to construct and operate a new vehicle depot-cum-office building in Chai Wan at the junction of Sheung Tat Street, Sheung On Street and Sheung Mau Street (hereinafter referred to as the "Project site"). According to the approved Chai Wan Outline Zoning Plan (OZP) No. S/H20/21, the Project site is zoned "Government, Institution or Community", whilst the surrounding areas are currently zoned "Industrial", "Government, Institution or Community" and "Open Space". The location of Project site is shown in ***Figure 1.1***. The Project site is a reclaimed land which is currently occupied by the Drainage Services Department (DSD) as a works and staging area.

1.2.2. The proposed Project will involve the construction and operation of a 6-storey building (with a mezzanine floor above Level 3) comprising various facilities for vehicle parking, vehicle washing and repair operation as well as offices. The area of the Project site is approximately 7,000m^2. A detailed description of the proposed Project is provided in *Section 3* below.

1.2.3. In accordance with Item A.6, Part I, Schedule 2 of the Environmental Impact Assessment Ordinance (EIAO), the proposed Project is a designated project under the category of "A transport depot located less than 200 m from the nearest boundary of an existing or planned (a) residential area and (b) educational institution". An EIA is required and an Environmental Permit (EP) is to be obtained prior to construction commencement. An application for the EIA Study Brief under Section 5(1) of the EIAO was submitted by AEC on 23 January 2014 with a Project Profile (No. PP-499/2014). An EIA Study Brief (No. ESB-267/2014) was issued by the Environmental Protection Department (EPD) on 5 March 2014 to proceed with an EIA study for the proposed Project.

1.3. PURPOSE AND OBJECTIVES OF THIS EIA STUDY

1.3.1. This EIA Report was prepared in accordance with the abovementioned EIA Study Brief (No. ESB-267/2014). The purpose of this EIA study is to provide information on the nature and extent of the potential environmental impacts arising from construction and operation of the proposed Project and associated works that will take place concurrently. This information will contribute to the decisions by EPD on:

- The overall acceptability of any adverse environmental consequences that are likely to arise as a result of the Project and associated works, and their staged implementation;
- The conditions and requirements for the detailed design, construction and operation of the proposed Project to mitigate against adverse environmental consequences; and
- The acceptability of residual impacts after the proposed mitigation measures are implemented.

1.3.2. According to the clause 2.1 of the EIA Study Brief, the specific objectives of this EIA study are as follows:

- To describe the proposed Project and associated works together with the requirements and environmental benefits for carrying out the proposed Project;
- To identify and describe the elements of the community and environment likely to be affected by the proposed Project, and/or likely to cause adverse impacts to the proposed Project, including both the natural and man-made environment and the associated environmental constraints;
- To identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;
- To propose the provision of infrastructure or mitigation measures to minimize pollution, environmental disturbance and nuisance during construction, operation of the proposed Project;
- To investigate the feasibility, effectiveness and implications of the proposed mitigation measures;
- To identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction, operation phases of the proposed Project in relation to the sensitive receivers and potential affected uses;
- To identify, assess and specify methods, measures and standards, to be included in the detailed design, construction, operation of the project which are necessary to mitigate these residual environmental impacts and cumulative effects and reduce them to acceptable levels;
- To design and specify the environmental monitoring and audit requirements; and
- To identify any additional studies necessary to implement the mitigation measures or monitoring and proposals recommended in the EIA Report.

1.4. APPROACH TO EIA STUDY

1.4.1. The following general principles and approaches for evaluating the potential environmental impacts were adopted in this EIA study:

Description of the Environment

1.4.2. The characteristics of the existing environment were described for the identification and prediction of potential impacts which are likely to arise from implementing the proposed Project. Baseline environmental surveys were conducted where necessary and relevant reports / documents were reviewed to determine the existing environmental conditions on the Project site and in all surrounding areas likely to be affected by the Project.

Impact Prediction

1.4.3. Individual aspect assessments were undertaken in accordance with the relevant guidelines on assessment methodologies given in the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) and the EIA Study Brief.

1.4.4. Similar methodologies applied in the assessment have previously been adopted in other EIA studies in Hong Kong, which have been generally accepted for predicting environmental impacts and for the comparison of assessment results with the EIAO-TM requirements. Limitations are however envisaged of these methodologies and the accuracy of the prediction will be affected by the degree of uncertainty in input data for quantitative assessments. For example, base data for future conditions such as weather conditions, which have to be considered during the formulation of assessment conclusions. These have been addressed by the adoption of realistic but worst case assumptions in order to provide a conservative assessment of environmental impacts.

Impact Evaluation

1.4.5. The predicted changes and effects resulting from the proposed Project were evaluated with respect to the criteria given in the EIAO-TM and were in quantitative assessments as far as practicable.

Impact Mitigation

1.4.6. Mitigation measures have been identified and evaluated to avoid, reduce and remedy the impacts. Priority was given to avoidance of impacts as a primary means of mitigation. The effectiveness of the proposed mitigation was assessed and the residual environmental impacts were identified and considered for their acceptability.

1.4.7. An implementation schedule for the mitigation measures was prepared to identify when and where each mitigation measure is required, and to identify which parties are responsible for its implementation and where necessary, for its maintenance.

1.5. EIA STUDY SCOPE

1.5.1. The environmental issues covered in this EIA study, as addressed in the EIA Study Brief (No. ESB-267/2014), are as follows:

- Potential air quality impacts on sensitive receivers due to the construction and operation of the proposed Project, including the construction dust emissions, fixed plant engine emissions, vehicular emissions from road traffic induced by operation of the proposed Project, odour emission from FEHD refuse collection vehicles (RCVs), and vehicular and/or odour emission due to the arrangement of traffic route of RCVs and other project induced vehicles during operation of the proposed Project;
- The potential hazard to life due to the neighbouring dangerous goods (DGs) processing and storage facilities (including but not limited to Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations operated by ExxonMobil at Sheung Mau Road and Sinopec at Chong Fu Road respectively, LPG wagon parking site at junction of Sheung On Street and Sheung Ping Street, as well as nearby potentially hazardous sources) during construction and operation of the proposed Project.
- Potential noise impacts on sensitive receivers due to the construction and operation of the proposed Project, including the noise generated by construction activities and operational noise from fixed noise sources, addition traffic flow induced by operation of the Project; and traffic noise due to the arrangement of traffic route of RCVs and other project induced vehicles during operation of the proposed Project;
- Potential water quality impact and sewerage impact from the construction and operation of the proposed Project;
- Potential waste management and land contamination implications arising from the construction and operation of the proposed Project;
- Potential landscape and visual impacts during the construction and operation of the proposed Project; and
- Potential cumulative environmental impacts of the proposed Project, through interaction or in combination with other existing, committed and planned projects in the vicinity of the Project, and that those impacts may have a bearing on the environmental acceptability of the proposed Project.

1.6. USE OF RELEVANT STUDIES

1.6.1. This EIA study has made use of findings from the previously approved EIA Reports, including the following:

- Reprovisioning of FEHD Sai Yee Street Environmental Hygiene Offices-cum-vehicle Depot at Yen Ming Road, West Kowloon Reclamation Area (No. EIA-216/2013)

- EMSD Hong Kong Workshop at Sheung On Street, Chai Wan (No. EIA-202/2012)
- Proposed Headquarters and Bus Maintenance Depot in Chai Wan (No. EIA-060/2001)
- New World First Bus Permanent Depot at Chai Wan (No. EIA-034/1999)
- Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment, Drainage Services Department, Hong Kong (No. EIA-48/2008)
- Comprehensive Feasibility Study for the Revised Scheme of South East Kowloon Development EIA, Territory Development Department, Hong Kong (No. EIA-059/2001)
- Central Kowloon Route Environmental Impact Assessment, Highways Department (No. EIA-208/2013)
- Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong (No. EIA-127/2006)
- Kai Tak Development, Civil Engineering and Development Department (No. EIA-157/2008)
- South Island Line, MTR Corporation Limited (No. EIA-185/2010)
- Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel, Civil Engineering and Development Department (No. EIA-183/2010)
- Tsuen Wan Bypass, widening of Tsuen Wan Road between Tsuen Tsing Interchange and Kwai Tsing Interchange, and associated junction improvement works, Civil Engineering and Development Department (No. EIA-152/2008)

1.7. STRUCTURE OF THIS REPORT

1.7.1. This EIA Report comprises 13 sections including this introductory section, which described the background, purpose, scope and approach of the EIA study. The other sections are outlined below:

- **Section 2** describes the consideration of alternative schemes of the proposed Project and the reasons for selecting the preferred scheme and construction methods. It also summarises the Project's anticipated environmental benefits;
- **Section 3** presents the Project site and its surrounding environment, preliminary design of the proposed Project and the major activities in the Project;
- **Section 4** identifies and assesses the potential air quality impacts arising during the construction and operation of the proposed Project;
- **Section 5** identifies and assesses the potential construction and operational noise impacts arising from the proposed Project;
- **Section 6** identifies and assesses the potential water quality and sewerage impacts during the construction and operation of the proposed Project;

- **Section 7** identifies and assesses the potential landscape and visual impacts arising during the construction and operation of the proposed Project;
- **Section 8** identifies and assesses the potential waste management implications during the construction and operation of the proposed Project;
- **Section 9** identifies and assesses the potential land contamination issues during the construction and operation of the proposed Project;
- **Section 10** identifies and assesses the potential risk arising during the construction and operation of the proposed Project;
- **Section 11** summaries the overall conclusion of this EIA Report;
- **Section 12** defines the scope of the environmental monitoring and audit (EM&A) requirements of the proposed Project; and
- **Section 13** provides the implementation schedule of the mitigation measures.

1.7.2. Impacts on ecology, historical and cultural heritage, agricultural and fisheries are not of concern in relation to the proposed Project and have not been included in the EIA study.

1.7.3. All quoted appendices and figures in this EIA Report are presented under separate covers, which are **APPENDICES** and **FIGURES** respectively.

2. NEED OF PROJECT AND CONSIDERATION OF ALTERNATIVES

2.1. INTRODUCTION

2.1.1. This Section provides information on the need for the proposed Project and describes scenarios with and without the proposed Project. Several options and alternatives were considered in terms of engineering feasibility, site conditions, programme, environmental considerations, design and construction methodologies for refinement and selection of the preferred option of the proposed Project.

2.1.2. This Section is prepared in accordance with clause 3.3 of the EIA Study Brief.

2.2. NEED OF THE PROJECT

2.2.1. Currently, the facilities of the proposed Project, namely the HKPF Hong Kong Island Police Vehicle Pound and Examination Centre (PVP&EC), the HKPF Centralised Case Property Store, the FEHD Depot, the EMSD Depot and the GL Specialist Laboratory, are occupying temporary sites that require periodic extensions of their tenancy duration. These temporary sites are sited at different locations, resulting in the need of additional resources, such as increased travelling time and distance, for the operations of the abovementioned facilities. The current arrangement is viewed as environmentally and economically inefficient. There is a long-term need for permanent Government vehicle depot and offices.

2.2.2. Moreover, the existing HKPF PVP&EC and the FEHD Depot are currently occupying temporary sites at Quarry Bay, both of which have been earmarked for the development of the extension of Quarry Bay Park Phase II by the Leisure and Cultural Services Department (LCSD). The relocation of the facilities would pave the way for future development of the Quarry Bay Park Phase II. Thus, there is an urgent need for available spaces to accommodate the aforementioned facilities.

2.2.3. The proposed Project will also resolve the shortage of laboratory accommodation faced by the GL and long-term need for permanent depot facility of the EMSD and centralised store for the HKPF's case property.

2.2.4. The proposed Project aims to accommodate these facilities. The specific functions and needs for each of the future operators of the proposed Project are summarised below.

<u>HKPF PVP&EC</u>

2.2.5. The HKPF PVP&EC at the Quarry Bay temporary site currently handles around 1,500 vehicles per year. As this is the only PVP&EC on Hong Kong Island at present, re-provisioning is necessary upon the development of the extension of Quarry Bay Park Phase II. The size of the new PVP&EC will be similar to the existing one in Quarry Bay.

2.2.6. The re-provisioning of the HKPF PVP&EC in the proposed Project will enable the HKPF to continue with its examination and detention services on vehicles involving in accidents/traffic offences/crime cases on Hong Kong Island. It is one of the Core Policy Objectives to enhance road safety by reducing traffic accidents and maintaining a smooth and safe traffic flow in Hong Kong. No vehicle maintenance works will be carried out in the new PVP&EC.

HKPF Centralised Case Property Store

2.2.7. The establishment of a Centralised Case Property Store for the HKPF in the proposed Project will enable the HKPF to enhance the investigative capabilities of its Crime Wing headquarters units through a more efficient deployment of manpower in retrieval and deposit of case property from the current scattered locations to a single secured location.

2.2.8. A permanent and centralised case property store can also ensure case property items to be held for protracted periods of time and enhance operational efficiency by saving travelling time of officers handling case property.

FEHD Depot

2.2.9. One of the objectives of the FEHD is to maintain a clean and hygienic living environment for Hong Kong citizens. The FEHD Depot is essentially required for ensuring the provision of quality environmental hygiene services and facilities to safeguard public health. Adequate provision of parking spaces and operational facilities plays an important role in providing effective hygiene services to the public.

2.2.10. There is a genuine operational need for keeping the vehicle depot under the FEHD in Hong Kong East as these vehicles have to serve North Point, Quarry Bay, Shau Kei Wan and Chai Wan. Thus, the permanent depot is required to be located at a suitable site in Hong Kong East to minimise travelling distance within the district.

EMSD Depot

2.2.11. The proposed Project enables the provision of the Hong Kong Vehicle Depot in Hong Kong Island Region for essential and emergency vehicle repair and maintenance services to meet its service requirement on the Hong Kong Island.

2.2.12. Although the Lands Department approved in 2009 a Temporary Government Land Allocation at Sheung On Street, Chai Wan for relocating the EMSD Depot which is pending the accommodation of a permanent vehicle depot. A permanent site is more desirable to ensure prompt emergency support to clients.

GL Specialist Laboratory

2.2.13. In view of a number of requests for enhanced and extended scope of scientific services from other Government departments including the Customs and Excise Department, the Department of Health and the FEHD etc., approval has been given to the GL for creation of a number of new posts and procurement of scientific equipment in the past few

Resources Allocation Exercises (RAEs). Additional accommodation was requested for installation of the procured equipment and service provision by the GL.

2.2.14. Currently, all the laboratory areas in the GL is fully utilised and suitable laboratory space is very limited despite continuous efforts in site searching in recent years. In addition, the annual expenditure for renting laboratory space from purpose-built laboratory premises is recorded to be substantial, the current proposal is regarded as the best long-term measure that settles the shortage of laboratory space faced by the GL and allows saving in rent.

2.3. CONSIDERATION OF ALTERNATIVES

"Without Project" Alternative

2.3.1. A fundamental alternative of the proposed Project is the option not to construct the new vehicle depot-cum-office building in Chai Wan, which is referred to as the "do-nothing" option in environmental terms. As spelt out in *Section 2.2* above, the site is earmarked for the development of the extension of Quarry Bay Park Phase II whilst services provided by the HKPF, FEHD and EMSD on Hong Kong Island is crucial to the public.

2.3.2. In the absence of the proposed Project, the services for the said region would have to depend upon other depot(s) in the other districts, which in turn demands longer travelling distance and time. It would lead to other environmental impacts including increase in traffic volume, and hence noise and vehicular emissions.

2.3.3. The absence of the proposed Project will also affect the future extension of Quarry Bay Park Phase II, as mentioned in *Section 2.2.2* and sustain the shortage problem of GL laboratory, EMSD permanent depot facility and HKPF's case property centralised store.

2.3.4. Taking the above reasons into account, the "do-nothing" option is not preferred and not considered to be an environmentally-preferred solution to cope with the current demand for vehicle repair / testing services from EMSD and operational services from the HKPF, FEHD, EMSD and GL in the region.

Site Location Alternative

2.3.5. As discussed in *Section 2.2* above, there is an urgent need for a vehicle depot-cum-office building on the Hong Kong Island, especially in the Eastern District. In the early planning stage of the proposed Project, two potential sites in the Chai Wan area were identified and shortlisted for evaluation. The locations of the two sites are indicated in ***Figure 2.1***, which include:

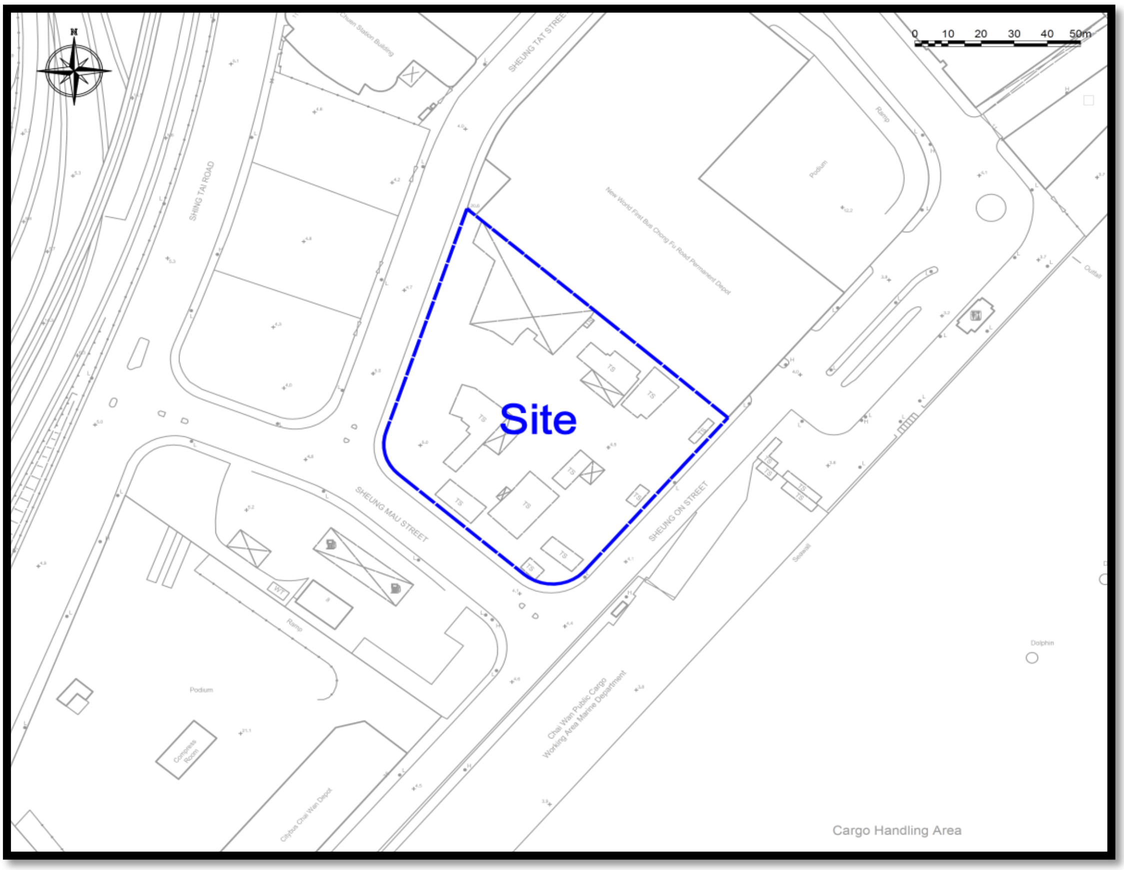
- Site A: the Project site, which is a land piece located at the junction of Sheung Tat Street, Sheung On Street and Sheung Mau Street
- Site B: a nearby land piece which is located at the junction of Sheung Tat Street and Chong Fu Road

2.3.6. Site A is located farther away from nearby residential developments while being sandwiched by the existing New World First Bus Chong Fu Road Permanent Depot (hereinafter referred to as NWFB Depot) to the north and Citybus Chai Wan Bus Depot (hereinafter referred to as Citybus Depot) to the south. The adjacent industrial developments allow less flexibility to building type of future development at the site. Industrial development is therefore considered as one of the most appropriate development types at the aforementioned land piece.

2.3.7. Besides, locating the proposed Project at Site A can also shorten the travelling distance and time to access the major carriageway, the Island Eastern Corridor (IEC). Such arrangement is anticipated to ease the ingress/ egress traffic and also introduce less vehicular emission and noise nuisance to nearby sensitive receivers.

2.3.8. Site B, on the other hand, is located less than 20m from the Heng Fa Chuen Playground and 120m from Knight Court and Heng Fa Chuen Block (Block 50). It is considered as a less favourable site for the proposed Project due to its close proximity to the nearby sensitive receivers and thus would have greater potential of air quality, noise, visual and hazard to life impacts towards nearby residents and users of recreational facilities.

2.3.9. Overall, Site A is deemed to be a more environmentally-favourable option than Site B with a view to the type of adjacent land use, distance to major carriageway and separation from nearby sensitive developments. Site A is eventually selected as the Project site of the proposed Project.



(Selected location of the Project site)

Design Alternatives

2.3.10. The following design options were considered and reviewed in order to optimise the operational and environmental benefits of the facilities:

Form & Scale

2.3.11. The proposed Project aims to re-provide the existing Government facilities, including offices, stores, workshop etc. in Chai Wan. The form and scale of proposed Project was reviewed to examine whether a vehicle depot-cum-office building or discrete facilities at different locations would be a preferred options.

2.3.12. The vehicle depot-cum-office building option enables various Government departments serving the Hong Kong Island to perform their duties in one single building relieving the pressure on land resources, reducing the quantity of building construction materials, giving rise to a more efficient transportation planning, and minimising the overall impacts on landscape resources and visual amenity by the avoidance of establishing multiple buildings or at multiple locations, etc.

Building Design

2.3.13. The building footprint has been optimised to fit the intended use as described in *Section 2.2* by all future operators. Floor-to-floor heights, and consequently the overall building height, of the building are minimised to reduce potential visual impact and at the same time provide sufficient space for vehicle maintenance works and parking of various types of vehicles in the building.

2.3.14. The use of underground basement floor has been considered. However, it would involve longer construction period and generate extensive amount of excavated materials and potential marine sediment. In order to reduce overall environmental impact, this option is not adopted.

Facilities Layout

2.3.15. Layout design was investigated in order to strike a balance between operational need and environmental considerations. Vehicle repair / testing activities that can have potential environmental implication will be fully covered and surrounded by spaces with uses that are relatively non-sensitive to noise impact, e.g. storerooms and staircases, for noise screening / buffering as far as possible.

2.3.16. Moreover, for the sake of enhancing the visual quality of the proposed Project, substantial greenery features were considered, including soft landscaping areas on Level 1 and roof, together with the use of non-reflective materials for building envelope.

Ventilation and Local Exhaust Design

2.3.17. The proposed Project will be fully covered, except the landscape area on Level 1 and the roof floor, with a vast amount of openings at the building façades to optimise the use of natural ventilation, supplemented with the mechanical ventilation system at the car parking areas. Due to the reduced number of mechanical ventilation system to be needed, potential nuisance, particularly the noise from the fixed plant systems, could be minimised.

2.3.18. In addition, for those activities with potential environmental nuisance including vehicle repair / testing activities, controlled mechanical ventilation with sufficient forced air changes is desired, rather than merely rely on natural ventilation. Ventilation exhaust at laboratories of GL is to be treated prior to discharge to the atmosphere. Location and orientation of the local exhaust were carefully examined to ensure sufficient dispersion and to avoid direct impact to the nearby sensitive receivers. Various gas treatments were evaluated and the most appropriate technologies with proven removal efficiency (e.g. activated carbon filter, chemical scrubber, etc.) will be applied when considered necessary, and subjected to detailed design.

Construction Alternatives

2.3.19. For the construction of the proposed Project, the major construction activities comprise the following:

- Site formation, excavation and filling;
- Foundation; and
- Main building construction.

2.3.20. The following factors have to be taken into account for the consideration of different feasible construction methods and sequence of works:

- Severity and duration of the construction impacts on nearby environmental sensitive receivers;
- Satisfaction to the design and functional requirements of the proposed Project, such as loading requirement and the space requirement for the proposed Project facilities;
- Site constraints, such as limited working space, potential impacts to adjacent facilities and ground profile.
- Coordination with concurrent interfacing projects and the future developments within and/or adjacent to the area.

2.3.21. There is no off-site work as part of the proposed Project.

Foundation Works

2.3.22. Foundation works are required for the construction of the proposed Project. The selection of foundation schemes are based on the following criteria:

- Type of structure to be supported;
- Load carrying capacity required;
- Availability of materials and plants;

- Local experience;
- Site constraints; and
- Construction schedule.

2.3.23. The piling options that were considered include:

- Option A – bored piles; and
- Option B – conventional steel H-piles.

2.3.24. Both of the technologies for bored piling and conventional steel-H piling are commonly found in Hong Kong. The advantages and disadvantages of these two piling methods are summarized in ***Table 2.1*** below.

Table 2.1 Advantages and Disadvantages of Bored Piling and Conventional Steel-H Piling

	Bored Piles	Conventional Steel-H Piles
Mechanism	Non-percussive piling method that replace existing soil via drilling	Percussive piling method that displace soils laterally
Applicability	Suitable for medium to high rise building due to its high pile capacity	Suitable for low rise building due to higher flexibility in the pile arrangement, enabling higher load/ capacity
Construction Period	Relatively long in comparison to other pile types (especially in rock)	Shorter construction time to minimize prolong adverse environmental impacts, e.g. fugitive dust, noise, site effluent, visual, C&D waste, etc. during construction phase
Noise Nuisance	Less vibration and noise nuisance	More perceptible impact noise resultant from metal striking
Waste Generation	Pile borehole diameter is normally large in size; Prior excavation is normally required and hence substantial excavation materials would be generated	Minimal waste is generated and fewer plants (e.g. sedimentation tank; grouting machines) are required
Visual Impact	Greater visual disturbance due to the need of more plants and the substantial amount of stockpiles of excavated materials	Visual disturbance is relatively less

2.3.25. Although less noise and vibration would be generated from bored piling during construction, it usually requires longer construction period and more extensive excavation. In view of avoiding and minimising prolonged adverse environmental impact, conventional steel H-piling is considered to be more suitable for the proposed Project.

Site formation, excavation and filling

2.3.26. The construction methods to be adopted for site formation are all conventional methods which include site clearance, excavation and backfilling of topsoil, construction of haul road and utilities laying and finally the landscape works. For these works, the methods are well established and there are limited alternatives.

Main building construction

2.3.27. Main building construction will likely to take the form of one of the following:

- Conventional in-situ reinforced concrete construction;
- Precast concrete construction; or
- Steelwork construction much of which will be in the form of prefabricated steelwork elements.

2.3.28. In general, the aforementioned superstructure construction options will not present significant differences in terms of the environmental impacts to the nearby sensitive receivers. Specific construction method will be determined upon the development of the structural form of the building during later design phase.

Preferred Option

2.3.29. With due considerations of alternatives, a preferred option has been selected for the proposed Project and as summarised below, based on which the detailed design phase will be proceeded and this EIA study was carried out:

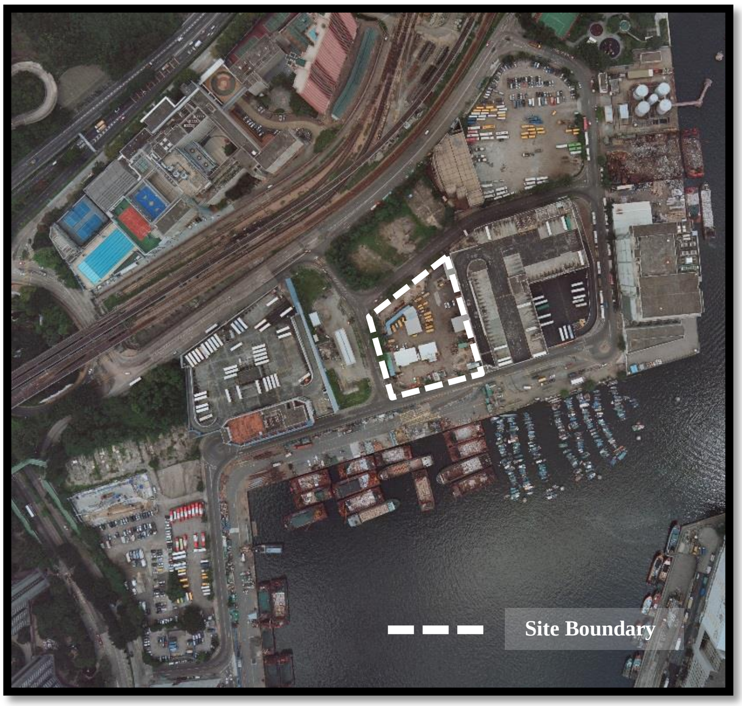
- Optimum site selection;
- Optimum design for form, building design, facilities layout, ventilation and local exhaust design; and
- Optimum construction method

2.3.30. This preferred option by using conventional steel-H piling is determined upon the comparison of the feasibility in line with the environmental benefits and dis-benefits of the various options and alternatives. It was also selected on the principal of minimising the environmental impacts and optimising overall environmental benefits and acceptability over the other options.

3. PROJECT DESCRIPTION

3.1. DESCRIPTION OF THE SITE AREA

3.1.1. The proposed Project is planned to be constructed on a piece of land which is currently allocated as a works and staging area by the Drainage Services Department (DSD). It is surrounded by Sheung Tat Street to the northwest, Sheung Mau Street to the southwest and Sheung On Street to the southeast. According to the approved Chai Wan Outline Zoning Plan (OZP) No. S/H20/21, the Project site is zoned "Government, Institution or Community (2)" ("G/IC(2)"). The proposed Project is subject to a building height restriction of 70mPD (including roof-top structures).



(Aerial Photographs taken on 1st June 2013)

3.1.2. As shown in ***Figure 1.1***, the Project site is located near the promenade of Chai Wan Public Cargo Working Area. The adjacent developments are identified and summarised as follows:

To the South:	Tsui Wan Estate, Citybus Depot
To the East:	Chai Wan Public Cargo Working Area
To the North:	NWFB Depot, Heng Fa Chuen
To the West:	Knight Court, Hong Kong Institute of Vocational Education (Chai Wan), Pamela Youde Nethersole Eastern Hospital

3.1.3. The historical land use activities in chronological order are summarised as follows:

Before 1984:	Marine environment
1984 – 1985:	Reclamation
1988 – 1997:	Sheung On Temporary Housing Area
2001 – 2002:	Temporary works area for road construction project in Chai Wan Reclamation Area
2003 – 2004:	A fee-paying public carpark
2005 – Present:	Temporary works area for Drainage Term Contract for Drainage Maintenance and Construction in Hong Kong Islands and Islands Districts

3.2. DESIGN OF THE PROPOSED PROJECT

3.2.1. Based on the preferred option as discussed in *Section 2.3*, the proposed Project will be constructed in the form of a six-storey building (with a mezzanine floor above Level 3), with a proposed height of +49.8 mPD. The area of the Project site is approximately 7,000 m^2. The floor plans that show the preliminary design of the proposed Project are set out in ***Figure 3.1***. The proposed Project involves the following facilities:

(a) Construction of the HKPF PVP&EC of 5,200 m^2 on Level 1 and 2, which includes:

- Vehicle examination area accommodates an inspection pit (100 m^2), a roller brake tester and load simulator (100 m^2), a vehicle lift (100 m^2), and a level floor examination area (150 m^2);
- Area of staff including offices, discussion room, lecture room, guard room and locker/ changing room (75 m^2);
- A brake test strip (660 m^2) and a brake test ramp (180 m^2);
- Store (39 m^2) and workshop (16 m^2);
- Parking spaces for detention of a minimum of 81 vehicles of various sizes including covered parking for 25 saloon car spaces and 20 motorcycles; and
- Parking spaces for 5 police operational vehicles.

(b) Construction of a vehicle depot under the FEHD of 4,600 m^2 or as appropriate on Level 3 and 4, which includes:

- Parking spaces with minimum headroom of 4 m for 70 vehicles of various sizes with a total required area of 3,755 m^2 or as appropriate with inclusion of circulation space;
- Vehicle washing bay for 1 vehicle with high pressure water jet guns and drainage facilities (72 m^2 or as appropriate);
- Water refilling bay for 2 vehicles (84 m^2 or as appropriate);

- Office area (49 m^2) (22.9m^2 for the open plan office for staff and F/E), ancillary area (233 m^2 or as appropriate), including meeting room, driver stand-by-briefing room, locker and changing rooms, toilet and shower facilities, storeroom and pantry;
- Fire services pump room, compressor room and switch room (100m^2 or as appropriate); and
- Security guard booth (2.5 m^2).

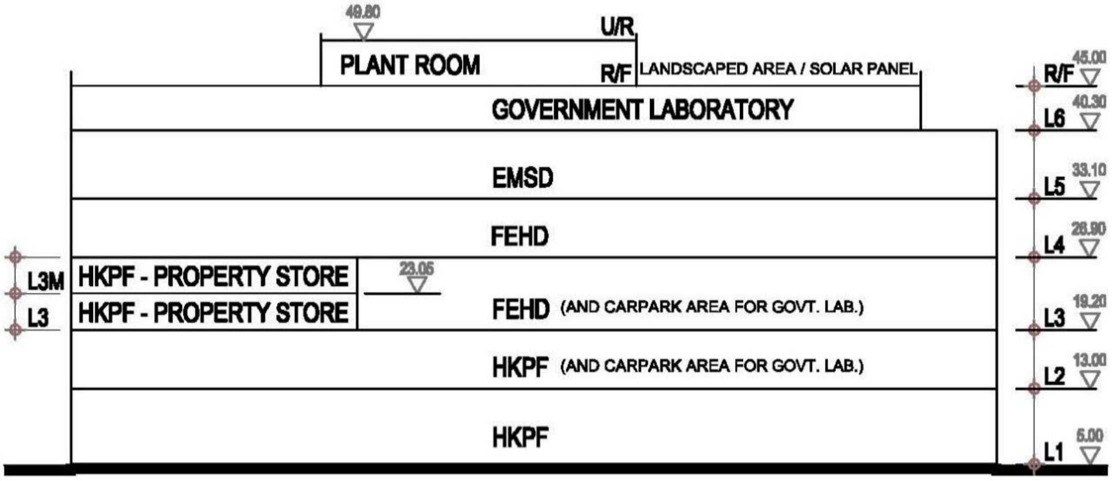
(c) Construction of the HKPF Centralised Case Property Store for the storage of case property for Crime Formations on Level 3 and 3M (about 1,942 m^2).

(d) Construction of a permanent depot under the EMSD of 2,200 m^2 on Level 5, which includes:

- Vehicle repair area and parking area (1,784 m^2);
- Battery charging room (9 m^2);
- Vehicle washing bay for two vehicles with petrol interceptor;
- Lubricant storage/lubricant dosing equipment/ chemical waste storage (37 m^2);
- Air compressor room (7 m^2);
- Tyre charger and tyre balancer area (8 m^2);
- Waste oil tank (200 Litre);
- Waste water sedimentation tanks;
- Office area (total 120 m^2) ; and
- Ancillary area with toilet, shower facilities, pantry, locker, changing rooms and storage.

(e) Construction of a specialist laboratory under the GL of about 2,160 m^2 on Level 6, which includes:

- Testing laboratory area;
- Storage rooms;
- Offices, changing rooms and meeting room;
- Dangerous good stores for Categories 2, 3 and 5 dangerous goods; and
- Parking spaces.



(Schematic Elevation Plan of the Proposed Project)

3.3. OPERATION OF THE PROPOSED PROJECT

Operation Hours in Proposed Project

3.3.1. The vehicles move in and out of the proposed Project only when operation needs, and the movement of vehicles within the proposed Project will be limited. The average daily in and out traffic volumes would be about 365. The total estimated daily numbers of vehicles detained in the proposed Project was determined to be of around 260 in maximum (which equals to the parking spaces for vehicles) and types of vehicles comprise RCVs, street washing vehicles, lorries, saloon cars, motorcycles, police operational vehicles, ambulances and vans.

3.3.2. Major vehicle repair / testing activities at the EMSD Depot will be taken from 0800 to 1800 hours on weekdays, whilst the HKPF examination works will be taken on irregular basis due to operation needs. The PVP & EC will be in operation 24 hours on 7-day per week basis. FEHD depot will operate daily from 0600 to 2330 hours. General offices of EMSD and GL, etc. will operate mainly during normal office hours (0800 to 1800 hours). The summary is shown in ***Table 3.1*** below:

Table 3.1 Operation Hours of the Project

Facilities	Operation Hours
HKPF PVP&EC	Mon – Sun, 24 hrs
HKPF Centralised Case Property Store	Irregular operation hours due to operational needs
FEHD Depot	Mon – Sun, 0600 – 2330 hrs
GL Specialist Laboratory	Mon – Fri, 0800 – 1800 hrs
EMSD Depot	Mon – Fri, 0800 – 1800 hrs

3.3.3. The number of staff working in the proposed Project is estimated to be about 180 and 55 during daytime (0800 to 1800 hours) and evening time (1800 to 2330 hours) respectively, which is shown in ***Table 3.2*** below.

Table 3.2 Total Number of Staff Working in the Proposed Project

Facilities	Total Number of Staff Working at Chai Wan Government Complex and Vehicle Depot		
	Day (0800 - 1800 hrs)	Evening (1800 – 0200 hrs)	Night (0200 – 0800 hrs)
HKPF PVP&EC	7	1	1
HKPF Centralised Case Property Store	21	0	0

FEHD Depot	80 + 3 (station in office during each shift)	41 + 3 (station in office during each shift)	0
GL Specialist Laboratory	36	0	0
EMSD Depot	33	10	0

Proposed Activities in Proposed Project

3.3.4. The activities to be carried out in the proposed Project are summarised in ***Table 3.3*** and further depicted below. Photos of the proposed activities are shown in ***Appendix 3.2***.

Table 3.3 Summary of Vehicle Repair / Testing Equipment and Activities

HKPF PVP&EC	EMSD Depot	FEHD Depot	GL Specialist Laboratory
Braking test (on grade)	Braking test (for vehicles other than motorcycle)	Vehicle washing	Vehicle parking
Braking test (on slope)	Braking test (for motorcycle)	Water refilling in vehicle	Chemical testing
Braking test (for vehicles other than motorcycle)	Speedometer test (for motorcycle)	Vehicle parking	
Use of compressed air, e.g. screw driving	Tyre balancing		
Hammering	Tyre changing		
Vehicle parking	Hammering		
Vehicle lifting	Use of compressed air, e.g. screw driving		
Vehicle examination (in pit)	Vehicle washing		
Vehicle examination (at ground)	Vehicle lifting		
	Engine testing		
	Vehicle parking		
	Chemical mixing, e.g. lubricant mixing		
	Battery charging		
	Chemical refilling, e.g. lubricant refilling		

HKPF PVP&EC

- **Braking test (on grade)** – The brake test strip is used to test the brake system on a vehicle that is operated on grade. During the test at the brake test strip, the vehicle runs at a maximum speed of 30 km/hr. As confirmed by the HKPF, the maximum number of use is assumed to be 5 times per day and it takes around 30 seconds for each operation.
- **Braking test (on slope)** – The brake test ramp is used to test the brake system on a vehicle that is operated on slope. During the test at the brake test ramp, the engine is either set at idle or off. During the test, minimal noise is generated. As confirmed by the HKPF, the maximum number of use is assumed to be 5 times per day and it takes 30 seconds for each operation.
- **Braking test (for vehicles other than motorcycle)** – A roller brake tester will be equipped at the HKPF PVP&EC. During the test, the roller brake tester runs the vehicle's front wheel or rear wheel at a low speed, while the vehicle has its engine switched off. The operator then applies the brake of the vehicle under testing and eventually the respective wheel is locked. The maximum torque is then recorded by the brake tester and the vehicle is pushed away from the brake tester indicating the end of the testing. It also consists of a load simulator which is a device with hydraulic cylinder to test the efficiency of the brake using difference braking forces when loaded or unloaded simulation. During the brake testing and loading test, minimal noise is generated. It takes a maximum of 2 minutes for each operation and the maximum number of use is estimated to be 5 times per day.
- **Use of compressed air, e.g. for screw driving** – An air compressor will be employed for providing power to the pneumatic tools for vehicle repair / testing activities. The air compressors will be housed in a dedicated compressor room. It also involves small wheel wrenches, small jacks, tyres inflators and pumps for pumping of used lube oil.
- **Hammering** – Hammer, a hand-held tool consisting a handle with a head of metal, is used for striking or pounding. It will be used by the vehicle examiner to test if the screw is loosen or to assist dismantling parts of the detained vehicles for testing only. No maintenance or repair services for the detained vehicles will be involved.
- **Vehicle parking** – Vehicle parking spaces will be assigned in the HKPF PVP&EC for various types of vehicles. Vehicle parking activity will be most likely found in day and evening time, whilst car parking at night-time will only be occasional.
- **Vehicle lifting** – A total of 1 vehicle lifting hoist for vehicles would be provided in the HKPF PVP&EC. The hoist is electrically powered with small output motors.
- **Vehicle examination (in pit)** – Vehicle examination pit is a narrow pit or trench over which a vehicle can be parked and conveniently worked on from beneath. The testing at the vehicle examination pit is performed with the engine set at idle.

- **Vehicle examination (at ground)** – There will be a designated area for parking a vehicle for inspection and examination in the HKPF PVP&EC. The testing at the vehicle examination ground is performed with the engine set at idle.

EMSD Depot

- **Braking test (for vehicles other than motorcycle)** – A roller brake tester will be equipped at the EMSD Depot at Level 5. During the test, the roller brake tester runs the vehicle's front wheel or rear wheel at a low speed, while the vehicle has its engine switched on. The operator then applies the brake of the vehicle under testing and eventually the respective wheel is locked. The maximum torque is then recorded by the brake tester and the vehicle is pushed away from the brake tester indicating the end of the testing. It takes around 30 seconds for each operation and the maximum number of use is estimated to be 6 times per day.

- **Braking test (for motorcycle)** – This activity consists of a motorcycle brake tester, and the necessary fixtures. The motorcycle tester operating in a principle similar to the roller brake tester which measures the torque of the wheel when brake is applied. The motorcycle engine running is, however, not required during operation and it takes around 2 minutes per operation and the frequency of use is estimated to be 3 times per day.

- **Speedometer calibration (for motorcycle)** – The motorcycle speedometer calibration involves the motor turning the back wheel of the motorcycle and increasing the speed gradually from 0 km/hr to 150 km/hr, which generates some noise during testing. The speedometer calibrator to be used in the EMSD Depot will be the same or similar to the one utilised at existing EMSD Workshop at Sheung On Street, Chai Wan.

- **Tyre balancing** – A tyre balancer is a piece of motorised measurement equipment which is used to identify the shift of centre of mass of a wheel. During operation, the tyre balancer spins the wheel under testing and suggests the location of calibration weight to be installed. The spinning is conducted at a low speed.

- **Tyre changing** – A tyre changer is an equipment to help the operator to remove and install the tyre from and onto the rim. It basically consists of a fixture and a hook that are placed between the tyre and the rim to pull the tyre from the rim in a rotation. The motor required for the tyre changer is small in scale. It takes around 2 minutes for each operation and the maximum number of use is estimated to be 10 times per day.

- **Hammering** – Hammer, a hand-held tool consisting a handle with a head of metal, is used for striking or pounding.

- **Use of compressed air, e.g. for screw driving** – An air compressor will be employed for providing power to the pneumatic tools for vehicle repair / testing activities. The air compressors will be housed in a dedicated compressor room. It also involves small wheel wrenches, small jacks, tyres inflators and pumps for pumping used lube oil.

- **Vehicle washing** – Water point will be provided for vehicle washing bay in the EMSD Depot. Each operation lasts for around 1 minute and the maximum number of use is estimated to be 10 times per day. As no automatic vehicle washing machine will be provided and thus operational noise generated from cleaning is not considered.
- **Vehicle lifting** – A total of 9 vehicle lifting hoists for vehicles will be provided in the EMSD Depot. The hoists are electrically powered with small output motors.
- **Engine testing** – The testing is performed with the engine set at idle.
- **Vehicle parking** – Vehicle parking spaces will be assigned at Level 5 for various types of vehicles. Vehicle parking activity will be found at day-time and evening time only. No cars will be entering and leaving the EMSD Depot at night-time.
- **Chemical mixing, e.g. lubricant mixing** – The lubricant dosing equipment is used to move a precise volume of liquid in a specified time period providing an accurate flow rate.
- **Battery charging** – An automatic battery charger is used for providing low current charging to vehicle sealed lead-acid battery. No gases/ electrolyte are discharged during the charging operation.
- **Chemical refilling, e.g. lubricant refilling** – Lubricant is filled to vehicles during operation, whilst fresh and waste lubricants are stored at the designated area in the EMSD Depot with spilling control system.

<u>FEHD Depot</u>

- **Vehicle washing** – 1 water point for manual vehicle washing and 1 automatic vehicle washing machine will be provided in the FEHD Depot. When passing the vehicle washing machine, vehicle keeps the engine running. It normally takes about 2 minutes to complete a washing cycle. It is expected that a maximum of about 33 vehicles (including RCVs) would use the automatic vehicle washing machine every day. More details in relation to the operation of RCVs are given in *Sections 3.3.5 to 3.3.8*.
- **Water refilling in vehicles** – 1 water refilling machine will be provided for street washing vehicles and the provision will be the same or similar to the one at existing FEHD Depot in Quarry Bay. Engine of street washing vehicle is switched off when refilling.
- **Vehicle parking** – 70 vehicle parking spaces will be assigned at Level 3 and 4 of the FEHD Depot for storage of various types of vehicles. Vehicle parking activity will be found in day-time, evening time and night-time.

<u>GL Specialist Laboratory</u>

- **Vehicle parking** – Vehicle parking spaces will be assigned at Level 2 and 3 for various types of vehicles for the GL. Vehicle parking activity will be found in day-time and evening time only.

- **Chemical testing** – Chemical testing will be carried out during normal office hours at Level 6 of the proposed Project. Samples to be analysed in the Government laboratory include sediment, soil, wastewater, marine water, river water, biota, consumer products, air canister, etc. Proper devices such as fumehood will be installed to minimise the exhaust of volatile compound and acidic gases.

Refuse Collection Vehicles (RCVs) in Proposed Project

3.3.5. A total of 17 parking spaces in the FEHD Depot will be designated for parking of RCVs. The fleet of 16 RCVs are expected to enter the proposed Project from 0600 to 2300 hours every day. The maximum hourly flow will happen between 1200 and 1300 hours, during which 8 RCVs will move in the proposed Project.

3.3.6. No vehicle repair / testing activities for RCVs will be conducted within the entire depot areas, including the EMSD Depot.

3.3.7. All the RCVs that visit the proposed Project are of enclosed-type and equipped with deodourising system with an odour removal efficiency of 85% or above. The design of the RCVs complies with the Code of Practice on the Operation of RCVs jointly published by the EPD, Transport Department and Environmental Contractors Management Association.

3.3.8. To avoid the spreading of odour, all RCVs will be fully off-loaded in designated refuse disposal sites and washed thoroughly in the Island East Transfer Station or disposal site before returning to the FEHD Depot. Extensive cleansing and clearance of refuse residual inside the compactor of the RCVs would not be carried out within the proposed Project. The body shell of RCVs may be rinsed again in the FEHD Depot to ensure the removal of any waste residue. All RCVs will be wiped dry before leaving proposed Project.

3.3.9. The metal tailgate cover and compactors of RCVs will not be opened while passing through the vehicle washing bay or automatic vehicle washing machine. It normally takes about 2 minutes to complete a washing cycle. Moreover, wastewater from the washing of RCVs will not be recovered for other uses. No potential odour, noise and waste water runoff nuisance is therefore anticipated.

3.4. CONSTRUCTION METHODOLOGY

3.4.1. Based on the preferred option of the proposed Project, at the commencement of construction, site formation works will be carried out and these will comprise the fencing off of the site boundary, cutting and removal of unwanted rocks, shrubs, trees and building debris, levelling of soil surface, excavation of soil to the required level with shoring if necessary. These tasks will involve the use of hand-held breakers and tracked excavators etc.

3.4.2. Conventional steel H-pile has been proposed. It is estimated that 325 nos. of 50 m steel H-pile may be required, subject to future design. Conventional bottom-up reinforced concrete construction will be adopted for the superstructure construction with beam-slab.

The floor consists of suspended beam and slabs which are supported by columns and structural walls. Formwork and temporary support for the beam and slab construction will be installed.

3.5. PROJECT IMPLEMENTATION PROGRAMME

3.5.1. The construction of the proposed Project will tentatively be commenced in period from Mid 2016 to Mid 2017 depending on the design process and will last for about 29 months. For the purpose of this EIA study, a conservative approach for the construction period is assumed to start in Mid 2016, where more concurrent projects are in place. The preliminary construction programme of the proposed Project is shown in ***Appendix 3.1***.

3.6. CONCURRENT PROJECTS

3.6.1. There are several concurrent projects in the vicinity of the Project site, as also depicted in ***Figure 1.1*** and summarised in ***Table 3.4***. At this stage, consideration of concurrent projects for cumulative environmental impacts will only take into account those with the available implementation programmes. Cumulative impacts from existing, committed and planned major concurrent projects, if any, have been assessed in the individual sections of this EIA study.

Table 3.4 List of Potential Concurrent Projects

Concurrent Projects	Potential Cumulative Impacts	
	Construction Phase	Operation Phase
Planned THEi New Campus (construction tentatively between the third quarter of 2013 and the third quarter of 2016; operation phase from the third quarter of 2016)	✓	✓
Existing EMSD Hong Kong Workshop at Chai Wan (EP-442/2012)	×	×
Existing New World First Bus Permanent Depot at Chai Wan (EP-052/2000)	×	✓
Existing Headquarter and Bus Maintenance Depot in Chai Wan (EP-107/2001)	×	✓

3.7. IDENTIFICATION OF KEY ENVIRONMENTAL ISSUES

3.7.1. The identified key environmental issues during the construction and operation phases include the following:

<u>During Construction Phase</u>

- Potential dust impacts arising from the construction works activities of the proposed Project;

- Potential noise impacts arising from the construction works activities of the proposed Project;
- Potential water quality and sewerage impacts arising from the construction works activities and workforce;
- Potential waste management implication and land contamination issues arising from the construction works activities;
- Potential landscape and visual impacts arising from the construction works activities;
- Potential hazard to life arising from the neighbouring dangerous goods (DGs) processing and storage facilities; and
- Potential cumulative environmental impacts through interaction or in combination with other existing, committed and planned concurrent projects.

<u>During Operation Phase</u>

- Potential fixed noise impacts arising from operation plant and vehicle repair / testing activities in the proposed Project and road carriageways in the vicinity of the proposed Project;
- Potential vehicular emission and pollutant emission impacts arising from the vehicle repair / testing activities in the proposed Project and road carriageways in the vicinity of the proposed Project;
- Potential sewerage impacts arising from the workforce in the proposed Project;
- Potential waste management implications arising from the vehicle repair / testing activities of the proposed Project;
- Potential hazard to life arising from the neighbouring dangerous goods (DGs) processing and storage facilities as well as the proposed Project;
- Potential landscape and visual impacts arising from the operation of the proposed Project; and
- Potential cumulative environmental impacts of the proposed Project, through interaction or in combination with other existing, committed and planned projects in the vicinity of the proposed Project, and that those impacts may have a bearing on the environmental acceptability of the proposed Project.

3.8. PUBLIC ENGAGEMENT

3.8.1. Public comment, including potential odour issues from the activities, road vehicular noise and air emissions, as well as the selection of traffic routing of the future vehicle fleets, were received from different stakeholders during the course of planning and development of the proposed Project in the meetings of District Facilities Management Committee (DFMC) of the Eastern District Council.

3.8.2. The project design team has been exploring possible design enhancement in response to the public comment received. For example, the current design of the proposed Project has already incorporated the provision of odour removal equipment and ventilation system in order to minimise nuisance to the neighbourhood. The proposed Project would also maximises the building footprint and be built with building height of 49.8mPD (or 45.0mPD excluding roof-top structures), in respond to the comments from DFMC that the site area shall be maximised and building height of the proposed Project should be comparable to that of the adjoining NWFB Depot, which is approximately 45.0mPD.

3.8.3. Furthermore, the associated environmental nuisances have been adequately assessed in the following sections of the report to address public concerns.

4. AIR QUALITY IMPACT ASSESSMENT

4.1. INTRODUCTION

4.1.1. This section identifies potential impacts on air quality that may arise from the construction and operation of the proposed Project. The construction dust impact and operational air quality impact from the proposed Project were assessed. Where necessary, appropriate mitigation measures have been recommended to reduce the impacts from the proposed Project at the air sensitive receivers (ASRs) to satisfy the related environmental ordinances, legislation, standards and guidelines.

4.2. ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

4.2.1. The establishment of the air quality impact assessment criteria of this EIA study was made in accordance with the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Air Pollution Control Ordinance (APCO) (Cap. 311), Air Pollution Control (Construction Dust) Regulation, Hong Kong Planning Standards and Guidelines (HKPSG), Annexes 4 and 12 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) as well as the requirements given in clause 3.4.3 and Appendix A of the EIA Study Brief (No. ESB-267/2014) issued in March 2014.

<u>Hong Kong Planning Standards and Guidelines</u>

4.2.2. The APCO provides regulatory framework on controlling air pollutants from a variety of stationary and mobile sources and encompasses a number of Air Quality Objectives (AQOs). Moreover, the Government's overall policy objectives for air pollution are laid down in Chapter 9 of the HKPSG as follows:

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

<u>Air Pollution Control Ordinance: Air Quality Objectives</u>

4.2.3. The AQOs stipulate the concentrations for a range of air pollutants, namely sulphur dioxide (SO_2), respirable suspended particulates (PM_{10}), fine suspended particulates ($PM_{2.5}$), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), and lead (Pb). The AQOs are summarised in ***Table 4.1.***

Table 4.1 Hong Kong Air Quality Objectives

Pollutant	Concentration Limit, µg/m^3 [1] (Number of Exceedances per Calendar Year Allowed in Brackets)				
	10-minute	**1-hour**	**8-hour**	**24-hour**	**Annual**
Sulphur dioxide (SO_2)	500 (3)			125 (3)	
Respirable suspended particulates (PM_{10}) [2]				100 (9)	50 (N/A)
Fine suspended particulates ($PM_{2.5}$) [3]				75 (9)	35 (N/A)
Nitrogen dioxide (NO_2)		200 (18)			40 (N/A)
Ozone (O_3)			160 (9)		
Carbon monoxide (CO)		30,000 (0)	10,000 (0)		
Lead (Pb)					0.5 (N/A)

Notes:
[1] All measurements of the concentration of gaseous air pollutants, i.e., SO_2, NO_2, O_3 and CO, are to be adjusted to a reference temperature of 293 K (20^{o}C) and a reference pressure of 101.325 kPa (one atmosphere). Meanwhile, “N/A” represents not applicable since there is no AQO for such parameter.
[2] PM_{10} means the suspended particulates in air with a nominal aerodynamic diameter of 10 µm or smaller.
[3] $PM_{2.5}$ means the suspended particulates in air with a nominal aerodynamic diameter of 2.5 µm or smaller.

<u>Environmental Impact Assessment Ordinance: Technical Memorandum on Environmental Impact Assessment Process</u>

4.2.4. The criteria and guidelines for evaluating air quality impacts are set out in Section 1 of Annex 4 and Sections 1 to 3 of Annex 12 respectively of the EIAO-TM. Annex 4 of the EIAO-TM stipulates that the 1-hour total suspended particular (TSP) level should not exceed 500 µg/m^3 measured at 298 K (25 ^{o}C) and 101.325 kPa (one atmosphere) for the construction dust impact assessment. Annex 12 describes the guidelines on conducting air quality assessment, including determination of ASR, identification of emission characteristics and impact prediction and assessment etc.

Air Pollution Control (Construction Dust) Regulation

4.2.5. Mitigation measures for construction sites are specified in the Air Pollution Control (Construction Dust) Regulation. Notifiable and regulatory works are, also, under the control of this Regulation, in which appropriate dust control and suppression measures should be duly provided.

4.2.5.1. Notifiable works under the Air Pollution Control (Construction Dust) Regulation include:

- Site formation;
- Reclamation;
- Demolition of a building;
- Work carried out in any part of a tunnel that is within 100 m of any exit to the open air;
- Construction of the foundation of a building;
- Construction of the superstructure of a building; and
- Road construction work.

4.2.6. Regulatory works include:

- Renovation carried out on the outer surface of the external wall or the upper surface of the roof of a building;
- Road opening or resurfacing work;
- Slope stabilisation work; and
- Any work involving any of the following activities:
  - Stockpiling of dusty materials;
  - Loading, unloading or transfer of dusty materials;
  - Transfer of dusty materials using a belt conveyor system;
  - Use of vehicles;
  - Pneumatic or power-driven drilling, cutting and polishing;
  - Debris handling;
  - Excavation or earth moving;
  - Concrete production;
  - Site clearance; and
  - Blasting.

4.2.7. The proposed Project will include site formation, excavation and filling, foundation and construction of the main building, and is therefore notifiable. It will also include stockpiling of dusty materials, loading, unloading or transfer of dusty materials, use of vehicles, pneumatic or power-driven drilling, cutting and polishing, debris handling and site clearance, and is therefore regulatory.

Odour Criterion

4.2.8. In accordance with Section 1 of Annex 4 of the EIAO-TM, the limit of 5 odour units (OU) based on an averaging time of 5 seconds for odour prediction assessment should not be exceeded at any ASRs.

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

4.2.10. In the proximity of the proposed Project, no odour-generating activity was identified. Nevertheless, odour emission due to the refuse collection vehicles (RCVs) of the proposed Project was evaluated and will be presented in the later sections.

Air Quality Criterion for Non-criteria Pollutants

4.2.11. Various organic or inorganic chemicals such as chloroethane, chloroform, hexachlorobenzene, arsenic, beryllium etc. would be released during the laboratory testing and operation of the GL Specialist Laboratory. In view of the absence of local statutory guidelines for non-criteria pollutants, the criteria available from international recognisable organisations are adopted in this study.

Other Environmental Guidelines Related to Air Quality

4.2.12. Other environmental guidelines and technical circulars published by the EPD which are of relevance to the study include:

- Guidelines on Assessing the 'TOTAL' Air Quality Impacts;
- Guidelines on Choice of Models and Model Parameters;
- Guidelines on Estimating Height Restriction and Position of Fresh Air Intake Using Gaussian Plume Models;
- Guidelines on the Estimation of 10-minute Average SO_2 Concentration for Air Quality Assessment in Hong Kong;
- Guidelines on the Estimation of $PM_{2.5}$ for Air Quality Assessment in Hong Kong; and
- Guidelines on the Use of Alternative Computer Models in Air Quality Assessment.

4.3. DESCRIPTION OF EXISTING ENVIRONMENT

Background

4.3.1. The proposed Project is planned to be constructed on area piece of land which is currently allocated as a works and staging area by DSD. It is surrounded by Sheung Tat Street to the northwest, Sheung Mau Street to the southwest and Sheung On Street to the southeast. The Project site is zoned “G/IC(2)”, whilst the surrounding areas are predominately zoned “Industrial”, “G/IC” and “Open Space”. As shown in ***Figure 1.1***, developments in the vicinity of the site are identified and summarised in *Section 3.1.2*.

4.3.2. Dominant air pollution sources include the road traffic emissions mainly from Shing Tai Road, Island Eastern Corridor (IEC) and Wing Tai Road Flyover and to a lesser extent from Sheung On Street, Sheung Tat Street and Sheung Mau Street.

Air Quality in Eastern District

4.3.3. There is no fixed air quality monitoring station close to the Project site. The nearest EPD air quality monitoring station (AQMS) with similar characteristics to the study area is the Eastern AQMS at Sai Wan Ho Fire Station at 20 Wai Hang Street, Sai Wan Ho. Its latest 5 years of air quality data, i.e. 2009 to 2013, are summarised in ***Table 4.2*** to depict the trend of the localised air quality.

Table 4.2 Background Air Quality at Eastern Air Quality Monitoring Station

Pollutant	5-year Annual Average Concentration 2009-2013 ($\mu g/m^3$)[1]	Annual AQO ($\mu g/m^3$)[2]
SO_2	8.4	N/A
PM_{10}	42.0	50
$PM_{2.5}$[3]	27.7	35
NO_2	<u>57.4</u>	40
O_3	42.0	N/A

Notes:
[1] Monitoring result(s) exceeding the AQO is/are underlined.
[2] “N/A” represents not applicable since there is no AQO for such parameter.
[3] Measured concentration is only available between 2011 and 2013.

4.4. IDENTIFICATION OF AIR SENSITIVE RECEIVERS

4.4.1. As stated in clause 3.4.3 of the EIA Study Brief, the study area for the air quality impact assessment should be defined by a distance of 500 m from the boundary of the Project site. ASRs were identified in accordance with Annex 12 of the EIAO-TM, including any domestic premises, hotels, hostels, hospitals, medical clinics, nurseries, temporary housing accommodation, schools, educational institutions, offices, factories, shops, shopping centres, places of public worship, libraries, courts of law, sports stadiums, performing arts centres or any recreational facilities. Assessment points of the identified ASRs were carefully selected in order to represent the worst impact point of these ASRs.

4.4.2. The existing ASRs were identified with reference to the latest best available information at the time of preparation of this report, like those showing on the survey maps, topographic maps, aerial photos and other relevant published land use plans. Various site surveys were conducted to verify the sensitive receivers and confirm with the desktop studies.

4.4.3. The existing ASRs include those at Knight Court, Hang Fa Tsuen, Tsui Wan Estate, the Hong Kong Institute of Vocational Education (Chai Wan) and Pamela Youde Nethersole Eastern Hospital etc.

4.4.4. The committed / planned ASRs were identified with reference to the latest best available information at the time of preparation of this study, which include those earmarked on the approved Chai Wan OZP (No. S/H20/21), and other relevant published land use plans, including plans and drawings published by the Lands Department and any land use and development applications approved by the Town Planning Board.

4.4.5. The committed / planned ASRs, such as a planned pet garden at Sheung On Street and a planned THEi New Campus were identified. Details of the representative existing and planned ASRs are shown in ***Figure 4.1*** and summarised in ***Table 4.3.*** The photos taken during the site visit on 20 May 2014 is presented in ***Appendix 4.1***.

Table 4.3 Representative Air Sensitive Receivers

ASR ID	Description	Approx. Horizontal Distance to Project Site (m)	Approx. Building Height (m)	Existing (E) or Planned (P)	Land Use
ASR 1	Metro Recreational Club Chai Wan Depot Club House (MTR Facilities)	210	6	E	Recreational
ASR 2	Heng Fa Chuen Lutheran Day Nursery	435	6	E	Educational
ASR 3	Heng Fa Chuen Block 1	465	48	E	Residential
ASR 4	Heng Fa Chuen Block 50	300	66	E	Residential
ASR 5	Heng Fa Chuen Playground	215	-	E	Recreational
ASR 6	Government Logistics Centre	135	48	E	Government
ASR 7	NWFB Depot	50	40	E	Industrial
ASR 8	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	145	18	E	Educational
ASR 9	Knight Court Flat A & B	180	72	E	Residential
ASR 10	Knight Court Flat C & D	160	72	E	Residential
ASR 11	Citybus Depot	55	12	E	Industrial
ASR 12	EMSD Workshop	190	-	E	Industrial
ASR 13	Wing Tai Road Garden	295	-	E	Recreational
ASR 14	Pamela Youde Nethersole Eastern Hospital - Block F	430	66	E	Community

ASR ID	Description	Approx. Horizontal Distance to Project Site (m)	Approx. Building Height (m)	Existing (E) or Planned (P)	Land Use
ASR 15	Pamela Youde Nethersole Eastern Hospital - East Block	440	27	E	Community
ASR 16	Tsui Wan Estate Playground	340	-	E	Recreational
ASR 17	Tsui Shou House, Tsui Wan Estate	345	93	E	Residential
ASR 18	Endeavourers Chan Cheng Kit Wan Kindergarten	340	3	E	Educational
ASR 19	Tsui Ching House, Hang Tsui Court	410	75	E	Residential
ASR 20	Tsui Wan Nursing Home Limited	400	3	E	Community
ASR 21	Tsui Wan Estate Shopping Complex	425	9	E	Commercial
ASR 22	S.K.H Li Fook Hing Secondary School	455	18	E	Educational
ASR 23	TWGHs & LKWFSL Mrs Fung Yiu Hing Memorial Primary School	455	18	E	Educational
ASR 24	Chai Wan Fire Station	440	15	E	Government
ASR 25	Chai Wan Industrial City Phase II	300	71	E	Industrial
ASR 26	Ming Pao Industrial Centre Block B	390	84	E	Industrial
ASR 27	Safety Godown Industrial Building	315	53	E	Industrial
ASR 29	Planned Pet Garden at Sheung On Street	255	-	P	Recreational
ASR 30	Planned THEi New Campus	200	63	P	Educational

4.5. IDENTIFICATION OF POTENTIAL SOURCES OF IMPACTS

Construction Phase

4.5.1. As mentioned in *Section 2.3* of this EIA Report, no major earthworks will be required for site formation works for the proposed Project where construction of basement structure does not exist. Only minor excavation works would be anticipated for the construction of the concrete footing for the support of the building structure and the underground plumbing and drainage works. Since the amount of construction and demolition materials generated would be minimal, impacts from the transportation of dusty materials would be negligible. In addition, dust potentially generated as a result of the concreting works for the footing and concrete floor slab would be insignificant as the concrete will be pre-mixed and transferred to the Project site by concrete lorry mixers.

Operation Phase

4.5.2. During operation of the proposed Project, potential sources to the surrounding would be air pollutant emissions from vehicular movement and idling vehicles with their started engines within the proposed Project. In addition, potential air quality impacts during the operation phase of the proposed Project would be dominated by the vehicular emissions from the nearby open roads.

4.5.3. Vehicular emission comprises a number of pollutants, including NO_x, PM_{10}, SO_2, CO, Pb, TAPs etc. Motor vehicles are the main causes of high concentrations of NO_x, PM_{10} and $PM_{2.5}$ at street level in Hong Kong and are considered as key air quality pollutants for projects located at urbanised area. For other pollutants, due to the low concentration in vehicular emission, they are not considered as key pollutants for the purpose of this study.

Nitrogen Oxides (NO_x)

4.5.4. NO_x are the major pollutants from fossil fuel combustion. According to the "Environment Hong Kong 2013" published by EPD and Environment Bureau, road transport is the second largest NO_x contributor which accounted for 29% of the total emission in Hong Kong in 2011. Increasing traffic flow would inevitably increase the NO_x emission and subsequently the roadside NO_2 concentration. Hence, NO_2 is one of the key pollutants for the operational air quality impact assessment of the proposed Project. 1-hour and annual averaged NO_2 concentrations at each representative ASRs would be assessed and compared with the local AQOs to determine the compliance.

Respirable Suspended Particulates (PM_{10})

4.5.5. PM_{10} refers to suspended particulates with a nominal aerodynamic diameter of 10μm or less. According to the "Environment Hong Kong 2013" published by EPD and Environment Bureau, road transport is the second largest PM_{10} contributor in 2011 which accounted for 19% of the total emission. Increasing traffic flow would inevitably increase the roadside PM_{10} concentration. Hence, PM_{10} is also one of the key pollutants for the operational air quality assessment of the proposed Project. 24-hour and annual averaged RSP concentrations at each representative ASRs would be assessed and compared with the local AQOs to determine the compliance.

Fine Suspended Particulates ($PM_{2.5}$)

4.5.6. $PM_{2.5}$ refers to suspended particulates with a nominal aerodynamic diameter of 2.5μm or less. $PM_{2.5}$ is also a component of PM_{10}. Given the importance of PM_{10} being a major air pollutant due to road traffic, increase in traffic volume would inevitably increases the roadside $PM_{2.5}$ concentration. Hence, $PM_{2.5}$ is also one of the key pollutants for the operational air quality assessment of the proposed Project. 24-hour and annual averaged FSP concentrations at each representative ASRs would be assessed and compared with the local AQOs to determine the compliance.

Sulphur Dioxide (SO_2)

4.5.7. SO_2 is formed primarily from the combustion of sulphur-containing fossil fuels. SO_2 emission from vehicular exhaust is due to the sulphur content in diesel oil. According to EPD's "Cleaning the Air at Street Level", ultra low sulphur diesel (ULSD) with a sulphur content of only 0.005% has been adopted as the statutory minimum requirement for motor vehicle diesel since April 2002, which is 3 years ahead of the European Union.

Given the use of ULSD, road transport is the smallest share of SO_2 emission sources in 2011 and only constitutes <1% of the total SO_2 emission, according to the information of the "Environment Hong Kong 2013" published by EPD and Environment Bureau. As from 1 July 2010, EPD has tightened the statutory motor vehicle diesel and unleaded petrol specifications to Euro V level, which further tightens the cap on sulphur content from 0.005% to 0.001%.

4.5.8. Road traffic therefore contributes to only a very small amount of SO_2 emission, relatively low measured concentrations. With 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 in the air impact assessment for road traffic.

Carbon Monoxide (CO)

4.5.9. CO is a typical pollutant emitted from fossil fuel combustion and comes mainly from vehicular emissions. With reference to the "Air Quality in Hong Kong 2012" issued by the EPD, the highest measured 1-hour average (3,810 $\mu g/m^3$) and the highest 8-hour average (3,018 $\mu g/m^3$) in 2012 were both recorded at the Causeway Bay roadside station; these values were around one eighth and one third of the respective AQOs limits. In view of the fact that there exists a huge margin to the AQOs, CO would not be a critical air pollutant of concern in this study.

Ozone (O_3)

4.5.10. O_3 is a secondary pollutant which is produced from photochemical reaction between NO_x and volatile organic chemicals (VOCs) in the presence of sunlight, which will not be generated by any man-made activities/ sources. Concentration of O_3 is governed by both precursors and atmospheric transport from other areas. When precursors transport along under favourable meteorological conditions and sunlight, O_3 will be produced. This explains why higher O_3 levels are generally not produced in the urban core or industrial area but rather at some distance downwind after photochemical reactions have taken place. In the presence of large amounts of NO_x in the roadside environment, O_3 reacts with nitrogen monoxide (NO) to give NO_2 and then results in O_3 removal. O_3 is therefore not considered as a key air pollutant for the operational air quality assessment of the proposed Project.

Lead (Pb)

4.5.11. The sale of leaded petrol has been banned in Hong Kong since 1 April 1999. According to the "Air Quality in Hong Kong 2012", the measured ambient lead concentrations of overall 3-month averages in 2012 range from 11 ng/m^3 (Tung Chung) to 57 ng/m^3 (Yuen Long). The measured concentrations were well below the AQOs limits. Therefore, lead is not considered as a critical air pollutant of concern.

Toxic Air Pollutants (TAPs)

4.5.12. TAPs, also known as hazardous air pollutants, refer to any airborne substances which may cause or have the potential to cause adverse health effects at anticipated ambient exposures. Since 1997, the EPD has started to monitor various TAPs and the monitoring data collected so far indicate that the levels of toxic air pollutants in Hong Kong are comparable to those observed in other major cities. TAPs due to the operation of the GL Specialist Laboratory would be discussed in later section and evaluate the level of impacts.

4.5.13. In short, 1-hour and annual concentrations of NO_2 as well as 24-hour and annual concentrations of PM_{10} and $PM_{2.5}$ would be simulated and calculated by appropriate air modelling softwares.

4.5.14. In order to assess the cumulative air quality impact, cumulative pollutant-emitting activities within the study area were reviewed in the air quality impact assessment, including:

- Road traffic emissions from all road links within the 500 m from the boundary of the Project site, including IEC, Wing Tai Road, Shing Tai Road, Sheung Mau Street and Sheung On Street etc.;
- Vehicular gaseous emissions within the proposed Project;
- Idling gaseous emissions within the proposed Project;
- Odour emissions within the proposed Project; and
- Volatile chemical emissions within the proposed Project.

4.6. LIST OF CONCURRENT PROJECTS

4.6.1. There are several concurrent projects in the vicinity of the Project site, as summarised in ***Table 3.4***. The list was based on the best available information received at the time of assessment and only those with implementation programme would be considered as concurrent projects for cumulative impacts. Potential cumulative impacts of various environmental aspects, if any, from the planned major concurrent projects, are assessed in the individual sections of this EIA study.

During Construction of the Concurrent Projects

4.6.2. As aforementioned in *Section 4.5.1* in this report, dust generated during construction of the proposed Project would be expected to be minimal. According to the reply from the Vocational Training Council, the construction works for the planned THEi New Campus at adjacent western boundary of the site would be anticipated to commence in around the third quarter of year 2013 and completed in around the third quarter of year 2016. Therefore, the construction of the proposed Project would have an overlapping with the planned THEi New Campus for a short period of time (probably only one to two months). With the implementation of sufficient dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation and good site practices, significant dust generated from the construction of the planned developments is not anticipated. Hence, adverse cumulative dust impact during the construction phase of the proposed Project would not be anticipated.

During Operation of the Concurrent Projects

4.6.3. For the concurrent projects during the operation phase of the proposed Project, vehicular emissions from the open road traffic are assessed by CALINE 4 to evaluate the air quality impact.

4.7. ASSESSMENT METHODOLOGY

Construction Phase

4.7.1. With the implementation of good site practices and sufficient dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation, significant dust generation from the construction of the proposed Project is not anticipated. No adverse impact to the representative ASRs would be anticipated. Therefore, quantitative dust impact assessment has not yet been considered as required.

Operation Phase

General Approach

4.7.2. The study area for this air quality impact assessment was defined by a distance of 500 m from the boundary of the Project site.

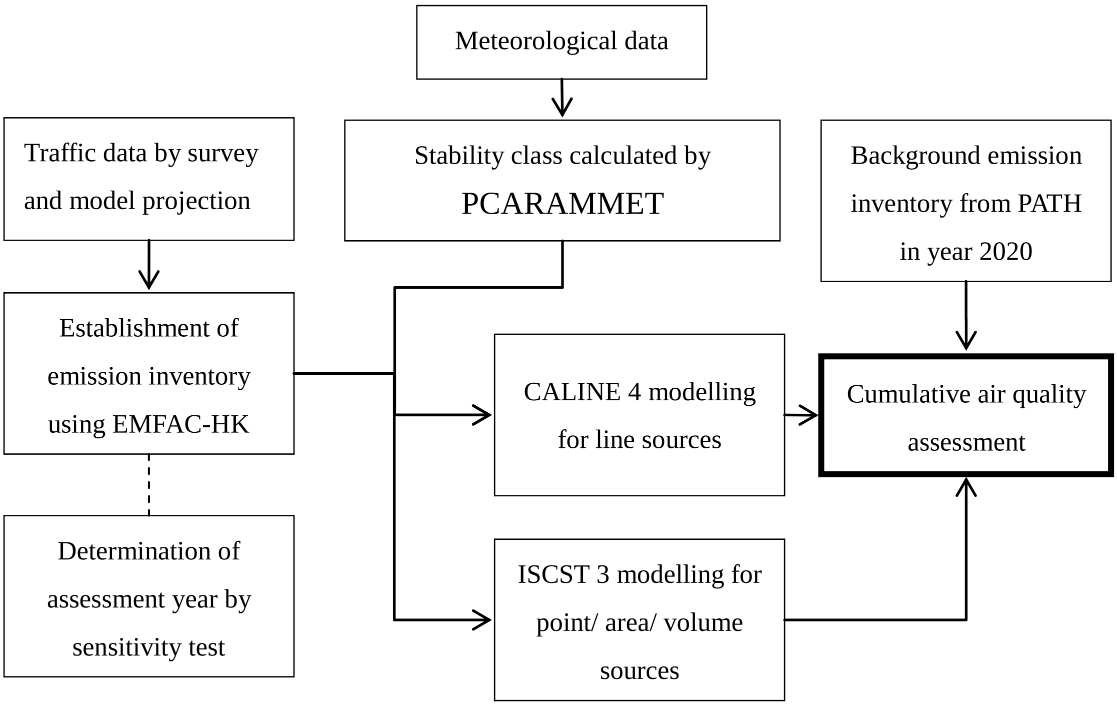
4.7.3. A regional air quality prediction model developed by the EPD, Pollutants in the Atmosphere and the Transport over Hong Kong (PATH), was used to quantify the background air quality levels in the study area. The closest PATH model year to the occupancy year of the proposed Project, i.e. 2020, was selected.

4.7.4. A near-field dispersion model was used, i.e. CALINE4, for line sources to quantify the air quality impacts at local scale from open road emission. Another near-field model ISCST3 was used to assess point and volume sources to quantify the air quality impacts at local scale from volume sources induced by the activities within the proposed Project.

4.7.5. The steps for the air quality modelling for operation phase started with formatting the traffic figures by survey and model projection. Secondly, the assessment year was determined using EMFAC-HK by finding out the maximum emission inventory of the modelled 3 years, i.e. 2018, 2023 and 2033. The calculated total vehicular tailpipe emission plus the traffic data were then used to establish the hourly emission factor for the open roads within the 500 m study area in the selected assessment year. With the aid of CALINE 4, air quality impacts due to NO_2, PM_{10} and $PM_{2.5}$ from open roads were predicted. On the other hand, the emissions from the proposed Project are assessed by ISCST3 for the same selected assessment year.

4.7.6. The cumulative concentrations of simulation results from CALINE 4 and ISCST 3, together with the PATH data in year 2020 at grid (33,25), (33,24), (34,25) and (34,24) as background concentrations, were predicted at the representative ASRs in this air quality assessment.

4.7.7. The overall methodology is illustrated below:



4.7.8. As mentioned in ***Table 3.1***, the operation hours of the proposed Project for different future users are various, and dependent on their operation needs. The average daily in and out traffic volumes will be about 365, where the breakdown of the hourly in and out traffic volume has been verified with the HKPF, EMSD, FEHD and GL respectively.

Meteorological Data from Hong Kong Observatory (HKO)

4.7.9. The meteorological characteristics of the nearest available HKO's meteorological station(s) are found representative for the study area. Weather data for the year 2013 was adopted in the model. It is also confirmed that the data is at least 90% valid. Relevant information are summarised as below:

- Temperature: hourly record in 2013 from King's Park Weather Station; and
- Relative humidity: hourly record in 2013 from King's Park Weather Station.

4.7.10. Under the circumstance where wind speed is 1.0 m/s or less, wind speed was assumed to be a minimum of 1.0 m/s to represent the worst-case scenario in accordance with the Guidelines on Choice of Models and Model Parameters.

4.7.11. Wherever the hourly meteorological data is not available, the results of the related hours were not considered.

4.7.12. The annual average hourly values are arithmetic mean of the same hourly interval over the entire year. Useful data was selected to obtain the annual hourly average of temperature and relative humidity to generate the representative emission factor from EMFAC-HK. The adopted values are given in ***Appendix 4.2***.

Meteorological Data from Mesoscale Model 5 (MM5) in PATH Model

4.7.13. MM5 meteorological data with a base year of 2010 directly extracted from the PATH model was used as input into the CALINE 4 and ISCST 3 models. Grid-specific composite meteorological data was adopted, including:

- Wind speed;
- Wind direction;
- Mixing height; and
- Temperature.

4.7.14. The hourly values for atmospheric stability class from meteorological surface observations was calculated by a separate model called PCARAMMET for the use in the CALINE 4 and ISCST 3 modelling.

4.7.15. The study area of the proposed Project covers grid (33, 25), (33, 24), (34, 25) and (34, 24) as appended in ***Figure 4.2***. Raw MM5 meteorological data was extracted from these grids for the purpose of assessment.

Traffic Data

4.7.16. The traffic data for this study was obtained from a traffic survey, historical trend, planning data and the road traffic induced by the proposed Project. The traffic forecast was prepared by the Traffic Consultant of the proposed Project for the years 2018, 2023 and 2033 and was endorsed by TD. Hourly forecast of weekday traffic flow, covering the 16 vehicle classes, on the major roads related to the proposed Project is summarised in ***Appendix 4.3***. Such data was used for EMFAC-HK modelling to calculate the vehicular emission factors and also for subsequent for CALINE 4 modelling within the study area.

Determination of Assessment Year

4.7.17. The potential air pollution impacts for future road traffic were determined by the highest emission strength from the vehicles among the assessed operation years after the completion of construction of the proposed Project. Sensitivity tests were conducted to determine the worst-case scenario within 15 years after the occupancy of the proposed Project, namely 2018, 2023 and 2033.

4.7.18. Pertaining to the emission control scheme in the selected years, together with the varied vehicle miles travelled (VMT), sets of emission inventories with emission factors from EMFAC-HK were produced for each year. Emission inventories in the year having the highest emission inventories of NOx, PM_{10} and $PM_{2.5}$ are used as the model year for the air quality impact assessment because it represents the worst-case scenario prediction associated with the vehicular gaseous emission.

Open Road Emission Model – CALINE 4

4.7.19. The modelling of impacts from open roads was undertaken using the CALINE 4 model. With the result data from EMFAC-HK, hourly emission rates of a particular road link, in terms of g/mile/hour were formulated by summing the product of the hourly emission rate of each vehicle class and the percentage of vehicle of that class. An example for the composite emission factor is as follows:

Emission factor = $\sum(\text{Emission rate})_i \times i\%$

$$= (\text{Emission rate})_{PC} \times PC\% + (\text{Emission rate})_{Taxi} \times Taxi\% + \cdots + (\text{Emission rate})_{MC} \times MC\%$$

4.7.20. In order to predict 1-hour, 24-hour and/or annual average of the pollutant levels, 8760 hourly meteorological data was taken into account in CALINE 4. Directional variability was calculated according to the stability class in PCRAMMET output file (Stability class A, standard deviation of wind direction (σ_A) = 22.5°; Stability class B, σ_B = 22.5°; Stability class C, σ_C = 17.5°; Stability class D, σ_D = 12.5°; Stability class E, σ_E = 7.5°; Stability class F, σ_F = 3.8°). Surface roughness factor of $(z_0/15\ \text{cm})^{0.2}$ was adopted where z_0 is the surface roughness in unit of cm. Surface roughness of 370 cm was adopted in this study as it is dominantly an urbanised area.

4.7.21. In view of the constraints of CALINE 4 in modelling elevated roads higher than 10m, the road heights of elevated road sections in excess of 10 m high above local ground or water surface were set to 10m in the CALINE4 model as a worst-case assumption.

4.7.22. Ozone Limiting Method (OLM) was adopted for the conversion of NO_x to NO_2, using the predicted O_3 level from SAQM data in PATH model. A tailpipe emission NO_2/NOx 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:

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

where $[NO_2]_{pred}$ is the predicted NO_2 concentration

$[NOx]_{pred}$ is the predicted NO_x concentration

MIN means the minimum of the two values within the brackets

$[O_3]_{bkgd}$ is the representative O_3 background concentration

(46/48) is the molecular weight of NO_2 divided by the molecular weight of O_3

4.7.23. The air quality impacts at 1.5m, 5m and 10m above local the ground level were modelled at the representative ASRs, due to the high rise buildings.

Fixed Exhaust Emission Model – ISCST 3

4.7.24. Hourly emission rates simulated by EMFAC-HK were used for the vehicular emission from travelling within the proposed Project. Other than that, emission rates due to the idling activities were made reference to the Road Tunnels: Vehicle Emissions and Air Demand for Ventilation published by the PIARC Technical Committee on Road Tunnel Operation in November 2004. Hourly NO_2, $PM_{2.5}$ and PM_{10} concentrations were then predicted and derived from ISCST 3 model.

4.7.25. In order to predict 1-hour, 24-hour and/or annual average of the pollutant levels, 8760 hourly meteorological data was taken into account in ISCST 3.

4.7.26. Surface roughness of 370cm was adopted in this study.

Determination of Vehicular Emissions from Open Roads

4.7.27. EMFAC-HK version 2.6.0 developed by the EPD was used to determine the emission factors of NOx, PM_{10} and $PM_{2.5}$.

- Vehicle Classes

4.7.28. All vehicles travelling down the roads included in the assessment are categorised into 16 vehicle classes in accordance with Appendix I of EMFAC-HK Guideline on Modelling Vehicle Emissions which is shown in ***Table 4.4***.

4.7.29. Details of vehicle classification for the proposed Project were incorporated in the methodology of the traffic forecast exercise.

Table 4.4 Vehicle Classification in EMFAC-HK

Index	EMFAC-HK Code	Description	Gross Vehicle Weight (Tonnes)
1	PC	Private cars	All
3	Taxi	Taxi	All
4	LGV3	Light goods vehicles ≤ 2.5 tonne	≤ 2.5ton
5	LGV4	Light goods vehicles >2.5-3.5 tonne	> 2.5-3.5ton
6	LGV6	Light goods vehicles >3.5-5.5 tonne	>3.5ton-5.5ton
7	HGV7	Medium & heavy goods vehicles > 5.5-15 tonne	>5.5ton-15ton
8	HGV8	Medium & heavy goods vehicles with > 15 tonne	> 15ton
11	PLB	Public light buses	All
12	PV4	Private light buses ≤ 3.5 tonne	≤ 3.5ton
13	PV5	Private light buses > 3.5 tonne	> 3.5ton
14	NFB6	Non-franchised buses ≤ 6.4 tonne	≤ 6.4ton
15	NFB7	Non-franchised buses 6.4-15 tonne	>6.4-15ton
16	NFB8	Non-franchised buses > 15 tonne	>15ton
17	FBSD	Single deck franchised buses	All
18	FBDD	Double deck franchised buses	All
19	MC	Motor cycles	All

- Road Groupings

4.7.30. Roads within the study area were grouped into 4 different categories as tabulated in ***Table 4.5***.

Table 4.5 Road Groupings

Road Type	Road Type Code	Description
Expressway	EX	Roads are designated as expressways under the Road Traffic (Expressway) Regulations. High capacity roads with no frontage access or development, pedestrians segregated, widely spaced grade-separated junctions. 24 hour stopping restrictions.
Primary distributor	PD	Roads with speed limit of 50 kph and with no frontage access. Usually 24 hour stopping restrictions.
District distributor	DD	Roads with speed limit of 50 kph and with junctions, pedestrian crossing and bus stop, etc. Usually peak hour stopping restrictions and parking restrictions throughout the day.
Local distributor	LD	Roads with speed limit of 50 kph and with capacity limited by waiting vehicles and etc.

- Exhaust Technology Fractions

4.7.31. EMFAC-HK includes as default all the existing vehicle emission control programmes, where the implementation schedule of vehicle emission standards for different vehicle classes is presented in Appendix II of the Guideline on Modelling Vehicle Emissions.

4.7.32. Since the proposed Project only involves activities such as parking and vehicle repair / testing and no emission control programme will be imposed, default values of such exhaust technology fractions remained unchanged.

- Vehicle Population

4.7.33. The vehicle population function in EMFAC-HK is only for natural replacement, no policy change can be reflected with this function. The proposed Project does not have influence on the age distribution, the default vehicle population forecast was adopted.

- Vehicle Accrual

4.7.34. As forecast information in the model year is absent for the proposed Project, default value was adopted in accordance with the EMFAC-HK Guideline on Modelling Vehicle Emissions.

- Daily Vehicle Mile Travelled (VMT)

4.7.35. VMTs were inputted in the model to represent the total distance travelled on a typical weekday. The site specific VMTs were calculated by multiplying the number of vehicles by the road length.

4.7.36. The diurnal traffic pattern was inputted to simulate the effect on the emissions, in which the daily traffic flow variation was estimated by the Traffic Consultant of the proposed Project. The traffic assessment report is currently seeking the endorsement from TD.

- Diurnal Variation of Daily Trips

4.7.37. Diurnal variation of daily trips was used to estimate the start emissions of petrol and LPG vehicles. Trips for vehicles other than petrol and LPG types are assumed to be zero. Estimations on the number of trips carried out per day for petrol and LPG vehicles were assumed as follows.

4.7.38. For expressway and primary distributor, number of trips per day was assumed to be zero because no cold start is expected on these road sections under normal circumstance.

4.7.39. For district distributor and local distributor, it was assumed that the number of trips would be equal to the number of cold starts in district distributors and local distributors. It was also assumed that the number of trips was directly proportional to VMT and this pattern was similar within the Hong Kong territory. Therefore, the number of trips for the proposed Project was estimated by the formula:

$$\textit{Trip (within study area)} = \frac{\textit{Trip (within Hong Kong)}}{\textit{VMT (within Hong Kong)}} \times \textit{VMT (within study area)}$$

4.7.40. Trip per VMT (within Hong Kong) for each vehicle class was calculated based on the default data of EMFAC-HK whereas VMT (within study area) was the result of multiplying the number of vehicles for that particular vehicle class by the road length travelled within the study area.

- Speed Fraction

4.7.41. It was believed that the types of road sections within the study area are typical in nature and similar to the conditions in Hong Kong, default speed fractions in EMFAC-HK were adopted.

- Scenario Type

4.7.42. Emfac mode of EMFAC-HK was employed.

- Output Frequency

4.7.43. Hourly emission factors were derived for 24-hour diurnal variation.

- Calculation of Emission Factors

4.7.44. Emission inventories and VMT were extracted from the model. Given the continuous flow nature of expressway and primary distributor, only running exhaust emission is considered; whereas both starting exhaust and running exhaust emissions were taken into account for road sections of district distributor and local distributor. The starting exhaust emission is however confined to petrol- and LPG-fuelled vehicles only.

4.7.45. The running exhaust emission includes the vehicle tailpipe emission while it is travelling on the road at various speeds and idling at intersections.

4.7.46. Proven by the EMFAC-HK output file, the highest cold start NO_x emission occurs when the engine restarts after 120-minute resting, whilst the highest PM_{10} and $PM_{2.5}$ emission occurs after 720-minute resting. Such assumptions were considered to be conservative and adopted for all vehicle classes at different meteorological conditions.

4.7.47. Generic emission factors for each of the vehicle categories in different temperature, relative humidity and speed were directly extracted from the EMFAC-HK output files. Composite emissions factors were then calculated for each road section in 24-hour diurnal traffic flow.

4.7.48. The calculated emission factors in terms of g/miles/vehicle in that particular hour were used in CALINE 4 for estimating road traffic emissions. That information is summarised in ***Appendix 4.3***.

Determination of Emissions Induced by Vehicular Travelling within the Proposed Project

4.7.49. The predicted hourly NO_2, PM_{10} and $PM_{2.5}$ concentrations were derived from the ISCST3 modelling at 1.5 m, 5 m, and 10 m above ground at each representative ASRs in the study area. The hourly emission rates calculated by EMFAC-HK were used for the vehicular emissions from travelling within the proposed Project. Relevant correspondence showing the endorsement of the traffic forecasts by the TD are shown in ***Appendix 5.3***. Emission rate, including running exhaust and starting exhaust, was predicted by EMFAC-HK, using the same approach of determining the emission rate from open roads as aforementioned. To estimate the worst-case emissions at the Project site, the following was assumed:

- The travelling distance of the vehicles within the site was assumed to be the longest travelling distance of 1000 m;
- Travelling speed was assumed to be 5 kph and 1 cold start was included for each trip;
- Vehicle breakdown followed the in and out traffic data obtained from future users; and
- The highest cumulative 1-hour average of pollutant emission rate among the 24-hour operating period was chosen for any other operating hour of a typical day.

4.7.50. In this study, it was assumed that the proposed Project will optimise the use of natural ventilation and will be supplemented with the mechanical ventilation. Hence, the emissions in the parking area were estimated as total emission in grams by EMFAC-HK at hourly basis in accordance with the hourly traffic data, which was then assumed to be released as volume sources through each opening in proportion to size of opening area. The size of the opening was assumed to follow the minimum requirements of permeability of building as recommended by the Buildings Department. Details of emission rate calculation and estimated location of volume sources are shown in ***Appendix 4.4*** and ***Figure 4.3*** respectively.

<u>Determination of Emissions Induced by Vehicular Idling Activities within the Proposed Project</u>

4.7.51. Some of the vehicles under repair / testing activities require engine running when it needs operating the hydraulic moving parts for braking test, engine test etc. The engine on-time duration is just a few minutes each time for preparing the aforesaid repair / testing works. Generally speaking, engine would then be turned off for carrying out the repair / testing works and no need to be turned on during the rest of the repair / testing time. All the proposed vehicle repair / testing activities and examination works were assumed to be limited to the normal working hours (0800 to 1800 hours) at the EMSD Depot and the HKPF PVP&EC respectively. Although the HKPF will be operated 24 hours a day, the vehicle testing activities is considered negligible during evening and night-time.

4.7.52. The activities of each future user department that require engine running are summarised in ***Table 4.6***.

Table 4.6 Activity List Requiring Engine Running

HKPF PVP&EC	EMSD Depot	FEHD Depot	GL Specialist Laboratory
Braking test (on grade)	Braking test (for vehicles other than motorcycle)	Vehicle washing	Nil
Braking test (on slope)	Engine testing		
Vehicle examination (in pit)			
Vehicle examination (at ground)			

4.7.53. As the vehicle repair / testing activities involving idling would be come-and-go basis, maximum engine on-time per each vehicle was assumed to be maximal 15 minutes in an hour of the repair / testing period as a conservative approach, although the repair / testing period for each vehicle may last for about 2 to 3 hours. The number of vehicles under repair / testing was limited by the number of repair / testing bays. Such assumptions are summarised below and were used for the operational activities that require engine running, including vehicle washing in the FEHD Depot, vehicle repair / testing in the EMSD Depot and vehicle examination works in the HKPF PVP&EC.

- Idling activity per vehicle lasts for maximum 900 seconds (15 minute) in 1 hour; and
- Maximum 20 idling vehicles in 1 hour.

4.7.54. No vehicle repair / testing, maintenance work that requires engine running will be involved as verified by the GL.

4.8. AIR QUALITY IMPACT ASSESSMENT

Construction Phase

4.8.1. The potential dust emission sources would be mainly from the construction work activities of the excavation and wind erosion at the work site. As the size of the work site is limited and the excavation is minor such that the amount of excavated materials generated would be small, no adverse dust impact would be anticipated at the representative ASRs with the implementation of sufficient dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation and good site practices.

Mitigation Measures

4.8.2. The implementation of sufficient dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation and good site practices should be carried out in order to further minimise the construction dust generated. The following measures are specifically recommended for implementation together with those presented in the aforementioned regulation.

- Use of regular watering, to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather;
- Use of frequent watering for particularly dusty construction 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 temporary stockpiles should be avoided or covered. Prevent placing dusty material storage plies 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;
- Imposition of speed controls for vehicles on unpaved site roads. 8 km/hr is the recommended limit;
- Routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs;
- Every stock of more than 20 bags of cement or dry pulverised fuel ash (PFA) , if applicable, should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3-sides; and
- Loading, unloading, transfer, handling or storage of large amount of cement or dry PFA should be carried out in a totally enclosed system or facility, and nay vent or

exhaust should be fitted with the an effective fabric filter or equivalent air pollution control system.

Operation Phase

Determination of Assessment Year

4.8.3. Composite emission factors for each road links were calculated based on the weighted average of the emission factors of 16 vehicle classes. As both of the NOx and PM_{10} emissions within the study area are the highest in the first year of occupancy, i.e. 2018, among the years 2018, 2023 and 2033, hence this worst assessment year was adopted for air quality modelling. The total NO_x, PM_{10} and $PM_{2.5}$ emission inventory for the selected years are tabulated in ***Table 4.7***, ***Table 4.8*** and ***Table 4.9*** respectively for comparison. Detailed information is summarised in ***Appendix 4.3***.

Table 4.7 Total NOx Emission Inventory for Selected Years

NOx Emission Inventory (g/day)	2018 w/o Project	2018 w/ Project	2023 w/ Project	2033 w/ Project
Total	77,798	<u>78,430</u>	54,145	26,065

Notes:
[1] "w/o Project" denotes the cases without the proposed Project in place.
[2] "w/ Project" denotes the cases with the proposed Project in place.
[3] The highest emission inventory is underlined.

Table 4.8 Total PM_{10} Emission Inventory for Selected Years

PM_{10} Emission Inventory (g/day)	2018 w/o Project	2018 w/ Project	2023 w/ Project	2033 w/ Project
Total	2,953	<u>2,980</u>	2,106	1,319

Notes:
[1] "w/o Project" denotes the cases without the proposed Project in place.
[2] "w/ Project" denotes the cases with the proposed Project in place.
[3] The highest emission inventory is underlined.

Table 4.9 Total $PM_{2.5}$ Emission Inventory for Selected Years

$PM_{2.5}$ Emission Inventory (g/day)	2018 w/o Project	2018 w/ Project	2023 w/ Project	2033 w/ Project
Total	2,714	<u>2,738</u>	1,937	1,215

Notes:
[1] "w/o Project" denotes the cases without the proposed Project in place.
[2] "w/ Project" denotes the cases with the proposed Project in place.
[3] The highest emission inventory is underlined.

4.8.4. Based on the above, it was observed that change of emission inventory with the proposed Project in place was less than 1% of increment.

Calculated Open Road Emissions in 2018

4.8.5. The calculated emission factors for different vehicle categories for the year 2018 are listed in ***Appendix 4.3***. The whole set of the calculated emission factors (hour 1 to hour 24) were used for the calculation of the composite emission factors for the CALINE 4 modelling.

Emissions Induced by Vehicular Travelling within the Proposed Project in 2018

4.8.6. The predicted hourly NO_2, PM_{10} and $PM_{2.5}$ concentrations were derived from the ISCST 3 modelling at 1.5m, 5m, and 10m above ground at the representative ASRs in the study area. Calculation of composite emission factors for ISCST 3 modelling is shown in ***Appendix 4.4***.

Emissions Induced by Vehicular Idling Activities within the Proposed Project in 2018

4.8.7. The vehicle repair / testing activities that require idling would be carried out within the proposed Project. Calculation of composite emission factors for ISCST 3 modelling is shown in ***Appendix 4.5***.

Determination of Odour Emissions

4.8.8. As aforementioned in *Section 3.3*, a total of 17 spaces for RCVs among the 70 parking spaces, 1 manual vehicle washing bay and 1 automatic vehicle washing machine provided in the FEHD Depot. All RCVs that visit the proposed Project are of enclosed-type and comply with relevant regulations. As verified by the FEHD, the RCVs will be equipped with metal tailgate cover and deodourising system with an odour removal efficiency of 85% or above to control the spread of odour. The RCVs are run and operated by the FEHD in an environmentally hygienic manner.

4.8.9. Before entering the proposed Project, all refuse collected in the district has been fully off-loaded in the designated refuse disposal points and the RCVs have been well rinsed in the transfer station/ disposal site before departure. Extensive cleansing and clearance of refuse residual inside the compactor of the RCVs would not be carried out within the proposed Project, where only washing of the body shell of RCVs would be taken place either at the manual washing bay or passing through the automatic vehicle washing machine. All RCVs will be wiped dry before leaving proposed Project. Other daily operations include vehicle parking and water refilling for the street washing vehicles. Since there will be no maintenance work in the entire depot area, opening of the RCVs' compactor is not anticipated. Between 0600 and 2300 hours every day, a maximum of 8 RCVs/ hour is expected to move in the proposed Project, where a total of 16 RCVs moving in per day. Having regard to the sufficient parking spaces, queuing of RCVs at the entrance is not expected. After 2300 hours, vehicle washing and other operational activities would be very limited. Traffic routing of RCVs will also be carefully arranged to avoid nuisance to surrounding sensitive areas.

4.8.10. Given the hygienic nature of RCV, provision of deodourising system and metal tailgate cover as well as unanticipated queuing at entrance, no odour emission is identified both at source of the RCVs and along its ingress/ egress traffic routing during the operating hours. Therefore potential odour impact imposed to the staff and workers of the proposed Project is not anticipated.

Determination of Volatile Chemicals Emissions from GL Specialist Laboratory

4.8.11. The main propose of the GL Specialist Laboratory is to provide chemical testing services for other Government departments. The testing handles environmental, food, medical/ Chinese medicine and commercial products. The chemical tests mainly involve wet chemistry (sample preparation, digestion, solvent extraction) and analytical chemistry. The type of organic and inorganic chemicals involved and their corresponding estimated emission rates in the testing are summarised in ***Appendix 4.6***.

4.8.12. As confirmed with the GL, all extracted gases from fumehood during testing within the laboratory were treated with activated carbon or scrubber before discharge to outdoor air. The emission control procedures follow the ISO14001 management system.

4.8.13. The estimated emission rates of the organic and inorganic chemicals emanated due to the operation of the GL are to be of minimal amount and fulfil the threshold limit value/ permissible exposure limit of relevant international occupational safety and health requirements. Details are also shown in ***Appendix 4.6***.

4.8.14. In this connection, impact due to the volatile chemicals emissions of the proposed Project is considered negligible.

4.9. CUMULATIVE IMPACTS

4.9.1. The predicted overall cumulative 1-hour and annual average concentrations of NO_2 and 24-hour and annual average concentrations of PM_{10} were calculated and are shown in ***Table 4.10*** and ***Table 4.11*** below.

4.9.2. In accordance with EPD guidelines, a factor of 0.71 and 0.75 were multiplied to the concentration of PM_{10} to determine the annual and daily ambient concentrations for $PM_{2.5}$ respectively. 24-hour and annual average concentrations of $PM_{2.5}$ are given in ***Table 4.12***.

Table 4.10 Summary of NO_2 Concentrations

ASR ID	Description	Assessment Height (mAG)	19th Highest 1-hour Concentration ($\mu g/m^3$)	Annual Concentration ($\mu g/m^3$)
AQO (Number of Exceedances per Calendar Year Allowed)			200 (18)	40 (N/A)
ASR 1	Metro Recreational Club Chai Wan Depot Club House (MTR Facilities)	1.5	147.7	20.7
		5	147.6	20.5
ASR 2	Heng Fa Chuen Lutheran Day Nursery	1.5	146.7	20.2
		5	146.7	20.1
ASR 3	Heng Fa Chuen Block 1	1.5	146.7	20.1
		5	146.7	20.0
		10	146.7	19.6

ASR ID	Description	Assessment Height (mAG)	19th Highest 1-hour Concentration (μg/m^3)	Annual Concentration (μg/m^3)
AQO (Number of Exceedances per Calendar Year Allowed)			200 (18)	40 (N/A)
ASR 4	Heng Fa Chuen Block 50	1.5	148.3	19.3
		5	148.2	19.1
		10	147.9	18.7
ASR 5	Heng Fa Chuen Playground	1.5	147.8	19.9
ASR 6	Government Logistics Centre	1.5	148.4	19.8
		5	148.2	18.6
		10	147.9	18.0
ASR 7	NWFB Depot	1.5	149.0	19.3
		5	148.9	19.2
		10	147.9	18.7
ASR 8	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	1.5	149.1	22.0
		5	149.0	21.6
		10	148.6	20.7
ASR 9	Knight Court Flat A & B	1.5	149.0	20.9
		5	148.9	20.7
		10	148.6	20.1
ASR 10	Knight Court Flat C & D	1.5	148.8	21.2
		5	148.7	20.9
		10	148.5	20.3
ASR 11	Citybus Depot	1.5	149.1	21.5
		5	149.0	21.2
		10	148.2	20.4
ASR 12	EMSD Workshop	1.5	147.6	21.8
ASR 13	Wing Tai Road Garden	1.5	149.7	22.4
ASR 14	Pamela Youde Nethersole Eastern Hospital - Block F	1.5	151.0	23.9
		5	151.0	23.6
		10	151.0	22.9
ASR 15	Pamela Youde Nethersole Eastern Hospital - East Block	1.5	144.5	24.6
		5	144.5	24.1
		10	144.5	22.7
ASR 16	Tsui Wan Estate Playground	1.5	153.8	28.2
ASR 17	Tsui Shou House, Tsui Wan Estate	1.5	152.8	25.8
		5	151.9	22.1
		10	146.1	18.1
ASR 18	Endeavourers Chan Cheng Kit Wan Kindergarten	1.5	153.0	26.2
ASR 19	Tsui Ching House, Hang Tsui Court	1.5	148.6	23.7
		5	148.6	21.6
		10	147.0	18.0
ASR 20	Tsui Wan Nursing Home Limited	1.5	147.4	19.4
ASR 21	Tsui Wan Estate Shopping Complex	1.5	146.1	18.6
		5	145.9	18.3
ASR 22	S.K.H Li Fook Hing Secondary School	1.5	145.8	18.0
		5	145.7	17.8
		10	145.6	17.3
ASR 23	TWGHs & LKWFSL Mrs Fung Yiu Hing Memorial Primary School	1.5	148.0	20.6
		5	147.4	19.7

ASR ID	Description	Assessment Height (mAG)	19th Highest 1-hour Concentration (μg/m^3)	Annual Concentration (μg/m^3)
AQO (Number of Exceedances per Calendar Year Allowed)			200 (18)	40 (N/A)
		10	146.1	17.7
ASR 24	Chai Wan Fire Station	1.5	153.9	21.2
		5	151.6	18.3
		10	147.8	15.9
ASR 25	Chai Wan Industrial City Phase II	1.5	149.8	21.2
		5	145.1	19.2
		10	143.9	17.7
ASR 26	Ming Pao Industrial Centre Block B	1.5	153.1	18.8
		5	147.0	17.0
		10	142.4	15.7
ASR 27	Safety Godown Industrial Building	1.5	150.9	21.1
		5	149.3	18.8
		10	148.7	17.6
ASR 29	Planned Pet Garden at Sheung On Street	1.5	146.7	22.8
ASR 30	Planned THEi New Campus	1.5	146.3	19.5
		5	145.4	19.0
		10	145.0	18.1

Table 4.11 Summary of PM_{10} Concentrations

ASR ID	Description	Assessment Height (mAG)	10th Highest 24-hour Concentration (μg/m^3)	Annual Concentration (μg/m^3)
AQO (Number of Exceedances per Calendar Year Allowed)			100 (9)	50 (N/A)
ASR 1	Metro Recreational Club Chai Wan Depot Club House (MTR Facilities)	1.5	73.1	38.7
		5	73.0	38.7
ASR 2	Heng Fa Chuen Lutheran Day Nursery	1.5	73.0	38.7
		5	73.0	38.7
ASR 3	Heng Fa Chuen Block 1	1.5	73.0	38.7
		5	73.0	38.7
		10	73.0	38.6
ASR 4	Heng Fa Chuen Block 50	1.5	72.9	38.6
		5	72.9	38.6
		10	72.9	38.6
ASR 5	Heng Fa Chuen Playground	1.5	72.9	38.7
ASR 6	Government Logistics Centre	1.5	72.9	38.7
		5	72.9	38.6
		10	72.9	38.6
ASR 7	NWFB Depot	1.5	73.0	38.7
		5	73.0	38.6
		10	73.0	38.6
ASR 8	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	1.5	73.2	38.7
		5	73.1	38.7
		10	73.1	38.7

ASR ID	Description	Assessment Height (mAG)	10th Highest 24-hour Concentration (μg/m³)	Annual Concentration (μg/m³)
AQO (Number of Exceedances per Calendar Year Allowed)			100 (9)	50 (N/A)
ASR 9	Knight Court Flat A & B	1.5	73.1	38.7
		5	73.1	38.7
		10	73.0	38.7
ASR 10	Knight Court Flat C & D	1.5	73.1	38.7
		5	73.1	38.7
		10	73.1	38.7
ASR 11	Citybus Depot	1.5	73.1	38.7
		5	73.1	38.7
		10	73.1	38.7
ASR 12	EMSD Workshop	1.5	72.5	38.4
ASR 13	Wing Tai Road Garden	1.5	72.5	38.4
ASR 14	Pamela Youde Nethersole Eastern Hospital - Block F	1.5	73.8	39.4
		5	73.8	39.4
		10	73.8	39.4
ASR 15	Pamela Youde Nethersole Eastern Hospital - East Block	1.5	73.4	39.2
		5	73.4	39.2
		10	73.3	39.1
ASR 16	Tsui Wan Estate Playground	1.5	73.3	38.7
ASR 17	Tsui Shou House, Tsui Wan Estate	1.5	73.1	38.6
		5	72.8	38.4
		10	72.4	38.2
ASR 18	Endeavourers Chan Cheng Kit Wan Kindergarten	1.5	73.1	38.6
ASR 19	Tsui Ching House, Hang Tsui Court	1.5	72.8	38.5
		5	72.7	38.4
		10	72.3	38.2
ASR 20	Tsui Wan Nursing Home Limited	1.5	72.4	38.3
ASR 21	Tsui Wan Estate Shopping Complex	1.5	72.3	38.3
		5	72.2	38.2
ASR 22	S.K.H Li Fook Hing Secondary School	1.5	72.2	38.2
		5	72.2	38.2
		10	72.1	38.2
ASR 23	TWGHs & LKWFSL Mrs Fung Yiu Hing Memorial Primary School	1.5	72.5	38.3
		5	72.4	38.3
		10	72.2	38.2
ASR 24	Chai Wan Fire Station	1.5	72.8	38.4
		5	72.4	38.3
		10	72.0	38.2
ASR 25	Chai Wan Industrial City Phase II	1.5	72.3	38.4
		5	72.2	38.3
		10	72.0	38.2
ASR 26	Ming Pao Industrial Centre Block B	1.5	72.5	38.3
		5	72.0	38.2
		10	71.8	38.2
ASR 27	Safety Godown Industrial Building	1.5	72.9	38.8
		5	72.9	38.7
		10	72.9	38.6

ASR ID	Description	Assessment Height (mAG)	10th Highest 24-hour Concentration (μg/m³)	Annual Concentration (μg/m³)
AQO (Number of Exceedances per Calendar Year Allowed)			100 (9)	50 (N/A)
ASR 29	Planned Pet Garden at Sheung On Street	1.5	72.4	38.4
ASR 30	Planned THEi New Campus	1.5	72.1	38.3
		5	72.1	38.3
		10	72.0	38.2

Table 4.12 Summary of $PM_{2.5}$ Concentrations

ASR ID	Description	Assessment Height (mAG)	10th Highest 24-hour Concentration (μg/m³)	Annual Concentration (μg/m³)
AQO (Number of Exceedances per Calendar Year Allowed)			75 (9)	35 (N/A)
ASR 1	Metro Recreational Club Chai Wan Depot Club House (MTR Facilities)	1.5	54.8	27.5
		5	54.8	27.5
ASR 2	Heng Fa Chuen Lutheran Day Nursery	1.5	54.8	27.5
		5	54.8	27.5
ASR 3	Heng Fa Chuen Block 1	1.5	54.7	27.5
		5	54.7	27.5
		10	54.7	27.5
ASR 4	Heng Fa Chuen Block 50	1.5	54.7	27.5
		5	54.7	27.5
		10	54.7	27.4
ASR 5	Heng Fa Chuen Playground	1.5	54.7	27.5
ASR 6	Government Logistics Centre	1.5	54.7	27.5
		5	54.7	27.4
		10	54.7	27.4
ASR 7	NWFB Depot	1.5	54.8	27.5
		5	54.8	27.5
		10	54.7	27.4
ASR 8	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	1.5	54.9	27.6
		5	54.9	27.5
		10	54.8	27.5
ASR 9	Knight Court Flat A & B	1.5	54.8	27.5
		5	54.8	27.5
		10	54.8	27.5
ASR 10	Knight Court Flat C & D	1.5	54.9	27.5
		5	54.9	27.5
		10	54.8	27.5
ASR 11	Citybus Depot	1.5	54.9	27.6
		5	54.9	27.5
		10	54.8	27.5
ASR 12	EMSD Workshop	1.5	54.5	27.3
ASR 13	Wing Tai Road Garden	1.5	54.5	27.3
ASR 14	Pamela Youde Nethersole Eastern Hospital - Block F	1.5	55.5	28.0
		5	55.4	28.0

ASR ID	Description	Assessment Height (mAG)	10th Highest 24-hour Concentration (μg/m^3)	Annual Concentration (μg/m^3)
AQO (Number of Exceedances per Calendar Year Allowed)			75 (9)	35 (N/A)
		10	55.4	28.0
ASR 15	Pamela Youde Nethersole Eastern Hospital - East Block	1.5	55.1	27.9
		5	55.1	27.9
		10	55.1	27.8
ASR 16	Tsui Wan Estate Playground	1.5	55.1	27.6
ASR 17	Tsui Shou House, Tsui Wan Estate	1.5	55.0	27.5
		5	54.7	27.3
		10	54.4	27.2
ASR 18	Endeavourers Chan Cheng Kit Wan Kindergarten	1.5	55.0	27.5
ASR 19	Tsui Ching House, Hang Tsui Court	1.5	54.8	27.4
		5	54.7	27.3
		10	54.4	27.2
ASR 20	Tsui Wan Nursing Home Limited	1.5	54.4	27.2
ASR 21	Tsui Wan Estate Shopping Complex	1.5	54.3	27.2
		5	54.3	27.2
ASR 22	S.K.H Li Fook Hing Secondary School	1.5	54.2	27.2
		5	54.2	27.2
		10	54.2	27.2
ASR 23	TWGHs & LKWFSL Mrs Fung Yiu Hing Memorial Primary School	1.5	54.5	27.3
		5	54.4	27.3
		10	54.3	27.2
ASR 24	Chai Wan Fire Station	1.5	54.8	27.3
		5	54.4	27.2
		10	54.1	27.1
ASR 25	Chai Wan Industrial City Phase II	1.5	54.4	27.3
		5	54.3	27.2
		10	54.1	27.2
ASR 26	Ming Pao Industrial Centre Block B	1.5	54.5	27.3
		5	54.1	27.2
		10	53.9	27.1
ASR 27	Safety Godown Industrial Building	1.5	54.7	27.6
		5	54.7	27.5
		10	54.7	27.4
ASR 29	Planned Pet Garden at Sheung On Street	1.5	54.4	27.4
ASR 30	Planned THEi New Campus	1.5	54.2	27.2
		5	54.1	27.2
		10	54.1	27.2

Cumulative Impact of NO_2

4.9.3. Under the worst case scenario (i.e. Year 2018 with Project), the predicted 19th highest cumulative 1-hour NO_2 concentration at the representative ASRs are in the range of 142.4 to 153.9μg/m^3 with the highest found at ASR 24 (Chai Wan Fire Station). The predicted number of exceedances against the AQO is below 18, and thus no non-compliance is found. Corresponding contour map is given in ***Figure 4.5***.

4.9.4. The predicted cumulative annual NO_2 concentration at the representative ASRs are in the range of 15.7 to 28.2μg/m^3 with the highest found at ASR 16 (Tsui Wan Estate Playground). No non-compliance against the AQO is found. Corresponding contour map is given in ***Figure 4.4***.

Cumulative Impact of PM_{10}

4.9.5. Under the worst case scenario (i.e. Year 2018 with Project), the predicted 10th highest cumulative 24-hour PM_{10} concentration at the representative ASRs are in the range of 71.8 to 73.8 μg/m^3 with the highest found at ASR 14 (Pamela Youde Nethersole Eastern Hospital – Block F). The predicted number of exceedances against the AQO is below 9, and thus no non-compliance is found. Corresponding contour map is given in ***Figure 4.7***

4.9.6. The predicted cumulative annual PM_{10} concentration at the representative ASRs are in the range of 38.2 to 39.4μg/m^3 with the highest also found at ASR 14. No non-compliance against the AQO is found. Corresponding contour map is given in ***Figure 4.6***.

Cumulative Impact of $PM_{2.5}$

4.9.7. Under the worst case scenario (i.e. Year 2018 with Project), the predicted 10th highest cumulative 24-hour $PM_{2.5}$ concentration at the representative ASRs are in the range of 53.9 to 55.5μg/m^3 with the highest found at ASR 14 (Pamela Youde Nethersole Eastern Hospital – Block F). The predicted number of exceedances against the AQO is below 9, and thus no non-compliance is found. Corresponding contour map is given in ***Figure 4.9***.

4.9.8. The predicted cumulative annual $PM_{2.5}$ concentration at the representative ASRs are in the range of 27.1 to 28.0μg/m^3 with the highest also found at ASR 14. No non-compliance against the AQO is found. Corresponding contour map is given in ***Figure 4.8***.

4.10. SUMMARY OF THE MITIGATION MEASURES

4.10.1. Mitigation measures listed in *Section 4.8* are recommended to be implemented during construction of the proposed Project.

4.10.2. According to the above *Section 4.9*, no adverse air quality impact is predicted in association with the operation of the proposed Project without mitigation measures. Therefore, no mitigation measure is required during operation. Nevertheless, a number of initiatives aimed at further reduction in air emissions are proposed to avoid the potential nuisance arising from their operations.

Facilities	Initiatives
FEHD Depot	There will be metal tailgate cover and deodourising system with odour removal efficiency of 85% or above equipped in every RCVs to mitigate the spread of odour.
GL Specialist Laboratory	Activated carbon or scrubber will be equipped in the GL to treat the extracted gases from fumehood prior to discharge.

4.11. RESIDUAL IMPACTS

4.11.1. No adverse residual impact during construction and operation phases of the proposed Project would be anticipated, provided that the dust suppression measures during construction phase aforementioned in *Section 4.8* are properly implemented.

4.12. ENVIRONMENTAL MONITORING AND AUDIT

Construction Phase

4.12.1. No adverse dust impact is anticipated at each representative ASRs, given that dust suppression measures during construction phase aforementioned in *Section 4.8* and recommendations under the Air Pollution Control (Construction Dust) Regulation are properly implemented. Regular site environmental audits during the construction of the proposed Project shall be conducted in accordance with the requirements in EM&A Manual.

Operation Phase

4.12.2. The results of the operation air quality impact assessment showed that no adverse impact due to vehicular movement, odour as well as laboratory emission would be anticipated during the operation of the proposed Project. Hence, EM&A auditing work is considered not necessary.

4.13. CONCLUSIONS

4.13.1. Air quality impact, odour and volatile chemicals emissions assessments were conducted for the construction and operation phases of the proposed Project within the 500 m study area.

4.13.2. For the construction aspect, there would be no major earthworks carried out for the site formation works of the Project site. With the implementation of sufficient dust suppression measures as recommended and stipulated under the Air Pollution Control (Construction Dust) Regulation, adverse construction dust impact would not be anticipated.

4.13.3. For the operation of the proposed Project, no adverse air quality impacts would be anticipated as there would be limited vehicular emissions from the repair / testing and parking activities of the proposed Project, considered with the cumulative effect of emissions from open roads networks within the 500m study area. Results show that the predicted 19th highest 1-hour and annual average NO_2 and 10th highest daily and annual average $PM_{2.5}$ and PM_{10} concentrations at each representative ASRs complied with the AQOs. No mitigation measure is required.

4.13.4. In view of the fact that extensive cleansing and clearance of refuse residual inside the compactor of the RCVs would be not carried out within the proposed Project, provision of deodourising system and no queuing at entrance is anticipated at the entrance, potential odour emissions would be negligible at the RCVs itself and along the traffic routes to/from the Project site. In other words, potential odour nuisance associated with the operation of the proposed Project is anticipated to be negligible.

4.13.5. Lastly, the estimated emission rates of the organic and inorganic chemicals emanated due to the operation of the GL Specialist Laboratory are to be of minimal amount and fulfil the threshold limit value/ permissible exposure limit of relevant occupational safety and health requirements. Potential volatile chemicals emissions associated with the operation of the proposed Project are negligible.

4.14. REFERENCES

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5. NOISE IMPACT ASSESSMENT

5.1. INTRODUCTION

5.1.1. This section presents a noise impact assessment, which identifies potential sources of noise impact, assesses the potential impacts and recommends mitigation measures where required to reduce the noise impacts to acceptable levels, for the construction and operation of the proposed Project.

5.2. ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

General

5.2.1. The Noise Control Ordinance, Cap 400 (NCO) and the Environmental Impact Assessment Ordinance (EIAO) (Cap 499) provide the statutory framework for noise control. Assessment procedures and standards relevant to the proposed Project are set out in the Technical Memoranda (TM) given below:

- 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); and
- TM for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites (IND-TM).

5.2.2. The carrying out of percussive piling is prohibited between 1900 and 0700 hours or at any time on a general holiday (including Sunday). A valid construction noise permit (CNP) is required for the carrying out of percussive piling during the permitted hours.

Construction Phase

<u>General Construction Activities during Non-Restricted Hours</u>

5.2.3. Noise impacts arising from general construction activities other than percussive piling between 0700 and 1900 hours on any day not being a Sunday or general holiday are assessed against the standards set out in the EIAO-TM. The noise standards are summarised in ***Table 5.1*** below.

Table 5.1 Noise Standards for Daytime Construction Activities

Use	Noise Standards, $L_{eq(30mins)}$ dB(A)
Domestic premises, hotels and hostels	75
Education institutions, kindergartens, nurseries and all others where voice communication is required	70 65 (during examination period)

Note: The above standards apply to noise sensitive uses which rely on opened window for ventilation.

5.2.4. According to the construction programme shown in ***Appendix 3.1***, all the proposed construction works will be carried out during non-restricted hours.

Operation Phase

Fixed Plant Noise

5.2.5. The NCO and IND-TM control noise from fixed noise sources from places or premises other than domestic premises, public places or construction sites. For the assessment of impacts from fixed noise sources, the Area Sensitive Rating (ASR) of the noise sensitive receivers (NSRs) must be determined in accordance with the IND-TM. Similar to the GW-TM and DA-TM, the appropriate Acceptable Noise Level (ANL) can be determined based on the ASR. There are 4 types of area described in the IND-TM which are summarised in ***Table 5.2*** below.

Table 5.2 Area Sensitivity Ratings of NSRs

Type of Area Containing NSR	Degree to which NSR is affected by Influencing Factors (IFs)		
	Not Affected	Indirectly Affected	Directly Affected
I. Rural area, including country parks, or village type developments	A	B	B
II. Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
III. Urban area	B	C	C
IV. Area other than those above	B	B	C

5.2.6. The ANLs based upon the different ASRs are shown in ***Table 5.3*** below.

Table 5.3 ANLs for Fixed Plant Noise

Time Period	ANL, dB(A)		
	ASR 'A'	ASR 'B'	ASR 'C'
Day and evening (0700-2300 hrs)	60	65	70
Night (2300-0700 hrs)	50	55	60

5.2.7. More stringent criteria for assessing fixed plant noise are specified in the EIAO-TM for planning purposes. The assessment criteria are:

- 5dB(A) below the appropriate ANL set out in the IND-TM (as shown in ***Table 5.3*** above); or
- The prevailing background noise level, whichever is the lower.

Road Traffic Noise

5.2.8. The EIAO-TM defines road traffic noise standards for planning purposes. The relevant criteria are shown in ***Table 5.4*** below.

Table 5.4 Road Traffic Noise Standards for Planning Purposes

Use	Road Traffic Noise Peak Hour Traffic, $L_{10(1\ hour)}$ dB(A)
Domestic premises	70
Hotel and hostels	70
Offices	70
Education institutions	65
Places of public worship and courts of law	65
Hospital & clinics, convalescences and homes for the aged, diagnostic rooms, wards	55

Note: The above standards apply to noise sensitive uses which rely on opened window for ventilation.

5.3. IDENTIFICATION OF NOISE SENSITIVE RECEIVERS

5.3.1. Representative NSRs were identified in accordance with Annexes 5 and 13 of the EIAO-TM and should include all domestic premises, temporary housing accommodation, educational institutions including kindergartens, nurseries, and all others where unaided voice communication is required, hospitals, medical clinics, homes for the aged, convalescent homes, places of public worship, libraries, courts of law, performing arts centres, auditoria, amphitheatres, hostels and country parks that have direct line-of-sight and substantial angle of view of the Project area. Study area is expanded beyond 300m from the Project site to include NSRs at Tsui Wan Estate.

5.3.2. The existing NSRs were identified with reference to the latest best available information at the time of preparation of this report, such as those showing on the survey maps, topographic maps, aerial photos and other relevant land use plans. Site surveys were conducted on 20 May 2014 to verify the sensitive receivers and confirm the desktop studies.

5.3.3. Planned NSR was identified with reference to the latest best available information at the time of preparation of this report. Confirmations have been obtained from various government departments in May 2014 on the planned developments. A planned THEi New Campus was identified as the only planned NSR of the proposed Project.

5.3.4. ***Figure 5.1*** shows the Project boundary, representative NSRs and noise assessment points (NAPs). Details of the representative existing and planned NSRs with the corresponding NAPs are summarised in ***Table 5.5***. Photos of the representative existing NSRs are shown in ***Appendix 5.1***.

Table 5.5 Representative Existing and Planned NSRs with the Corresponding NAPs

NSR ID	NAP ID	Name of Building	Use [1]	Potential Impact [2]	No. of Storeys	Approx. Distance from the Site (m)	Shielded/ No Direct Line-of-Sight
NSR 1	NAP 101	Heng Fa Chuen Block 50	R	C, R, F	21	300	Nil
NSR 2	NAP 201	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	E	C, R, F	6	145	Nil
	NAP 202			R		248	1/F – 6/F
NSR 3	NAP 301	Knight Court Flat C & D [4]	R	R	24	160	1F – 24/F
NSR 4	NAP 401	Tsui Shou House, Tsui Wan Estate	R	C, R, F	30	345	Nil
NSR 5	NAP 501	Endeavourers Chan Cheng Kit Wan Kindergarten	E	C, R, F	1	340	Nil
NSR 6	NAP 601	Tsui Fuk House, Tsui Wan Estate	R	C, R, F	30	375	Nil
NSR 7	NAP 701	Tsui Hong House, Tsui Wan Estate	R	C, R, F	30	380	1/F – 6/F
NSR 8 [3]	NAP 801	Planned THEi New Campus	E	C, F	14	200	Nil
	NAP 802		E	R	14	260	5/F- 13/F

Notes:
[1] R- Residential, E- Educational
[2] C- Construction air-borne noise, R- Operational road traffic noise, F- Operational fixed plant noise
[3] The classrooms will be located from 5/F to 13/F at NSR 8.
[4] The eastern façade of Knight Court are provided with windows with special key lock for cleansing purpose only (i.e. not relying on such windows for ventilation).

5.3.5. According to the site visit on 20 May 2014, split-type / window-type air-conditioners (A/Cs) have been installed at the Hong Kong Institute of Vocational Education (Chai

Wan) (NSR 2) and Endeavourers Chan Cheng Kit Wan Kindergarten (NSR 5). ***Appendix 5.1*** shows the existing A/Cs of NSR 2 and NSR 5.

5.3.6. Notwithstanding the provision of A/Cs, the abovementioned schools are considered as NSRs for noise impact assessment since natural ventilation by windows may also be available.

Area Sensitivity Rating (ASR) of Noise Sensitive Receivers

5.3.7. According to the latest Outline Zoning Plan (OZP) (No. S/H20/21) in the area, there are existing industrial zoning areas at the east and southeast of the proposed Project.

5.3.8. According to the Annual Traffic Census of 2013 published by the Transport Department (TD), the annual average daily traffic (AADT) at Wing Tai Road Flyover was about 36,620 vehicles per day while the AADT at Island Eastern Corridor (IEC) between Mong Lung Street and Wing Tai Road was about 54,600 vehicles per day. By definition, these two roads are IFs within the study area in accordance with the IND-TM.

5.3.9. Chai Wan area is an urban district consisting of high-rise developments. NSR 2 to NSR 8 are either directly or indirectly affected by IFs. Therefore, an ASR of C would be assigned to these NSRs. Since there is no direct line-of-sight between some residential premises at Block 50 of Heng Fa Chuen (NSR 1) (e.g. Room 8) and IEC, an ASR of B ,which would impose a more stringent fixed plant noise assessment criteria, would be assigned to the entire Block 50 as a conservative approach.

5.3.10. The identified ASRs of the NSRs are tabulated in ***Table 5.6*** below.

Table 5.6 Identified Area Sensitivity Ratings of NSRs

NSR ID	Name of Building	IF	Directly Affected/ Indirectly Affected / Not Affected	ASR
NSR 1	Heng Fa Chuen Block 50	IEC	Not affected	B
NSR 2	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	IEC & Wing Tai Road Flyover	Directly affected	C
NSR 3	Knight Court Flat C & D	IEC	Directly affected	C
NSR 4	Tsui Shou House, Tsui Wan Estate	Wing Tai Road Flyover	Directly affected	C
NSR 5	Endeavourers Chan Cheng Kit Wan Kindergarten	Wing Tai Road Flyover	Directly affected	C
NSR 6	Tsui Fuk House, Tsui Wan Estate	Wing Tai Road Flyover	Directly affected	C
NSR 7	Tsui Hong House, Tsui Wan Estate	Wing Tai Road Flyover	Directly affected	C
NSR 8	Planned THEi New Campus	Wing Tai Road Flyover	Directly affected	C

Note: In any event, the ASR assumed in the EIA Report is only indicative and it is used for assessment only. It should be noted that the fixed noise sources are controlled under Section 13 of the NCO. Therefore, the Noise Control Authority shall determine noise impact from concerned fixed noise sources on the basis of prevailing legislation and practices being in force, and taking account of contemporary conditions/ situations of adjoining land uses. Nothing in the EIA study shall bind the Noise Control Authority in the context of law enforcement against any of the fixed noise sources being assessed.

5.3.11. In order to determine the fixed plant noise assessment criteria, prevailing background noise surveys were conducted on 20 and 22 September 2014 and 16 May 2015. The lowest measured background noise levels in the same time period were adopted for determining the fixed plant noise assessment criteria. The survey locations are shown in ***Figure 5.2***. The results of the prevailing background noise surveys and the fixed plant noise assessment criteria are shown in ***Table 5.7*** and ***Appendix 5.2***. As NSR 2, NSR 5 and NSR 8 are educational institutions, there is no night-time operation as confirmed by the institutions and thus no night-time prevailing background noise measurement was conducted for these NSRs.

Table 5.7 Lowest Measured Prevailing Background Noise Levels for NSRs and Fixed Plant Noise Assessment Criteria

NSR ID	Location ID	Lowest Measured Background Noise Level $L_{eq\ (30mins)}$ dB(A)		ANL – 5 dB(A)		Fixed Plant Noise Assessment Criteria $L_{eq\ (30mins)}$ dB(A)	
		Day/ evening time	Night-time	Day/ evening time	Night-time	Day/ evening time	Night-time
NSR 1	NLM 1	57	54	60	50	57	50
NSR 2	NLM 2	64	N/A	65	N/A	64	N/A
NSR 3	NLM 3	58	56	65	55	58	55
NSR 4	NLM 4	70	62	65	55	65	55
NSR 5	NLM 5	71	N/A	65	N/A	65	N/A
NSR 6	NLM 6	66	60	65	55	65	55
NSR 7	NLM 7	65	58	65	55	65	55
NSR 8	NLM 8	72	N/A	65	N/A	65	N/A

Note:
[1] "N/A" denotes not applicable.
[2] The lowest measured background noise levels in the same time period were adopted for determining the fixed plant noise assessment criteria.

5.4. DESCRIPTION OF THE EXISTING ENVIRONMENT

5.4.1. The Project site is located in Chai Wan. The surrounding land uses comprise residential, recreational, community and industrial uses. Site visit conducted on 20 May 2014 revealed that the background noise environment of the representative NSRs was dominated by traffic noise mainly from Shing Tai Road, IEC and Wing Tai Road Flyover and to a lesser extent from Sheung On Street, Sheung Tat Street and Sheung Mau Street. There are also 2 bus maintenance depots operated by Citybus Limited and New World First Bus Services Limited in the vicinity.

5.5. IDENTIFICATION OF POTENTIAL NOISE SOURCES

Construction Phase

5.5.1. The potential sources of noise impact during the construction phase of the proposed Project are the use of PME for various construction activities. As broadly indicated in the preliminary construction programme in ***Appendix 3.1***, the construction of the proposed Project would tentatively start in Mid-2016 and last for about 29 months. The major construction activities include:

- Site formation, excavation and filling;
- Foundation; and
- Main building construction.

5.5.2. Referring to *Section 2.3.24*, conventional steel H-piling is considered to be more preferable for the proposed Project and a CNP in force issued by the Noise Control Authority is required for carrying out percussive piling. As the issuance of a CNP depends on the application submitted by the Contractor, noise assessment for percussive piling activities is not included in this EIA study.

5.5.3. In order to provide a realistic noise assessment for the construction activities, the percentage on-time of PME to be operated on site were considered when calculating the total sound power level (SWL) of the construction activities. The Architectural Services Department (ArchSD) confirmed the validity of the assumed construction plant inventory and considered the percentage on-time of the plant reasonable.

Operation Phase

5.5.4. Operational noise from and associated with the proposed Project includes the following:

- Fixed plant noise
  - Vehicle repair / testing activities
  - Mechanical ventilation and air conditioning system (MVAC) equipment and other fixed noise sources equipment
- Road traffic noise

<u>Fixed Plant Noise – Vehicle Repair / Testing Activities</u>

5.5.5. During the operation phase, noise sources shall include vehicle repair / testing activities for vehicles and engine noise emission from vehicles from the HKPF PVP&EC, EMSD and FEHD Depots. Major vehicle repair / testing activities at the EMSD Depot will be conducted from 0800 to 1800 hours on weekdays, whilst the vehicle / testing activities at the HKPF will be taken place on irregular basis due to operational needs. The HKPF PVP&EC will be operated 24 hours on 7 days per week basis. All of the vehicle repair / testing activities will be carried out within the covered area.

5.5.6. Vehicle repair / testing activities during night-time period will be avoided as far as practicable. Occasional testing and examination work for HKPF PVP&EC may be carried out for urgent need of the HKPF. As a conservative approach, night-time operation is included in this study. Details of fixed plant noise emitted from night-time operation at the HKPF PVP&EC are shown in ***Appendix 5.6***.

5.5.7. For the planned vehicle repair / testing activities as advised by the EMSD, most of them would be the same as the existing workshop at Sheung On Street, Chai Wan. In this connection, the SWLs, operation frequencies and durations will be adopted from the approved EIA study for *EMSD Hong Kong Workshop at Sheung On Street, Chai Wan* (AEIAR-202/2012). In addition to the existing vehicle repair / testing activities, the EMSD proposed other activities which were not included in the existing workshop. Regarding these additional activities, the approved EIA Report for *Reprovisioning of FEHD Sai Yee Street Environmental Hygiene Offices-cum-vehicle Depot at Yen Ming Road, West Kowloon Reclamation Area* (AEIAR-216/2013) will be referenced.

5.5.8. All vehicle repair / testing activities of the proposed Project were verified by the future users, and it has been discussed in detail in *Section 3.3*. A variety of equipment will be provided in the proposed Project but not all of them would be considered to be significant noise sources in this study, because of their SWL and nature of operation. The details are given in ***Table 5.8***.

5.5.9. SWLs associated with the identified noise sources as listed in ***Table 5.8*** are obtained by making reference to the approved EIA Reports for *New World First Bus Permanent Depot at Chai Wan* (AEIAR-029-2000), *Proposed Headquarters and Bus Maintenance Depot in Chai Wan* (AEIAR-045/2001), *Reprovisioning of FEHD Sai Yee Street Environmental Hygiene Offices-cum-vehicle Depot at Yen Ming Road, West Kowloon Reclamation Area* (AEIAR-216/2013) and *EMSD Hong Kong Workshop at Sheung On Street, Chai Wan* (AEIAR-202/2012).

5.5.10. It is noticed that no SWL data for brake test strip can be adopted from previously approved EIA reports for other projects, on-site noise measurements were therefore conducted at the existing HKPF Depot in Quarry Bay to obtain the relevant noise level information for the assessment. The noise measurement methodology and estimated noise levels are presented in ***Appendix 5.9***.

Table 5.8 Identification of Noise Sources

Location	Activity	Equipment	Noise Source	Remark
HKPF PVP&EC	Braking test (on Grade)	Brake test strip	Yes	Noise level information obtained from on-site noise measurements
	Braking test (on Slope)	Brake test ramp	No	The vehicle engine is either set at idle or off
	Braking test (for Vehicles other than Motorcycle)	Roller brake tester with a load simulator	No	The vehicle engine is set at idle
	Motorcycle speedometer calibration	Motorcycle speedometer calibrator	Yes	SWL obtained from AEIAR-202/2012
	Use of compressed air, e.g. for screw driving	Pneumatic tools	Yes	SWL obtained from AEIAR-216/2013
	Hammering	Hammer	Yes	SWL obtained from AEIAR-216/2013
	Vehicle parking	--	No	Vehicle moving at a low speed
	Vehicle lifting	Vehicle lifting hoists	No	The hoists are electrically powered with small output motors
	Vehicle examination (in pit)	--	No	The vehicle engine is set at idle

Location	Activity	Equipment	Noise Source	Remark
	Vehicle examination (at ground)	--	No	The vehicle engine is set at idle
EMSD Depot	Braking test (for vehicles other than motorcycle)	Roller brake tester	Yes	SWL obtained from AEIAR-216/2013
	Braking test (for motorcycle)	Motorcycle brake tester	Yes	SWL obtained from AEIAR-216/2013
	Speedometer testing (for motorcycle)	Motorcycle speedometer	Yes	SWL obtained from AEIAR-202/2012
	Tyre balancing	Tyre balancer	No	Spinning of tyres will be conducted at a low speed
	Tyre changing	Tyre changer	Yes	SWL obtained from AEIAR-216/2013
	Hammering	Hammer	Yes	SWL obtained from AEIAR-216/2013
	Use of compressed air, e.g. for screw driving	Pneumatic tools	Yes	SWL obtained from AEIAR-216/2013
	Vehicle washing	--	No	Manual washing only
	Vehicle lifting	Vehicle lifting hoists	No	The hoists are electrically powered with small output motors
	Engine testing	--	No	The vehicle engine is set at idle
	Vehicle parking	--	No	Vehicle moving at a low speed
	Battery charging	Automatic battery charger	No	No moving part
	Chemical mixing, e.g. lubricant mixing	Lubricant dosing equipment	No	Manual operation only
FEHD Depot	Vehicle washing	Automatic vehicle washing machine	Yes	SWL obtained from AEIAR-216/2013
	Water refilling for vehicles	Water refilling machine	No	The vehicle engine is set at idle
	Vehicle parking	--	No	Vehicle moving at a low speed
GL Specialist Laboratory	Vehicle parking	--	No	Vehicle moving at a low speed
	Chemical testing	--	No	No moving part

Fixed Plant Noise - Corrections

5.5.11. Corrections for tonality, intermittency or impulsiveness for each MVAC equipment and other fixed noise sources and vehicle repair / testing activity are determined according to the IND-TM.

5.5.12. A correction of + 3 dB(A) for impulsiveness was applied to hammering activities. For correction for tonality, as information was not available, a correction of + 6 dB(A) was applied to water pumps and transformers as a conservative assumption in this assessment. The corrections for tonality, impulsiveness and intermittency were not applied to the rest of the MVAC equipment and other fixed noise sources and vehicle repair / testing activities.

5.5.13. The quantities, referenced SWLs, operation durations and operation frequencies of workshop equipment and repair / testing activities in the proposed Project are shown in ***Appendix 5.6***.

Fixed Plant Noise – MVAC equipment and other fixed noise sources

5.5.14. MVAC equipment and other fixed noise sources associated with the operation of the proposed Project were identified as potential noise sources. They will be enclosed within plant rooms except the outdoor units of the air conditioning system on roof.

5.5.15. The locations of key fixed noise sources are shown on the preliminary design layout plans in ***Figure 5.4***. The estimated quantity of identified noise sources to be operated during day/ evening and night-time periods are shown in ***Appendix 5.6***.

Road Traffic Noise

5.5.16. The proposed Project does not involve the construction of new roads. However, vehicles entering and leaving the proposed Project may potentially increase the traffic noise levels at the NSRs. Vehicles are expected to access the proposed Project via IEC to/ from other districts, and passing by Sheung On Street, Sheung Mau Street, Shing Tai Road and Shun Tai Road.

5.5.17. As shown in ***Appendix 5.3***, the predicted AM peak of road traffic flow of the proposed Project is 43 vehicles at 0800 to 0900 hours and the PM peak is 36 vehicles at 1500 to 1600 hours. The proof of endorsement of the traffic forecast data by TD and the proposed ingress/ egress routings provided in the technical note of traffic forecast submitted to TD are enclosed in ***Appendix 5.3***. According to a letter dated 24 September 2014, TD had no comment on the technical note of traffic forecast for EIA study for the proposed Project from a traffic point of view.

5.6. ASSESSMENT METHODOLOGY

Construction Phase

5.6.1. Methodology for assessing noise impacts from the construction activities associated with the proposed Project is developed based on the GW-TM and is summarised as follows:

- Identification of notional noise source locations of the work site with respect to NSRs;
- Determination of distance attenuation and screening effects between NSRs and notional noise sources;
- Estimation of construction noise levels at NSRs in the absence of any mitigation measures;
- Proposal of mitigation measures and evaluation of their effectiveness; and
- Determination of residual impacts.

5.6.2. The adopted approach to assess 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).

5.6.3. The proposed NAPs for the construction noise impact assessment are summarised in ***Table 5.5***. The NAPs were identified at the worst façade location nearest to the proposed Project. The construction inventory for the major construction activities are shown in ***Appendix 5.5*** and the locations of notional noise sources are provided in ***Figure 5.3***.

5.6.4. The construction noise impact was then assessed against the noise standards given in the EIAO-TM as shown in ***Table 5.1***.

Operation phase

<u>Fixed Plant Noise</u>

5.6.5. As discussed in *Section 5.5*, major fixed plant noise sources of the proposed Project include vehicle repair / testing activities and operation of MVAC equipment and other fixed noise sources.

5.6.6. The noise sources of the vehicle repair / testing activities and MVAC equipment and other fixed noise sources were identified based on the preliminary design layout plans.

5.6.7. The assessment approach for the fixed plant noise impacts from the proposed Project was conducted with consideration of standard acoustic principles and are summarised as follows:

- SWLs associated with the operation of mechanical equipment and vehicle were obtained from previously approved EIA reports discussed in *Section 5.5.9*;
- On-site noise measurements were conducted to obtained the SWLs if no data was available from previous approved EIA report; and
- Sound pressure levels (SPLs) at NAPs were calculated based on distance attenuation, tonality correction, impulsiveness correction, intermittency correction, percentage on-time correction, barrier correction, quantity correction and façade correction.

5.6.8. The quantity and the operation duration of vehicle repair / testing activities and MVAC equipment and other fixed noise sources at the proposed Project were verified by the future users.

5.6.9. Since the design of the equipment to be installed in the plant rooms was not available during the course of this study, the maximum allowable SWLs for MVAC equipment & other fixed noise sources would be determined taking into account of the concurrent operational noise from vehicle repair / testing activities.

Road Traffic Noise

5.6.10. The road traffic noise impact was evaluated according to the "Calculation of Road Traffic Noise" published by the Department of Transport UK and Guidance Note titled "Road Traffic Noise Impact Assessment under the Environmental Impact Assessment Ordinance" (GN 12/2010). Noise models for the road traffic noise impact assessment were established using computer simulation software *RoadNoise 2000*.

5.6.11. The extent of road sections at IEC paved with polymer modified friction course as low noise road surface as advised by the Highways Department is presented in ***Appendix 5.4***. A correction of -3.5 dB(A) was added to the BNLs for all road sections paved with low noise road surface.

5.6.12. The road traffic noise impact contributed by road traffic generated from vehicles entering and leaving the proposed Project on the NSRs in the vicinity was evaluated in *Section 5.7*.

5.7. PREDICTION AND EVALUATION OF NOISE IMPACT

Construction Phase

5.7.1. The extent of construction noise impacts depends on the type and number of PME to be used in different construction activities and hence may vary throughout the construction phase. As shown in ***Appendix 3.1***, the preliminary construction programme is expected to last for about 29 months. For the purpose of this EIA study, the construction period is assumed to start from mid-2016 to end-2018. The construction activities are expected to be conducted during normal daytime working hours only (i.e. 0700 to 1900 hours on any day not being a Sunday or general holiday).

5.7.2. Concurrent projects were also taken into account in the construction noise assessment. One concurrent project was identified. The anticipated works for the planned THEi New Campus are shown in ***Table 5.9***.

Table 5.9 Anticipated Works of Planned THEi New Campus

Anticipated Work	Anticipated Construction Period	Anticipated Construction Work of the Project
Foundation works	Mar 2014 – Oct 2014	Nil
Superstructure works	Nov 2014 – Jun 2016	Nil
Interior fitting out and users moving-in	Feb 2016 – Aug 2016	Site formation, excavation and filling work from mid-2016

5.7.3. Construction plant inventory for interior fitting out works for the planned THEi New Campus was reviewed and confirmed by the Project Proponent of the planned THEi New Campus. It was estimated based on the best available information. The construction plant inventory, calculation of unmitigated construction noise impact from the proposed Project alone and cumulative construction noise impact are provided in ***Appendix 5.5***.

5.7.4. No examination will be scheduled at the kindergarten (NSR 5) as confirmed by the institution. The examination schedule for academic year 2014-2015 provided by the Hong Kong Institute of Vocational Education (Chai Wan) (NSR 2) is listed in ***Table 5.10***. It is assumed that the examination periods will be scheduled from January to July each year and last around 54 days in each academic year. No examination schedule for the planned THEi New Campus could be obtained at the time of preparation of this study. However, examinations are unlikely to be arranged in September and October of each academic year at the THEi New Campus, which was verified by the Vocational Training Council (VTC) .

Table 5.10 Examination Schedule of Hong Kong Institute of Vocational Education (Chai Wan) for Academic Year 2014 - 2015

Examination Period (Academic year 2014 – 2015)	No. of Days (including Saturdays)
September 2014	Nil
October 2014	Nil
November 2014	Nil
December 2014	Nil
January 2015	21
February 2015	Nil
March 2015	2
April 2015	4
May 2015	9
June 2015	11
July 2015	7
August 2015	Nil

5.7.5. ***Table 5.11*** and ***Table 5.12*** summarise the predicted construction noise levels due to the Project only and predicted cumulative construction noise levels respectively. The maximum construction noise levels during normal daytime working hours were predicted.

The results indicate that construction activities of the proposed Project, if unmitigated, would cause exceedance of the construction noise standards at the Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block (NAP 201) and Planned THEi New Campus (NAP 801) during examination periods. Mitigation measures are therefore considered to minimize the construction noise impact.

Table 5.11 Predicted Construction Noise Levels at Representative NAPs during Normal Daytime Working Hours due to the Project Only for Unmitigated Scenario

<table>
<tr><th rowspan="2">NAP ID</th><th rowspan="2">Description</th><th rowspan="2">ANL, dB(A)</th><th colspan="3">Predicted Maximum Construction Noise Level, dB(A)</th></tr>
<tr><th>Site Formation, Excavation and Filling</th><th>Foundation</th><th>Main Building Construction</th></tr>
<tr><td>NAP 101</td><td>Heng Fa Chuen Block 50</td><td>75</td><td>63</td><td>63</td><td>63</td></tr>
<tr><td>NAP 201</td><td rowspan="2">Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block</td><td rowspan="2">70/65 [1]</td><td>70</td><td>70</td><td>70</td></tr>
<tr><td>NAP 202</td><td>56</td><td>55</td><td>55</td></tr>
<tr><td>NAP 301</td><td>Knight Court Flat C & D</td><td>75</td><td>59</td><td>59</td><td>59</td></tr>
<tr><td>NAP 401</td><td>Tsui Shou House, Tsui Wan Estate</td><td>75</td><td>63</td><td>63</td><td>63</td></tr>
<tr><td>NAP 501</td><td>Endeavourers Chan Cheng Kit Wan Kindergarten</td><td>70 [2]</td><td>63</td><td>63</td><td>63</td></tr>
<tr><td>NAP 601</td><td>Tsui Fuk House, Tsui Wan Estate</td><td>75</td><td>62</td><td>62</td><td>62</td></tr>
<tr><td>NAP 701</td><td>Tsui Hong House, Tsui Wan Estate</td><td>75</td><td>62</td><td>62</td><td>62</td></tr>
<tr><td>NAP 801</td><td rowspan="2">Planned THEi New Campus
(i.e. Classrooms from 5/F onwards)</td><td rowspan="2">70/65 [1]</td><td>67</td><td>67</td><td>67</td></tr>
<tr><td>NAP 802</td><td>55</td><td>55</td><td>55</td></tr>
</table>

Notes:

[1] Construction noise criteria for schools are 70 dB(A) at normal school days and 65 dB(A) during examinations.

[2] No examinations will be scheduled at Endeavourers Chan Cheng Kit Wan Kindergarten and only construction noise criteria for school at normal school days will be applied.

[3] Noise levels exceeding the construction noise criteria are **bolded**.

Table 5.12 Predicted Cumulative Construction Noise Levels at Representative NAPs during Normal Daytime Working Hours for the Unmitigated Scenario

NAP ID	Description	ANL, dB(A)	Predicted Maximum Construction Noise Level, dB(A)
NAP 101	Heng Fa Chuen Block 50	75	64
NAP 201	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	70/65 [1]	**72**
NAP 202			59
NAP 301	Knight Court Flat C & D	75	66
NAP 401	Tsui Shou House, Tsui Wan Estate	75	72
NAP 501	Endeavourers Chan Cheng Kit Wan Kindergarten	70 [3]	**71**
NAP 601	Tsui Fuk House, Tsui Wan Estate	75	67
NAP 701	Tsui Hong House, Tsui Wan Estate	75	55
NAP 801	Planned THEi New Campus (i.e. Classrooms from 5/F onwards)	N/A [4]	
NAP 802			

Notes:

[1] Construction noise standards for schools are 70 dB(A) at normal school days and 65 dB(A) during examinations.

[2] Noise levels exceeding the construction noise standards are **bolded**.

[3] No examinations will be scheduled at Endeavourers Chan Cheng Kit Wan Kindergarten and only construction noise standards for school at normal school days were applied.

[4] Planned THEi New Campus is the concurrent project under construction and thus no cumulative construction noise level applied.

Operation Phase

<u>Fixed Plant Noise</u>

5.7.6. During the operation phase, noise impacts due to the fixed plant noise sources including vehicle repair / testing activities, MVAC equipment and other fixed noise sources were assessed. Based upon the assumptions discussed in *Section 5.6*, the predicted fixed plant noise levels at the NAPs are shown in ***Table 5.13***. Detailed calculations of fixed plant noise impact assessment and the maximum allowable SWL of each equipment, which should not be exceeded in order to comply with the fixed plant noise assessment criteria, are presented in ***Appendix 5.6***.

5.7.7. It is anticipated that there should be no sudden change in noise levels at various floor levels at all the NAPs. The predicted maximum fixed plant noise levels at the NAPs at representative floors (high, mid and low zones) are presented in ***Table 5.13*** and comply with both day/ evening time and night-time fixed plant noise assessment criteria.

5.7.8. If there is any change in design information during detailed design stage or fitting-out stage, the design of fixed plant should be reviewed by the Engineer/ Contractor to ensure that both the NCO and fixed plant noise criteria at the NSRs will be met in the future.

Table 5.13 Summary of Predicted Fixed Plant Noise Levels at NAPs

NAP ID	Level	Assessment Height (m)	Predicted Maximum Noise Level, $L_{eq\ (30mins)}$ dB(A)		ANL, $L_{eq\ (30mins)}$ dB(A)	
			Day-time & Evening	Night-time	Day-time & Evening	Night-time
NAP 101	1/F	8.7	57	49	57	50
	10/F	35.7	57	49		
	21/F	68.7	57	49		
NAP 201	1/F	6.4	63	No operation in night-time	64	No operation in night-time
	3/F	12.4	63			
	6/F	21.4	63			
NAP 202	1/F	6.4	49	No operation in night-time	64	No operation in night-time
	3/F	12.4	49			
	6/F	21.4	49			
NAP 301	1/F	10.2	50	44	58	55
	12/F	43.2	50	44		
	24/F	79.2	50	43		
NAP 401	1/F	8.4	57	50	65	55
	15/F	50.4	57	50		
	30/F	95.4	57	50		
NAP 501	G/F	5.4	57	No operation in night-time	65	No operation in night-time
NAP 601	1/F	8.9	56	49	65	55
	15/F	50.9	56	49		
	30/F	95.9	56	49		
NAP 701	1/F	8.4	56	48	65	55
	15/F	50.4	56	49		
	30/F	95.4	56	49		
NAP 801	5/F	26.8	61	No operation in night-time	65	No operation in night-time
	9/F	43.6	61			
	13/F	60.2	61			
NAP 802	5/F	26.8	49	No operation in night-time	65	No operation in night-time
	9/F	43.6	49			
	13/F	60.2	49			

Road Traffic Noise

5.7.9. The predicted AM and PM peaks of the road traffic caused by the proposed Project are at 0800 to 0900 hours and 1500 to 1600 hours respectively. By comparing the noise levels between "with project" and "without project" during the AM and PM peaks, the highest noise contribution from the operation of the proposed Project could be determined.

5.7.10. In order to assess the significance of the noise contribution, the assessment year shall be within 15 years upon tentative commencement of the operation, i.e. 2018. It is anticipated that there is no major change in the traffic pattern for Years 2014, 2018 and 2033. Gradual natural increase in traffic flow is expected in the coming 15 years and thus Year 2033 is determined to be the assessment year in which the traffic flow will be the highest. The traffic forecasts for "with project" and "without project" scenarios for Years 2018 and 2033 were provided by the Traffic Consultant of the proposed Project and were endorsed by TD. The endorsed traffic forecasts and the proof of the endorsement by TD are summarised and provided in ***Appendix 5.3***.

5.7.11. The noise contribution from the road traffic generated by the proposed Project is considered insignificant when the difference in traffic noise levels at the NSRs with and without the project is less than 1.0 dB(A).

5.7.12. The predicted overall traffic noise levels at NAPs during both AM and PM peaks in Year 2033 for the "with project" and "without project" scenarios are summarised in ***Appendix 5.7***. The assessment results indicated that noise contribution from road traffic generated by the proposed Project will be in the range of 0.0 dB(A) to 0.2 dB(A) at all NAPs in Year 2033 scenario. The noise contribution is considered insignificant (i.e. less than 1.0 dB(A)) under the worst case scenario. The operation of the proposed Project is anticipated to have no significant contribution to road traffic noise impact on the NSRs.

5.8. PROPOSED MITIGATION MEASURES

Construction Phase

5.8.1. Mitigation measures are required for the NSRs at which unmitigated construction noise levels are predicted to exceed the corresponding construction noise standards as shown in ***Table 5.12***.

5.8.2. A number of available construction noise mitigation measures are proposed in this assessment, including:

- Selection and optimisation of construction programmes, such as avoidance of simultaneous operation of noisy PME, and/or reduction in the percentage on-time of PME during noise sensitive periods such as school examination period;
- Use of quality powered mechanical equipment (QPME) and quiet working methods;
- Use of movable at-source noise mitigation measures such as movable noise barriers, noise enclosures, noise jacket and mufflers;
- Implementation of good site practices to limit noise from construction site; and
- Preparation of Construction Noise Management Plan before construction commencement.

Selection and Optimisation of Construction Programmes

5.8.3. The timing and sequencing of the various construction activities shall be carefully arranged according to the actual site work situation, in order to limit the amount of concurrent activities and where applicable, to avoid simultaneous operation of noisy PME in order to minimise the total noise generated during the construction periods. Limiting the quantity of PME to be operated concurrently and also the percentage on-time of PME were recommended in the proposed Project and incorporated in this assessment. The proposed quantity of PME and their percentage on-time were confirmed feasible by the Project Proponent. In the case during school examination when a more stringent construction noise standard is imposed, the potentially most disruptive construction activities should be avoided and arranged to be conducted during school holidays as far as practicable.

Use of QPME and Quiet Working Methods

5.8.4. QPME is defined as a PME having actual SWL lower than the value specified for PME in the GW-TM. SWLs for typical PMEs provided in the GW-TM and that for equivalent QPME are presented in ***Table 5.14***.

5.8.5. The use of QPME can result in reduction in noise levels. It is possible to further reduce the noise impact by adopting quiet working methods and specifying maximum SWL for specific plant equipment.

5.8.6. The QPME adopted in this assessment is for reference only and to be confirmed by the Contractor, in view of the actual construction conditions and programmes. Whilst QPME are listed, the Contractor may be able to obtain particular models of plant that are quieter than the QPMEs listed. The associated mitigation measures to the particular PME should be reviewed by the Contractor and.

Table 5.14 Maximum SWLs for Selected QPME

Identification Code in GW-TM	Description	SWL in GW-TM, dB(A)	Example in QPME List from EPD	SWL of QPME, dB(A)
CNP 081	Excavator/ loader, wheeled/ tracked	112	EPD-02383	92
CNP 101	Generator, Standard	108	EPD-00668	79
CNP 186	Roller, vibratory	108	EPD-00509	95
CNP 065	Drill/ grinder, hand-held (electric)	98	Other [1]	89
CNP 048	Mobile Crane	112	EPD-02602	102
CNP 170	Poker, vibratory, hand-held	113	Other [1]	102

Note: [1] It refers to examples in "Sound Power Levels of Other Commonly Used PME"

Use of Movable Noise Barriers

5.8.7. Movable noise barrier is very effective in screening noise from construction plant. Noise barrier located close to a PME can produce at least 10 dB(A) screening for stationery plant and 5 dB(A) for mobile plant provided that the direct line-of-sight of the PME is blocked. Subject to site condition, the noise barriers should be placed near to the construction plant as far as practical.

5.8.8. Barrier material of surface mass in excess of 10 kg/m^2 is recommended to achieve the maximum screening effect. The Contractor shall be responsible for the design of the movable noise barrier with due consideration given to the size of the PME and the requirement of intercepting the line-of-sight of the PME, as well as ensuring that the barrier should have no openings and gaps.

Implementation of Good Site Practices

5.8.9. Good site practices and noise management can provide considerable reductions in noise impact of the site activities. The following practices should be followed while carrying out construction works for the proposed Project:

- Use only well-maintained and regularly-serviced plant during the works;
- Turn off or throttle down the plant in intermittent use to a minimum;
- Orient the plant known to emit noise strongly in one direction to face away from the NSRs;
- Use silencers, mufflers and enclosures for plant where possible and maintain properly throughout the works;
- Site fixed plant as far away from NSRs as possible; and
- Use stockpiles of excavated materials and other structures such as site buildings effectively to screen noise from the works.

Operation Phase

Fixed Plant Noise – Vehicle Repair / Testing Activities

5.8.10. The future operators should ensure that the vehicle repair / testing activities are carried out under the covered area of the proposed Project as the building itself provides noise screening to the NSRs.

5.8.11. As the ANL during night-time (2300 to 0700 hours next day) is more stringent than that of the day/ evening time (0700 to 2300 hours), the future operators should avoid carrying out vehicle repair / testing activities during night-time as far as practicable.

Fixed Plant Noise – MVAC equipment and other fixed noise sources

5.8.12. With reference to “Good Practices on Ventilation System Noise Control” (GP-VS), acoustic treatments, such as acoustic louvres, silencers and enclosures, could be applied to achieve noise attenuation. Prior to the operation phase of the proposed Project, as part of the design process, commissioning test should be conducted to ensure the fixed plant noise shall comply with relevant noise criteria and such requirement should be included in the tender document and/or specification.

5.8.13. A regular plant maintenance programme should be developed and implemented so that equipment is properly operated and serviced in order to maintain a controlled level of noise. The programme should be implemented by trained personnel.

Road Traffic Noise

5.8.14. The assessment results demonstrate that with the low level of traffic generation from the proposed Project, operation of the proposed Project will have no significant contribution to road traffic noise impact on the NSRs. No mitigation measure is needed for the road traffic noise.

5.9. ASSESSMENT OF NOISE IMPACT WITH THE APPLICATION OF MITIGATION MEASURES

Construction Phase

5.9.1. Construction noise calculation was carried out with the incorporation of different noise mitigation measures as discussed in *Section 5.8*, as far as practicable according to the actual construction condition and limitation.

5.9.2. ***Table 5.15*** and ***Table 5.16*** summarise the predicted construction noise levels due to the Project only and cumulative construction noise levels at NAPs under mitigated scenario respectively. The detailed calculations are shown in ***Appendix 5.8***.

Table 5.15 Predicted Construction Noise Levels at Representative NAPs under Mitigated Scenario due to the Project Only

NAP ID	Description	ANL, dB(A)	Predicted Maximum Construction Noise Level, dB(A)		
			Site Formation, Excavation and Filling	Foundation	Main Building Construction
NAP 101	Heng Fa Chuen Block 50	75	62	58	58
NAP 201	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	70/ 65 [1]	**69**	65	65
NAP 202			55	50	50
NAP 301	Knight Court Flat C & D	75	58	54	54
NAP 401	Tsui Shou House, Tsui Wan Estate	75	62	58	58
NAP 501	Endeavourers Chan Cheng Kit Wan Kindergarten	70 [2]	62	58	58
NAP 601	Tsui Fuk House, Tsui Wan Estate	75	61	57	57
NAP 701	Tsui Hong House, Tsui Wan Estate	75	61	57	57
NAP 801	Planned THEi New Campus (i.e. Classrooms from 5/F onwards)	70/ 65 [1]	66	62	62
NAP 802			54	50	50

Notes:

[1] Construction noise criteria for schools are 70 dB(A) at normal school days and 65 dB(A) during examination periods.

[2] No examinations will be scheduled at Endeavourers Chan Cheng Kit Wan Kindergarten and only construction noise standards for school at normal school days were applied.

[3] Noise levels exceeding the construction noise standards are **bolded**.

Table 5.16 Predicted Cumulative Construction Noise Level at Representative NAPs under Mitigated Scenario

NAP ID	Description	ANL, dB(A)	Predicted Maximum Construction Noise Level, dB(A)
NAP 101	Heng Fa Chuen Block 50	75	64
NAP 201	Hong Kong Institute of Vocational Education (Chai Wan) - Academic Block	70/65 [1]	**71**
NAP 202			58
NAP 301	Knight Court Flat C & D	75	66
NAP 401	Tsui Shou House, Tsui Wan Estate	75	72
NAP 501	Endeavourers Chan Cheng Kit Wan Kindergarten	70 [2]	71
NAP 601	Tsui Fuk House, Tsui Wan Estate	75	67
NAP 701	Tsui Hong House, Tsui Wan Estate	75	73
NAP 801	Planned THEi New Campus (i.e. Classrooms from 5/F onwards)	N/A [3]	
NAP 802			

Notes:

[1] Construction noise standards for schools are 70 dB(A) at normal school days and 65 dB(A) during examination periods.

[2] No examinations will be scheduled at Endeavourers Chan Cheng Kit Wan Kindergarten and only construction noise standards for school at normal school days will be applied.

[3] Planned THEi New Campus is the concurrent project under construction and thus no cumulative construction noise level applied.

[4] Noise levels exceeding the construction noise standards are **bolded**.

5.9.3. In view of the results shown in ***Table 5.15*** and ***Table 5.16***, the predicted construction noise levels with mitigation measures at the representative NSRs, except NSR 2, shall comply with the construction noise standards including the criterion during examination period.

5.9.4. The predicted construction noise levels at the Hong Kong Institute of Vocational Education (Chai Wan) (NAP 201) comply with the corresponding construction noise criterion during normal school days but exceedance is expected during examination period when the criterion will be 65 dB(A), when site formation, excavation and filling works take place in July 2016. According to the examination schedule provided by the Hong Kong Institute of Vocational Education (Chai Wan), the duration of the exceedance was 7 days. In this connection, the Contractor should keep close liaison with the nearby educational institutions to obtain the examination schedule and should control noise from their construction works such as avoiding concurrent operation of noisy PME, and /or reduction in the percentage on-time of PME during school examination periods. A Construction Noise Management Plan shall be provided by the Contractor before commencement of the construction to avoid noise exceedance.

5.9.5. Noise mitigation measures as proposed in *Section 5.8* are recommended to be implemented as far as practicable in order to minimise the potential construction noise impact associated with the proposed project.

Operation Phase

Fixed Plant Noise

5.9.6. With the MVAC and other fixed noise sources properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, no adverse fixed noise impact is anticipated.

Road Traffic Noise

5.9.7. The assessment results demonstrate that with the low level of traffic generation from the proposed Project, operation of the proposed Project will have no significant contribution to road traffic noise impact on the NSRs. No mitigation measure is necessary.

5.10. RESIDUAL IMPACT

Construction Phase

5.10.1. As mentioned in *Section 5.3.5* and *5.3.6*, although the nearby educational institutions are provided with A/Cs for ventilation, there will be a possibility that the abovementioned schools to rely on opened windows for ventilation. Exceedance is expected during examination period when the noise criteria will be 65 dB(A), when site formation, excavation and filling works take place in July 2016. According to the examination schedule provided by the Hong Kong Institute of Vocational Education (Chai Wan), the duration of the exceedance will be around 7 days. In this connection, the Contractor should keep close liaison with the nearby educational institutions to obtain the examination schedule and should control noise from their construction works such as avoiding concurrent operation of noisy PME, and /or reduction in the percentage on-time of PME during school examination periods. A Construction Noise Management Plan shall be provided by the Contractor before commencement of the construction to avoid noise exceedance.

Operation Phase

5.10.2. With the MVAC and other fixed noise sources properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, no adverse fixed noise impact is anticipated.

5.10.3. The assessment results demonstrate that with the low level of traffic generation from the proposed Project, operation of the proposed Project will have no significant contribution to road traffic noise impact on the NSRs. No mitigation measure is necessary.

5.11. ENVIRONMENTAL MONITORING AND AUDIT

Construction Phase

5.11.1. Noise monitoring at the nearby NSRs during the construction phase of the proposed Project is recommended. Environmental monitoring and audit (EM&A) programme is proposed to be established to ensure the implementation of mitigation measures as well as a noise complaint handling mechanism. Details of the programme are provided in a stand-a-lone EM&A Manual.

Operation Phase

5.11.2. With the implementation of the recommended noise mitigation measures and use of a set of specified maximum SWLs for the MVAC equipment and other fixed noise sources, no adverse impact is expected during the operation phase. Noise monitoring during the operation phase of the proposed Project is considered not necessary.

5.12. CONCLUSION

Construction Phase

5.12.1. With the implementation of the recommended mitigation measures such as the use of QPME, limiting the number of construction plants operating concurrently, using movable noise barriers and adopting good site practices, adverse construction noise impact is not anticipated except at NSR 2. As it is close to the site, NSR 2 is predicted to expose to construction noise exceeding the relevant noise standard during examination period when site formation, excavation and filling works take place in mid-2016. The duration of the exceedance is expected to be around 7 days. It is recommended that more detailed construction planning, which includes the arrangement on work sequence and plant locations, etc. before actual construction work is undertaken by the Contractor, and practicable noise mitigation measures should be implemented according to the actual site condition and constraints, in order to reduce the construction noise impact. In this connection, the Contractor should keep close liaison with the nearby educational institutions to obtain the examination schedule and should control noise from their construction works such as avoiding concurrent operation of noisy PME, and /or reduction in the percentage on-time of PME during school examination periods. A Construction Noise Management Plan shall be provided by the Contractor before commencement of the construction to avoid noise exceedance.

5.12.2. Environmental monitoring and auditing procedures are recommended in EM&A Manual to ensure the implementation of construction noise mitigation measures as well as to establish a noise complaint handling mechanism.

Operation Phase

5.12.3. With the implementation of the mitigation measures for vehicle repair / testing activities (such as vehicle repair / testing activities to be carried out under the covered area during daytime and evening as far as possible) and the MVAC and other fixed noise sources properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, adverse fixed noise impact on the NSRs is not anticipated during operation phase.

5.12.4. A comparison of the noise levels for the “with project” and “without project” scenarios predicted for year 2033 (i.e. the worst case scenarios) indicated that traffic noise contribution from the road traffic generated by the proposed Project will be insignificant. Therefore, operation of the proposed Project will have no significant contribution to road traffic noise impact on the nearby NSRs.

6. WATER QUALITY AND SEWERAGE IMPACT ASSESSMENT

6.1. INTRODUCTION

6.1.1. This section presents a water quality impact assessment, which identifies water quality impacts, assesses the potential impacts and recommends mitigation measures where required, for the construction and operation of the proposed Project.

6.2. ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

General

6.2.1. The water quality impact assessment is carried out with reference to the following:

- Environmental Impact Assessment Ordinance (Cap. 499);
- EIA Study Brief No. ESB-267/2014, particularly clause 3.4.6 and Appendix D1 and D2;
- Environmental Impact Assessment Ordinance Technical Memorandum (EIAO-TM), particularly Annex 6 and 14; and
- Water Pollution Control Ordinance (Cap. 358).

6.2.2. Other relevant guidelines include:

- Water Supplies Department (WSD) Water Quality Criteria;
- Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (WPCO-TM);
- Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94);
- Practice Note for Professional Persons on Drainage Plans subject to Comment by the Environmental Protection Department (ProPECC PN 5/93); and
- Sewerage Manual (SM) and the Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF).

Water Pollution Control Ordinance (Cap. 358)

6.2.3. The Water Pollution Control Ordinance (WPCO) is the principal legislation to protect the water quality in Hong Kong. Under this Ordinance, Hong Kong's waters are classified into 10 Water Control Zones (WCZs) with specific Water Quality Objectives (WQOs) stipulated for each WCZ. The Project area is adjacent to the Eastern Buffer WCZ and the respective WQOs are summarised in ***Table 6.1***.

Table 6.1 Summary of WQO for Eastern Buffer Water Control Zone

Parameters	WQOs	Sub-zone
Offensive Odour, Tints	Not to be present	Whole zone
Visible foam, oil scum, litter	Not to be present	Whole zone
E. coli	Not exceed 610 per 100mL, calculated as the geometric mean of all samples collected in one calendar year	Fish culture subzones
	Less than 1 per 100mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days	Water gathering ground subzones
	Not exceed 1000 per 100mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days	Other inland waters
Colour	Change due to human activity not to exceed 30 Hazen units	Water gathering ground
	Change due to human activity not to exceed 50 Hazen units	Other inland waters
Dissolved oxygen (DO) within 2m of seabed	Not less than 2 mg/L for 90% of the sampling occasions during the whole year	Marine waters and Fish culture subzones
Depth-averaged DO	Not less than 4 mg/L for 90% of the sampling occasion during the whole year	Marine waters except Fish culture subzones
	Not less than 5 mg/L for 90% of the sampling occasion during the year	Fish culture subzones
	Not less than 4 mg/L	Water gathering ground subzone and other inland waters
pH	To be in the range of 6.5 – 8.5, change due to human activity not to exceed 0.2	Marine waters
	To be in the range of 6.5 – 8.5	Water gathering ground subzones
	To be in the range of 6.0 – 9.0	Other inland waters
Temperature	Change due to human activity not to exceed 2°C	Whole zone
Salinity	Change due to human activity not to exceed 10% of ambient	Whole zone
Suspended Solids (SS)	Not to raise the ambient level by 30% caused by human activity and shall not accumulate to affect aquatic communities	Marine waters
	Change due to human activity not to exceed 20 mg/L of annual median	Water gathering ground subzones
	Change due to human activity not to exceed 25 mg/L of annual median	Other inland waters

Parameters	WQOs	Sub-zone
Unionised Ammonia (UIA)	Annual average (arithmetic mean) not to exceed 0.021 mg/L as unionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
	Annual mean depth-averaged inorganic nitrogen not to exceed 0.4 mg/L	Marine waters
5-day Biochemical oxygen demand (BOD_5)	Not to exceed 3 mg/L	Water gathering ground subzones
	Not to exceed 5 mg/L	Other inland waters
Chemical oxygen demand (COD)	Not to exceed 15 mg/L	Water gathering ground subzones
	Not to exceed 30 mg/L	Other inland waters
Toxic substances	Should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms	Whole zone
	Human activity should not cause a risk to any beneficial use of the aquatic environment	Whole zone

WSD Water Quality Criteria

6.2.4. Besides the WQOs set under the WPCO, WSD has also specified a set of water quality objectives for water quality at flushing water intakes as show in ***Table 6.2***.

Table 6.2 WSD Water Quality Standards at Flushing Water Intakes

Parameter (in mg/L unless otherwise stated)	Target Limit
Colour (Hazen Unit)	< 20
Turbidity (NTU)	< 10
Threshold Odour Number (odour unit)	< 100
Ammonia Nitrogen	< 1
Suspended Solids (SS)	< 10
Dissolved Oxygen	> 2
5-day Biochemical Oxygen Demand (BOD_5)	< 10
Synthetic Detergents	< 5
E. coli (no. per 100 mL)	< 20,000

Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

6.2.5. Discharges of effluents into WCZs are controlled by the WPCO through a licensing system. The Technical Memorandum on Standards for Effluents Discharged into Drainage Sewerage Systems, Inland and Coastal Waters set limits for effluent discharge, covering the physical, chemical, and microbial quality of effluents. Any effluent from the construction and operation of the proposed Project must comply with the standards for effluents discharged into the foul sewers, inland/inshore/marine waters of the Eastern Buffer WCZ.

Practice Note for Professional Persons on Construction Site Drainage

6.2.6. The EPD has issued the Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94) that controls site runoff and wastewater generated during construction phase of the proposed Project. It provides guidelines for handling and disposal of construction discharges. Practices given in the ProPECC PN 1/94 shall be followed as far as possible during construction phase to minimise potential water quality impacts due to construction site drainage. Other ProPECC Notes including ProPECC PN 5/93 Drainage Plan would also be considered.

6.3. EXISTING ENVIRONMENT

6.3.1. A desktop study was conducted to collect and review background information on the water systems, the respective catchments and sensitive receivers that may be affected by the potential water quality impact from the proposed Project.

6.3.2. The Project site is located adjacent to the Chai Wan Eastern Buffer Water Control Zone with Chai Wan Preliminary Treatment Works located in the vicinity. The Stonecutter Island Sewage Treatment Works (SCISTW) was commissioned under Harbour Area Treatment Scheme (HATS) Stage 1 in 2002 to collect the sewage generated from eight Preliminary Treatment Works (PTW), including Chai Wan PTW, for treatment. Since its implementation, the pollution load (in terms of organic pollutants) into the harbour has reduced by 70%. In 2012, the Eastern Buffer WCZ has achieved full compliance (100%) with the WQO according to the "Marine Water Quality in Hong Kong in 2012".

6.3.3. There are five representative EPD's marine water quality monitoring stations within Eastern Buffer WCZ that are in vicinity of the Project site, namely EM1, EM2, EM3, ET1 (Chai Wan Cargo Handling Basin) and ET2 (Aldrich Bay Typhoon Shelter). The locations of the monitoring stations are shown in ***Figure 6.1***. The monitoring data at these stations are summarised in ***Table 6.3*** upon the latest available information.

6.3.4. Based on the best available information at the time of the EIA study, no major change in the existing environmental condition is anticipated in the future in the absence of the proposed Project.

Table 6.3 Marine Water Quality for Eastern Buffer WCZ in 2012

Parameters	EPD's Monitoring Stations				
	EM1	**EM2**	**EM3**	**ET1**	**ET2**
Temperature (ºC)	23.0 (15.0 – 28.4)	22.9 (14.9 – 28.7)	22.8 (14.9 – 28.1)	22.9 (15.2 – 28.6)	22.7 (15.1 – 28.1)
Salinity (ppt)	31.7 (30.3 – 32.9)	31.8 (30.3 – 33.0)	32.1 (31.0 – 33.1)	30.8 (29.7 – 32.3)	30.8 (30.1 – 32.3)
Dissolved Oxygen (mg/L)	6.7 (4.5 – 9.7)	7.0 (4.2 – 9.7)	7.0 (4.5 – 9.7)	6.8 (4.6 – 9.1)	5.9 (3.2 – 8.7)
Bottom Dissolved Oxygen (mg/L)	6.7 (4.3 – 9.6)	6.8 (3.5 – 9.7)	6.6 (3.2 – 9.7)	6.7 (4.7 – 9.1)	5.7 (2.3 – 8.8)
SS (mg/L)	2.9 (0.8 – 6.8)	3.0 (1.2 – 7.8)	2.3 (1.3 – 3.9)	2.1 (1.1 – 3.9)	1.8 (1.3 – 2.6)
BOD_5 (mg/L)	0.5 (0.2 – 0.9)	0.5 (0.2 – 1.0)	0.4 (0.2 – 0.8)	0.7 (0.4 – 1.1)	0.4 (0.1 – 0.6)
Unionised Ammonia (mg/L)	0.002 (<0.001 – 0.006)	0.002 (<0.001 – 0.005)	0.001 (<0.001 – 0.005)	0.003 (<0.001 – 0.008)	0.003 (0.001 – 0.009)
Total Inorganic Nitrogen (mg/L)	0.23 (0.14 – 0.32)	0.19 (0.09 – 0.31)	0.17 (0.06 – 0.28)	0.30 (0.20 – 0.37)	0.38 (0.23 – 0.46)
Chlorophyll-*a* (µg/L)	1.6 (0.4 – 4.8)	1.8 (0.5 – 5.6)	1.6 (0.5 – 4.3)	3.2 (0.5 – 9.3)	1.2 (0.2 – 2.9)
E. coli (count/100mL)	57 (1 – 550)	18 (1 – 140)	4 (1 – 35)	380 (140 – 1100)	710 (110 – 2300)

Notes:

[1] Data presented are depth averaged (except as specified) and are the annual arithmetic mean except for E. coli (geometric mean);

[2] Data in brackets indicate the ranges;

[3] Underlined indicates occurrence of non-compliance with that parameter of WQO.

6.4. WATER SENSITIVE RECEIVERS

6.4.1. The water quality impact assessment identified and analysed the existing and planned future activities, beneficial uses and water sensitive receivers (WSRs) within 500 m from the boundary of the Project site and Eastern Buffer Water Control Zone in accordance with clause 3.4.6.2 of the EIA Study Brief and evaluates the potential water quality impact from the proposed Project. The review was made with reference to the latest best available information at the time of preparation of this study, which include those earmarked on the approved Chai Wan OZP (No. S/H20/21), Development Permission Area Plans, Outline Development Plans and Layout Plans, and other relevant published land use plans, including plans and drawings published by Lands Department and any lands use and development applications approved by the Town Planning Board.

6.4.2. Due to the highly urbanised nature of the area, no natural streams or rivers are located within 500 m from the Project site. Also, there are no marine biological sensitive receivers, such as shellfish culture grounds, marine park/reserves or commercial fishing rounds, identified within the assessment area. However, a cargo handling basin and seawater abstraction points for flushing and cooling are identified within the assessment area. The details of the key WSRs that may potentially be affected by the proposed Project are provided in ***Table 6.4*** and shown in ***Figure 6.1***.

Table 6.4 Water Sensitive Receivers in Eastern Buffer WCZ

WSR No.	Descriptions
WSR 1	WSD Water Flushing Intake – Sai Wan Ho
WSR 2	Shau Kei Wan Typhoon Shelter
WSR 3	Cooling Water Intake – Pamela Youde Nethersole Eastern Hospital
WSR 4	Chai Wan Cargo Handling Basin
WSR 5	WSD Water Flushing Intake – Siu Sai Wan
WSR 6	Cape Collinson – Corals
WSR 7	Joss House Bay – Corals
WSR 8	Tung Lung Chau West – Corals
WSR 9	Tung Lung Chau Fish Culture Zone
WSR 10	Tung Lung Chau North – Corals
WSR 11	Tung Lung Chau South – Corals

6.5. ASSESSMENT METHODOLOGY

6.5.1. The water quality impact assessment follows the criteria and guidelines as stated in Annexes 6 and 14 of the EIAO-TM.

6.5.2. The assessment reviews specific construction methods and operational activities of the proposed Project to identify potential pollution sources, including pollutants from point discharges and non-point sources to surface water run-off, sewage from workforce and polluted discharge generated from the proposed Project.

6.5.3. The identified pollution sources have been evaluated to determine the significance of the physical, chemical and biological disruptions to the adjacent water system and sensitive receivers.

6.5.4. The potential cumulative impacts due to other related concurrent and planned projects or pollution sources within assessment area have been assessed with proposed mitigation measures where required to ensure that any water quality impacts would be controlled to acceptable levels.

6.6. CONSTRUCTION PHASE IMPACT ASSESSMENT

Identification of Pollution Sources

6.6.1. As described in *Section 3* of this EIA Report, the proposed Project comprises mainly the construction of land-based structures with foundation piling. Upon site clearance, site formation will be carried out in limited scale as the site is relatively flat, followed by construction of foundation work by piling. As marine construction works are not required, potential water pollution sources during construction phase would originate from the land-based works activities including excavation works, piling, footing, concrete slab, utilities work, etc.

6.6.2. Major potential sources of water quality impacts during construction phase of the proposed Project are identified, which include:

- Construction site run-off;
- Accidental spillage of chemicals; and
- Sewage generated from on-site construction workers.

Construction Site Run-off

6.6.3. Construction site run-off may increase the loads of sediment and other contaminants. The discharge of uncontrolled site run-off may cause potential blockage of drainage channel and increase of SS level and turbidity in the Eastern Buffer WCZ. The pH of the water system may be altered from the release of contaminants and result in toxic effects to the water biota. However, these potential impacts are considered as temporary and reversible.

6.6.4. Major construction site run-off comprises:

- Contaminated surface run-off and erosion from site surfaces, exposed bare soil and earth, drainage channels, earth working areas and stockpiles;
- Effluents from dewatering associated with piling, grouting and cement washing;
- Wastewater from dust suppression sprays and vehicle wheel washing; and
- Contaminated surface run-off by fuel, oil, solvents and lubricants from maintenance area for construction equipment and vehicle.

6.6.5. The potential release of high levels of pollutants into the stormwater drainage system and coastal marine water can be minimised by the adoption of good site practices and relevant guidelines for construction run-off. Adequate site drainage with sedimentation tank and perimeter drain along Site boundary will be provided on Site. With the implementation of mitigation measures and good site practices outlined in *Section 6.9*, the effluent discharge quality will meet the requirements specified on the discharge licence and the WPCO-TM. Therefore, unacceptable water quality impacts on the water system including nearby WSRs are not anticipated.

Accidental Spillage of Chemicals

6.6.6. Surface soils may be contaminated by the accidental spillage of trace of chemicals used in general construction works, e.g. lubricant oil, paints, diesel and solvents, etc. The contaminated soil may be washed away by construction site run-off and enter nearby stormwater drainage channels, thus resulting in adverse water quality impacts. These potential impacts are considered as temporary and reversible.

6.6.7. Implementation of good construction and site management practices, such as perimeter drain along site boundary and sediment trap, will ensure the generation of accidental chemical spillage is minimised. As such, spillage of chemicals shall not enter nearby stormwater drains and adverse water quality impacts on the water system including nearby WSRs will be avoided.

Sewage Generated from On-Site Workforce and Staff

6.6.8. There will be sewage generation from eating areas, temporary sanitary facilities and waste disposal area for on-site construction workforce and staff. The characteristics of the sewage may include high levels of BOD_5, ammonia and *E. coli*. However, adverse water quality impacts on the water system including nearby WSRs are not anticipated by adequate control of construction phase sewage through provision of sewage collection and disposal facilities, such as on-site chemical toilets.

6.7. OPERATION PHASE IMPACT ASSESSMENT

Identification of Pollution Sources

6.7.1. According to the current design as shown in ***Figure 3.1***, the entire Project site, except the landscape area on Level 1 and the roof floor, is enclosed by the building envelop that is impermeable to water. With reference to the operational activities as described in *Section 3*, major potential sources of water quality impacts during operation phase of the proposed Project are identified, which include:

- Sewage generated from vehicle washing and maintenance;
- Spillage from use and storage of chemical; and
- Sewage generated from staffs at office and depot.

Existing, Committed and Planned Sewerage Facilities

6.7.2. The proposed Project will be constructed in the form of a six-storey building comprising various facilities for vehicle washing and repair / testing operation, vehicles parking as well as offices. An automatic vehicle washing machine will be provided for the FEHD while a vehicle washing bay for manual vehicle washing will be provided for each of the FEHD and the EMSD Depots.

6.7.3. A desktop study was carried out to identify the existing sewerage networks, sewage treatment and disposal facilities and the characteristics of the concerned sewerage catchments within and in the vicinity of the proposed Project.

6.7.4. An assessment of the DSD sewerage record drawings has concluded that there are existing sewerage networks in the vicinity of the proposed Project for serving the concerned sewerage catchments. The existing public sewers have pipe diameters ranging from 225mm to 600mm running along Sheung On Street and Sheung Ping Street. These sewers are then connected into the 2100mm trunk sewer for discharging into the DSD Chai Wan PTW at the downstream end, which is located approximately 400m to the southeast of the proposed Project.

6.7.5. Apart from the above existing sewers, no committed or planned sewerage networks, sewage treatment or disposal facilities was identified in the vicinity of the proposed Project.

Sewage generated from Vehicle Washing and Maintenance

6.7.6. Potential contaminated wastewater may be generated from vehicle washing activities that contain high levels of oil and grease and suspended solids. The estimated quantity of water use for vehicle washing is shown in ***Appendix 6.1***. Limited amount of oil and grease run-off may also be generated from vehicle examination and maintenance areas, repair / testing areas, brake testing areas, parking area and parking spaces.

6.7.7. Proper drainage channels with wastewater treatment facilities will be provided at these areas to confine the potential contaminated wastewater and run-off within the Site area. The collected wastewater will be treated by the wastewater treatment facilities, including sedimentation tank and petrol interceptor, and discharged to public sewerage system[1]. Therefore, no potential contaminated wastewater is anticipated to be washed out to the uncovered portions of the Project site. A preliminary layout of drainage system is provided in ***Figure 6.3*** for indicative purpose and subject to review and confirm during detail design stage.

6.7.8. Since the potential contaminated wastewater will be properly treated to comply with WPCO-TM standards prior to discharge to prevent the potential contaminated wastewater from entering public sewerage system, adverse water quality impact on the water system including nearby WSRs is not anticipated.

Spillage from Use and Storage of Chemical

6.7.9. Chemical spillage may contaminate surface run-off during the storage, transfer and trans-shipment of operation chemicals, such as oil, fuel and disinfectant fluid, at workshops, stores, battery charging room, dangerous goods stores, lubricant storage area, fire services facilities, air compressor room and waste oil tank if handled improperly.

6.7.10. By implementation of appropriate practices with suitable facilities, such as provision of drip tray underneath each chemical container for retention of potential chemical spill and appointment of licenced collector, contamination of surface run-off would be prevented and spillage shall not enter the public stormwater drainage system and the public sewerage system. As such, adverse water quality impact on the water system including nearby WSRs would be avoided.

[1] The public sewerage system corresponds to the public foul water drainage system.

Sewage generated from Staffs at Office and Depot

6.7.11. Sewage from the operation of the proposed Project would be generated mainly from toilet and shower facilities in workshop and office, including sanitary wastewater and showering facilities and floor drainage, while potentially contaminated run-off is anticipated to be generated from the cleaning activities at vehicle washing bays and maintenance area within the proposed Project.

6.7.12. According to the GESF, the average dry weather flows (ADWF) from the proposed Project is estimated to be 210 m^3/d based on the estimated sewage generation in ***Appendix 6.1***. A peaking factor of 8 and a catchment inflow factor of 1.10 have then been applied to the ADWF to establish the peak wet weather flow (PWWF) of 0.0214 m^3/s, which includes the stormwater allowances in accordance with the GESF, in order to provide a conservative basis for the performance assessment of the sewerage facilities.

Potential Impact on Public Stormwater System

6.7.13. No maintenance activity will be carried out on roof floor except for access to plant rooms. Proper drainage will be provided in each plant room on roof floor to ensure no wastewater or run-off from plant room will enter the uncovered portion of the roof. Contamination of rainwater from plant room is not anticipated.

6.7.14. No fertilisers or pesticides will be routinely used for vegetation management in landscape area in accordance with the *General Specification for Building (2012 edition)* by Architectural Services Department (ASD). During heavy rainfall, trace of pollutants may be wash-off and is often bound or adsorbed onto particles (i.e. loose soil or litter). The stormwater drainage system will be equipped with silt trap to remove the particles and associated pollutants prior to discharging into the public stormwater drainage system. The stormwater discharge will satisfy the effluent standards and requirements stipulated in the WPCO-TM, notably, with respect to prohibited substances as stated in clauses 8.4 and 9.1, as the case may be. The detailed design of silt traps will be reviewed and confirmed during detailed design stage so that WPCO-TM, in particular, the aforesaid requirements pertaining to prohibited substances, will be complied with.

6.7.15. Two existing public stormwater drainage systems, i.e. along Sheung Mau Street and along Sheung On Street North, were identified nearby the Project site according to the drainage record plans from DSD. As shown in ***Figure 6.1***, the collected stormwater will be discharged to the stormwater drainage system along Sheung On Street North with outfall located near the entrance/exit of the cargo handling basin, which is anticipated to have relatively non-stagnant water due to the frequent travelling of vessels as compared to the stormwater drainage system along Sheung Mau Street with outfall located near the end of the basin (i.e. on the south-western boundary of the basin), to minimise the potential impact on the cargo handling basin. The discharge is clear from the remaining sensitive receivers.

6.7.16. Since the stormwater will be properly treated to satisfy the effluent standards prior to discharge and complies with the clearance requirements as listed in the WPCO and its TM, no adverse water quality impact on the public stormwater drainage system and nearby water bodies and WSRs is anticipated during operation of the Project.

Potential Impact on Public Sewers and Sewerage Facilities

6.7.17. With the provision of the stormwater drainage system as shown in ***Figure 6.3***, no rainwater would enter public sewerage system during operation phase in accordance with ProPECC PN 5/93.

6.7.18. The collected sewage flows from the proposed Project will be connected and discharged into the existing 225 mm diameter gravity sewer along Sheung On Street. The PWWF to be discharged into the existing sewer is estimated to be 0.0214 m^3/s (with peaking factor of 8 taken into account).

6.7.19. A hydraulic assessment, which has taken into account of the sewage discharge from the surrounding development listed in ***Table 6.5***, is conducted for the existing sewerage system as shown in ***Appendix 6.1***. Comparing the PWWF of 0.0214 m^3/s from the proposed Project with the capacities of the existing 225 mm diameter gravity sewer and the downstream 400 mm, 600 mm and 2100 mm diameter gravity sewers, no significant impact to the receiving sewerage networks and the associated sewage treatment and disposal facilities arising from the proposed Project is anticipated. Mitigation works for the sewerage networks, sewage treatment and disposal facilities are not required.

Agreement with Government Authorities for Proposed Sewerage Discharge

6.7.20. The proposed sewerage layout plans for the proposed Project for connection into the public sewerage system as shown in ***Figure 6.2*** shall be submitted to the Government authorities (including DSD and EPD) for approval in the detailed design stage of the proposed Project. Agreement from the authorities should be sought prior to the commencement of the proposed sewerage connection work.

6.7.21. As there would be discharge of treated effluent from the proposed Project, application for a discharge licence pursuant to the WPCO should be submitted to EPD for approval.

6.8. CUMULATIVE IMPACTS

6.8.1. The known concurrent projects to the proposed Project, as described in *Section 3* of this EIA Report, would include the following:

Table 6.5 List of Potential Concurrent Projects

Concurrent Projects	Potential Cumulative Water Quality Impacts	
	Construction Phase	Operation Phase
Planned THEi New Campus (construction tentatively between the third quarter of 2013 and the third quarter of 2016; operation phase from the third quarter of 2016)	×	×
Existing EMSD Hong Kong Workshop at Chai Wan (EP-442/2012)	×	×
Existing New World First Bus Permanent Depot at Chai Wan (EP-052/2000)	×	×
Existing Headquarter and Bus Maintenance Depot in Chai Wan (EP-107/2001)	×	×
Government Logistics Centre	×	×

6.8.2. The construction phase of the planned THEi New Campus will be nearly completed when the construction of the proposed Project commences in mid-2016. Therefore, the interfacing construction of the two projects is limited. In view of the works practices and the associated environmental measures to be implemented, it is anticipated that no adverse cumulative water quality impact would be arisen during construction phase.

6.8.3. The operation phase of the proposed Project will interface with the operation of four projects as listed in ***Table 6.5***, where the EMSD Workshop will be shut down. It should be noted that the sewage from the operation phase of the planned THEi New Campus is discharged to another sewerage system along Shing Tai Road. Given that individual water quality mitigation measures, such as provision of stormwater drainage system, petrol interceptor, etc., would be implemented by each project to ensure that the discharge complies with WPCO-TM standards, unacceptable cumulative water quality impact is not anticipated during operation phase.

6.9. MITIGATION MEASURES

Construction Site Run-off and General Construction Activities

6.9.1. In accordance with ProPECC PN 1/94, potential water quality impact shall be minimised by the implementation of construction phase mitigation measures and general good practices including the following:

- At the establishment of works site, perimeter cut-off drains to direct off-site water around the Site should be constructed with internal drainage works and erosion and sedimentation control facilities implemented. Channels (both temporary and permanent drainage pipes and culverts), earth bunds or sand bag barriers should be provided to divert the stormwater to silt removal facilities. The design of the temporary on-site drainage system will be undertaken by the Contractor prior to the commencement of construction, followed by proper maintenance and management practices throughout the construction phase;

- Dikes or embankments for flood protection should be implemented around the boundaries of earthwork areas. Temporary ditches should be provided to facilitate the run-off discharge into an appropriate watercourse, through a silt/sediment trap. Silt/sediment traps should also be incorporated in the permanent drainage channels to enhance deposition rates;

- The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94, which states that the retention time for silt/sand traps should be 5 minutes under maximum flow conditions. The sizes may vary depending upon the flow rate, but for a flow rate of 0.1 m^3/s, a sedimentation basin of 30 m^3 would be required and for a flow rate of 0.5 m^3/s the basin would be 150 m^3. The detailed design of the sand/silt raps should be undertaken by the Contractor prior to the commencement of construction;

- The construction works should be programmed to minimise surface excavation works during rainy seasons (April to September), as possible. All exposed earth areas should be completed and vegetated as soon as possible after completion of the earthwork, or alternatively, within 14 days of the cessation of earthworks where practicable. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means;

- The overall slope of works sites should be kept to a minimum to reduce the erosive potential of surface water flows, and all trafficked areas and access roads should be protected by coarse stone ballast. An additional advantage accruing from the use of crushed stone is the positive traction gained during the prolonged periods of inclement weather and the reduction of surface sheet flows;

- All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure their proper and efficient operation at all times particularly following rainstorms. Deposited silts and grits should be removed regularly and disposed of by spreading evenly over stable, vegetated areas;

- Measures should be taken to minimise the ingress of site drainage into excavations. If the excavation of trenches in wet season is inevitable, they should be dug and backfilled in short sections wherever practicable. The water pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities;

- All open stockpiles of construction materials (for example, aggregates, sand and fill materials) should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system;

- Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system and storm run-off being directed into foul sewers;

- Precautions to be taken at any time of the year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecasted and during or after rainstorms, are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface run-off during storm events;

- All vehicles and plants should be cleaned before leaving the Project site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing bay should be provided at the exit of Project site where practicable. Wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-washing bay to public roads should be paved with sufficient backfall toward the wheel-washing bay to prevent vehicle tracking of soil and silty water to public roads and drains;

- Oil interceptors should be provided in the drainage system downstream of any oil/fuel pollution sources. Oil interceptors should be emptied and cleaned regularly to prevent the release of oil and grease into the storm water drainage system after accidental spillage. A bypass should be provided for oil interceptors to prevent flushing during heavy rain. Any drainage channels connecting storm drains via designed sand/silt removal facilities should be disconnected/removed after completion of construction stage to prevent any direct discharge to the stormwater system;

- The construction solid waste, debris and rubbish on-site should be collected, handled and disposed of properly to avoid causing any water quality impacts. The requirements for solid waste management are detailed in *Section 8* of this EIA Report; and

- All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching the nearby WSRs.

6.9.2. By adopting the above mitigation measures with best management practices, it is anticipated that the impacts of construction site run-off will be reduced to an acceptable level.

6.9.3. There is a need to apply to the EPD for a discharge licence for discharge of effluent from the construction site under the WPCO. The discharge quality must meet the requirements as specified in the discharge licence. All the run-off and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the Technical Memorandum. Minimum distances of 100 m should be maintained between the discharge points of construction site effluent and the existing seawater intakes. Incorporation of these requirements in the contract document of the proposed Project shall be considered. In addition, no new effluent discharges in nearby typhoon shelters should be allowed. The beneficial uses of the treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., would minimise water consumption and reduce the effluent discharge volume.

Sewage Generated from On-site Construction Workers

6.9.4. Portable chemical toilets and sewage holding tanks are recommended for the handling of the construction sewage generated by the workforce. A licenced contractor should be employed to provide appropriate and adequate portable toilets and be responsible for appropriate disposal and maintenance.

Accidental Spillage of Chemicals

6.9.5. The Contractor must register as a chemical waste producer if chemical wastes would be produced from the construction activities. The Waste Disposal Ordinance (Cap. 354) and its subsidiary regulations in particular the Waste Disposal (Chemical Waste) (General) Regulation should be observed and complied with for control of chemical wastes.

6.9.6. Any maintenance facilities should be located on hard standings within a bunded area, and sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should be undertaken within the areas appropriately equipped to control these discharges.

Operation Phase of the Project

6.9.7. All sewage arising from the proposed Project should be collected and diverted to the public sewerage system via proper connections to minimise water quality impact from the operation of the proposed Project and ensure compliance with WPCO-TM.

6.9.8. Run-offs from the covered areas including vehicle washing bays and vehicle examination / maintenance / repair / testing area would be properly treated prior to discharge into the sewerage system. The wastewater treatment facilities for the proposed Project, which comprised of petrol interceptor and sedimentation tank, would be designed using sedimentation process with adequate treatment capacity. Oily waste collected by petrol interceptors is considered and disposed of as chemical waste. The wastewater treatment facilities for the proposed Project will be designed during the detailed design stage and the treated effluent for discharging into the public sewerage system should comply with the effluent standards as stated in the WPCO-TM.

6.9.9. Best practices with appropriate management should be implemented during transfer of operation chemicals. Each chemical container should be provided with drip trays at storage. In case of chemical spillage, licenced collector would be appointed for waste collection.

6.9.10. There is a need to apply to the EPD for a discharge licence for discharge of the operational effluent from the proposed Project, i.e. the effluents as mentioned in Section 6.7.1, under the WPCO. The discharge quality must meet the requirements as specified in the discharge licence.

6.10. RESIDUAL IMPACTS

6.10.1. With the implementation of the above mitigation measures, the proposed Project is not anticipated to result in adverse residual impacts on the water system including nearby WSRs, with regards to the standards and guidelines as listed in *Section 6.2*, during the construction and operation phases.

6.11. ENVIRONMENTAL MONITORING AND AUDIT

6.11.1. The implementation of good construction works practices as well as the various specific mitigation measures recommended above will be important to prevent pollution of marine water during the construction phase. It is, therefore, recommended that construction activities should be subject to a routine audit programme throughout the construction period. Further details on the scope of this audit are provided in the EM&A Manual.

6.11.2. With the full implementation of the recommended mitigation measures during operation phase, no adverse water quality impact is anticipated. Therefore, no operation phase EM&A for water quality is considered required.

6.12. CONCLUSIONS

6.12.1. Potential water pollution sources have been identified as construction site run-off, sewage from workforce, and potential risk of chemical spillage. Mitigation measures including the implementation of the construction site practices in accordance with the EPD’s ProPECC PN 1/94 Construction Site Drainage, provision and management of portable chemical toilets on-site as well as preventive measures for avoiding accidental chemical spillages are recommended to mitigate any adverse water quality impacts. With the implementation of these measures, adverse residual impacts would not be anticipated. Furthermore, there would be insignificant sewerage and sewage treatment implications during the operation of the proposed Project, and adverse water quality impact would not be anticipated with the implementation of the recommended mitigation measures based on the findings of this EIA study.

7. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

7.1. INTRODUCTION

7.1.1. This section presents the landscape and visual impact assessment (LVIA) for the construction and operation of the proposed Project to outline and examine the landscape baseline conditions of existing landscape resources (LRs) and the landscape character areas (LCAs), the visual amenity, visual sensitive receivers (VSRs), and the planning and development control frameworks within the assessment area. The assessment area includes all areas within 500m from the Project boundary, while the study area for the visual impact assessment is defined by the visual envelop (VE) of the proposed Project. The assessment includes:

- A definition of the scope and contents of the proposed works;
- A review of relevant planning and development control framework;
- A baseline study providing a comprehensive and accurate description of the baseline landscape resources, landscape character areas and visual sensitive receivers (VSRs);
- Identification of the potential landscape and visual impacts and prediction of their magnitude and potential significance, before and after the mitigation measures;
- Recommendations for appropriate mitigation measures; and
- An assessment of the acceptability or the predicted residual impacts.

7.1.2. The landscape and visual impact assessment follows the criteria and guidelines as stated in Annexes 10 and 18 of the Technical Memorandum on Environmental Impact Assessment Ordinance (EIAO-TM). Colour photographs showing baseline conditions and illustrative materials supporting conclusions are provided and the locations of all key viewpoints have been clearly mapped. Photomontages at representative locations provide a comparison between existing views, proposals on day 1 after completion with and without mitigation measures, and in year 10 after completion with mitigation measures in accordance with EIAO Guidance Note (GN) No. 8/2010.

7.2. ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

7.2.1. The LVIA has been conducted in accordance with the following:

- Environmental Impact Assessment Ordinance (EIAO) (Cap.499);
- EIA Study Brief No. ESB-267/2014, particularly clause 3.4.10 and Appendix F;
- EIAO-TM, particularly Annex 10 and 18;
- EIAO GN No. 8/2010 “Preparation of Landscape and Visual Impact Assessment under the Environmental Impact Assessment Ordinance”;

- Town Planning Ordinance (Cap.131);
- Study on Landscape Value Mapping of Hong Kong;
- Hong Kong Planning Standards and Guidelines Chapter 4 Recreation, Open Space and Greening, and Chapters 11 Urban Design Guidelines;
- Chai Wan Outline Zoning Plan (OZP) No. S/H20/21;
- WBTC No. 25/95 Allocation of Space for Urban Street Trees;
- WBTC No. 7/2002 Tree Planting in Public Works;
- WBTC No. 14/2002 Management and Maintenance of Natural Vegetation and Landscape Works and Tree Preservation;
- WBTC No. 2/2004 Maintenance of Vegetation and Hard Landscape Features;
- WBTC No. 9/2004 Registration of Old and Valuable Trees and the Guidelines for Preservation; and
- DEVB TC(W) No. 10/2013 Tree Preservation.

7.3. PLANNING AND DEVELOPMENT CONTROL FRAMEWORK

7.3.1. A review of the existing and planned development for the proposed works and for the surroundings has been undertaken. It aims at gaining insight to the future outlook of the potentially affected area, identifying issues with neighbouring planned land uses, identifying potential resources and sensitive receivers and ensuring a high compatibility between the proposed Project and the surroundings.

7.3.2. The Site is located near the promenade of Chai Wan Public Cargo Working Area. The Site falls within an area zoned as “Government, Institution or Community (G/IC(2))” on the latest Chai Wan Outline Zoning Plan (OZP) No. S/H20/21, which is always permitted for Government use. Therefore, application for permission under Section 16 of the Town Planning Ordinance is not required.

7.3.3. According to the Notes of the OZP, the planning intention of the zone is intended “for the provision of Government, institution or community facilities serving the needs of the local residents and/or a wider district, region or the territory. It is also intended to provide land for uses directly related to or in support of the work of the Government, organizations providing social services to meet community needs, and other institutional establishments.” As mentioned in *Section 2.2*, the proposed Project would provide facilities for uses directly related to and in support of the work of the Government to meet community needs, such as the provision of FEHD vehicle depot allows the FEHD to provide quality environmental hygiene services and the provision of PVP&EC for the HKPF to enhance road safety and maintain smooth and safe traffic flow in Hong Kong. Therefore, the proposed Project satisfies the planning intention.

7.3.4. The Project site is surrounded by areas zoned as G/IC(2), where Government buildings and public bus depots have been developed. The proposed Project is consistent with the visual character of the area.

7.3.5. As described in *Section* 3, the proposed Project is a six-storey building with building height of +49.8 mPD, which complies with the height restriction of 70 mPD as stipulated on the OZP for the subject site. The building height of the proposed Project is also within the range of building heights of the surrounding developments, which is between 19.6 mPD and 71 mPD.

7.3.6. The provision of tree planting and shrubs on Level 1 along the subject site boundary as mentioned in *Section 7.8.6 and 7.8.7* is also consistent with *Section 6.2.41* of the Urban Design Guideline in *Hong Kong Planning Standards and Guidelines*, which recommends the provision of landscape areas along streets to soften hard edges and to reduce heat build-up of street environment.

7.3.7. There is no specific requirement on landscape strategy, landscape framework, designed view corridors, open space network and landscape link for the proposed Project.

7.3.8. Outline Development Plan (No. D/H20A/1A), neighbouring OZPs (i.e. Nos. S/H18/10 and S/TKO/21) and planning briefs have also been reviewed. Potential developments shall be anticipated at the vacant land at the junction of Shing Tai Road and Sheung Mau Street and the public open parking space located at the junction of Shing Tai Road and Chong Fu Road, which are zoned as “Government, Institution or Community (G/IC(2))”on the latest Chai Wan OZP. However, there is no programme of the two potential developments during the course of the report and is therefore not assessed in this study. No committed or planned development is identified other than the planned THEi New Campus.

7.3.9. The findings of the planning and development control review on areas within the Landscape Impact Assessment Area are summarised in ***Table 7.1***.

Table 7.1 Review of Existing Planning and Development Control Framework

Land Use Zonings	**Landscape Planning, Design and Conservation Intention of Zoning**	**Potential Impacts**	**Mitigation Measures and Future Outlook of the Area with the Proposed Works**
Outline Zoning Plan Number S/H20/21 – Chai Wan			
Country Park (CP)	This zone encompasses the Tai Tam Country Park on the west of the assessment area that is designated under the Country Park Ordinance (Cap. 208). The Country Parks contribute to the conservation of the natural environment and provide both passive and active recreational outlets.	This zone is outside the Project Area. No impact to this zone due to this Project is anticipated.	This zone is outside the Project Area. The proposed works of this Project will not affect the future outlook of this zone. No mitigation measure is proposed.
Government, Institution or Community (G/IC)	This zone encompasses the bus depots of Citybus and New World First Bus (NWFB), the Government Logistics Centre, Hong Kong Institute of Vocational Education (Chai Wan) and the Project site. This zone is intended primarily for the provision of Government, institution and community facilities serving the needs of the local residents and/or a wider district, region or territory. It is also intended to provide land for uses directly related to or in support of the work of the Government or organizations providing social services meet community needs, and other institutional establishments.	The proposed Project is consistent with the planning intention of this zone. No rezoning is required for this Project.	The exterior of the permanent structure of the proposed Project would use non-reflective external finishes in light colour that is unobtrusive with surrounding context to blend in with the surrounding environment. Trees, shrubs or groundcovers will be provided in the landscape area on Level 1 and roof floor within the Project Area. Details of the proposed mitigation measures are described in *Section 7.8*.
Industrial (I)	This zone encompasses the strip of industrial buildings on the east and southeast of the assessment area. This zone is intended primarily for general industrial uses to ensure an adequate supply of industrial floor space to meet demand from production-oriented industries. Information technology and telecommunications industries and office	This zone is outside the Project Area. No impact to this zone due to this Project is anticipated.	This zone is outside the Project Area. The proposed works of this Project will not affect the future outlook of this zone. No mitigation measure is proposed.

Land Use Zonings	Landscape Planning, Design and Conservation Intention of Zoning	Potential Impacts	Mitigation Measures and Future Outlook of the Area with the Proposed Works
	related to industrial use are always permitted in this zone.		
Open Space (O)	This zone encompasses the Heng Fa Chuen Playground on the north and the Chai Wan Park on the south of the assessment area. This zone is intended primarily for the provision of outdoor open-air public space for active and/or passive recreational uses serving the needs of local residents as well as the general public.	This zone is outside the Project Area. No impact to this zone due to this Project is anticipated.	This zone is outside the Project Area. The proposed works of this Project will not affect the future outlook of this zone. No mitigation measure is proposed.
Other Specified Uses (OU)	This zone mainly encompasses the Chai Wan Cargo Working Area on the east, the Mass Transit Railway (MTR) Comprehensive Development Area on the north-west, and the gas station on the immediate south of the assessment area. This zone is intended to provide adequate open space and community facilities within the development to serve the residents, or designated for "Business" use to allow flexibility in the use of existing industrial and industrial-office buildings as well as in the development of new buildings for both commercial and clean industrial uses.	This zone is outside the Project Area. No impact to this zone due to this Project is anticipated.	This zone is outside the Project Area. The proposed works of this Project will not affect the future outlook of this zone. No mitigation measure is proposed.
Residential (Group A) (R(A))	This zone encompasses the Tsui Wan Estate on the south of the assessment area. This zone is intended primarily for high-density residential developments. Public housing projects and a few private residential developments are within this zone. Major community facilities and open space as well as commercial facilities are provided within these public housing	This zone is outside the Project Area. No impact to this zone due to this Project is anticipated.	This zone is outside the Project Area. The proposed works of this Project will not affect the future outlook of this zone. No mitigation measure is proposed.

Land Use Zonings	Landscape Planning, Design and Conservation Intention of Zoning	Potential Impacts	Mitigation Measures and Future Outlook of the Area with the Proposed Works
	developments to serve the needs of the residents.		

7.4. ASSESSMENT METHODOLOGY

Landscape Baseline Review and Impact Assessment

Identification of Landscape Resources and Landscape Character Areas

7.4.1. A baseline study of the existing landscape resources (LRs) and landscape character areas (LCAs) was conducted based on desktop study and field surveys to identify and examine the existing landscape elements that contribute to landscape character of the study area, which is within 500m from the Project site boundary in accordance with clause 3.4.10.2 of the Study Brief. The size and scale of the study area is considered as sufficient to provide representative data for the assessment. Basic landscape elements include topography, natural landscape form and patterns of settlement of built features, lands use, streetscapes, and any cultural historical and/or religious identity.

7.4.2. A tree survey has been conducted within the Project site and its immediately adjacent areas to identify the landscape resources and quality with respect to the tree species characters, ecological/conservation value, health and structure conditions of the existing trees of the Site.

7.4.3. The LCAs formed by various broadly homogenous units of similar landscape characters within the study area have been mapped and annotated on a plan.

Methodology of Landscape Impact Assessment

7.4.4. Potential impacts arisen from the construction and operation stages of the proposed Project were assessed.

7.4.5. The sensitivity of LRs/LCAs are normally influenced by the importance or rarity, quality and maturity of the landscape elements, the ability of the elements to accommodate change, and the significance of the change in local and regional context. The sensitivity was assessed as follows:

- **High**: an important component or a landscape of particularly distinctive character susceptible to small changes;
- **Medium**: a landscape with moderately-valued characteristics reasonably tolerant to change; and
- **Low**: a relatively unimportant landscape that is able to accommodate extensive change.

7.4.6. The magnitude of change to LRs/LCAs depends on the scale of the proposed Project, compatibility of the proposed Project with the surrounding landscape, duration of impacts under construction and operation phase, and reversibility of change. The magnitude is classified as follows:

- **Large**: notable change in landscape characteristics over extensive area, or very intensive change over a more limited area;

- **Intermediate**: moderate change to local area;
- **Small**: changes limited to components; and
- **Negligible**: no perceptible change.

7.4.7. The system for the assessment of the overall landscape impact is summarised in ***Table 7.2*** below. The significance of landscape impact has been derived from the combined analysis of the magnitude of change and the sensitivity of the LRs/LCAs to the change in accordance with Section 3.7 (f) of EIAO GN No. 8/2010. The significance is defined as follows:

- **Significant:** the landscape resource/landscape will experience major change;
- **Moderate:** the landscape resource/landscape will experience moderate change;
- **Slight:** the landscape resource/landscape will experience slight or barely perceptible change; and
- **Insubstantial:** the landscape resource/landscape will experience unnoticeable change.

Table 7.2 Significance of Landscape and Visual Impact

		Sensitivity of Resource		
		Low	**Medium**	**High**
Magnitude of Change	**Large**	Moderate Impact	Moderate/Significant Impact	Significant Impact
	Intermediate	Slight/Moderate Impact	Moderate Impact	Moderate/Significant Impact
	Small	Slight Impact	Slight/Moderate Impact	Moderate Impact
	Negligible	Insubstantial Impact	Insubstantial Impact	Insubstantial Impact

Visual Baseline Review and Impact Assessment

<u>Baseline Review of Visual Envelop and Identification of Visual Sensitive Receivers</u>

7.4.8. The assessment area for the visual impact assessment has been defined as the visual envelop (VE) that is generally the viewshed formed by natural or manmade features such as ridgeline or building blocks according to EIAO GN No. 8/2010 and is considered as sufficient to provide representative data for the assessment. The visibility of the proposed Project from key groups of visual sensitive receivers (VSRs) has been determined through site surveys and desktop study of topographical plans and aerial photographs.

7.4.9. The key VSRs are categorised according to the nature of settlement as follows:

- **VSRs-H:** residential VSRs that view the proposed Project from homes. They are considered as the most sensitive due to the potential of intrusion on their home environment and the associated quality of life;

- **VSRs-O:** occupational VSRs that view the proposed Project from workplaces, institutional and educational buildings. They are considered as relatively less sensitive since the visual amenity will be less important to their quality of life;
- **VSRs-R:** recreational VSRs that view the proposed Project from recreational landscapes. Their sensitivity to change varies depending on the types of recreational activity, and
- **VSRs-T:** travelling VSRs that view the proposed Project from public roads and railways during travelling on vehicles or on foot. Their sensitivity to change is the least in general.

<u>Methodology of Visual Impact Assessment</u>

7.4.10. Potential visual impacts arisen from the construction and operation stages of the proposed Project were assessed.

7.4.11. The sensitivity of VSRs are normally influenced by the value and quality of existing views, availability and amenity of alternative views, type and estimated number of receiver population, duration or frequency of view, and degree of visibility. The sensitivity of the VSRs to change is rated as "high", "medium" or "low".

7.4.12. Typical viewpoint (vantage point) has been identified and photograph showing the current view was taken.

7.4.13. The magnitude of change for in view to the VSRs depends on the scale of the proposed Project, compatibility of the proposed Project with the surrounding landscape and planned setting, duration of impacts under construction and operation phases, reversibility of change, viewing distance and potential blockage of view. The magnitude is classified as follows:

- **Large:** major changes in view to the VSRs
- **Intermediate:** moderate changes in view to the VSRs
- **Small:** minor changes in view to the VSRs
- **Negligible:** no discernible change in view to the VSRs

7.4.14. The significance of visual impact has been derived from the combined analysis of the magnitude of change and the sensitivity of the VSRs to the change in accordance with Section 3.7(f) of EIAO GN No. 8/2010. The significance is defined as follows:

- **Significant:** the VSRs will experience major change in view;
- **Moderate:** the VSRs will experience moderate change in view;
- **Slight:** the VSRs will experience slight or barely perceptible change in view; and
- **Insubstantial:** the VSRs will experience unnoticeable change in view.

7.4.15. The system for the assessment of the overall visual impact is summarised in ***Table 7.2*** above.

Identification of Potential Mitigation Measures

7.4.16. Wherever possible and necessary, mitigation measures have been considered in order to avoid, reduce, remedy or offset the adverse impacts resulting from the proposed Project. Impact avoidance would be the priority. If impacts cannot be avoided, alternative measures have been explored on methods of reduction and/or compensation.

Residual Impacts

7.4.17. The residual impacts after implementation of the recommended mitigation measures are identified and assessed. The significance of impacts are classified into five levels with reference to Annex 10 of the EIAO-TM as follows:

- The impact is **<u>beneficial</u>** if the proposed Project would complement that the landscape and visual character of its setting, follow the relevant planning objectives and improve overall landscape and visual quality;
- The impact is **<u>acceptable</u>** if the assessment indicated that there would be no significance effects on the landscape, no significant visual effects caused by the appearance of the proposed Project, or no interference with key views;
- The impact is **<u>acceptable with mitigation measures</u>** if there would be some adverse effects, but there can be eliminated, reduced or offset to a large extent by specific measures;
- The impact is **<u>unacceptable</u>** if the adverse effects would be considered too excessive and unable to mitigate practically;
- The impact is **<u>undetermined</u>** if significant adverse effects would be likely, but the extent to which they may occur or may be mitigated cannot be determined from the study. Further detailed study would be required for the specific effects in question.

Photomontage

7.4.18. The visual impacts and the proposed mitigation measures are demonstrated using photomontage to illustrate existing views and future views (Day 1 to Year 10) from key VSRs to illustrate existing conditions and the conditions during operation phase in relation to other developments and prominent visual features. Three viewpoints have been selected for preparing the photomontages (refer to ***Figure 7.6***) as described below:

- **Vantage Point 1 (VP1):** VP1 is located at ground level of Block E of Pamela Youde Nethersole Eastern Hospital to represent a general view of the Project site from residents on the West. Although these VSRs will have a distant view of the Project site, their frequency of view and the potential affected population are relatively high.

- **Vantage Point 2 (VP2):** VP2 is located at 5/F of Hong Kong Institute of Vocational Education (Chai Wan). It is the only occupational VSRs that have direct view of the Project site along their view corridors of the harbour area. The potential affected population of these VSRs are expected to be intermediate.

- **Vantage Point 3 (VP3):** VP3 is located at various levels of Tsui Shou House in Tsui Wan Estate. It represents the view of the Project site from residents on the South that have relatively high viewing frequency and potential affected population.

- **Vantage Point 4 (VP4):** VP4 is located at ground level on Sheung On Street near the intersection with Sheung Mau Street. It represents the travelling VSRs that are close to the Project site and have a direct view of the Project site. The potential affected population of these VSRs are expected to be low.

7.5. BASELINE STUDY

Baseline Landscape Study

7.5.1. This section describes the baseline conditions of existing landscape resources (LRs) and landscape character areas (LCAs) within 500m from the Project site boundary. ***Figure 7.1*** displays the extent of various types of existing landscape resources within the study area.

Existing Landscape Resources (LRs)

<u>LR1 Natural Woodland</u>

7.5.2. LR1 refers to the natural woodland within the study area. Since the study area is highly urbanised, it is only observed at the natural slope on the north-eastern side of Pamela Youde Nethersole Eastern Hospital:

- LR1-1 On the north-eastern side of Pamela Youde Nethersole Eastern Hospital: these areas are approximately 4.28ha in size and refer to the natural woodlands scattered with the vegetated engineered slope (LR2-1) along the north-eastern boundary of Pamela Nethersole Eastern Hospital. There are approximately 1000 trees in this LR with heights mainly range from 6m to 11m. The area is dominated by native secondary woodland tree species, including *Alangium chinense*, *Bridelia tomentosa*, *Ficus hispida*, *Litsea glutinosa*, *Macaranga tanarius*, *Mallotus paniculatus*, *Sapium discolor*, *Sterculia lanceolata*, and woody climbers such as *Byttneria aspera*, understory herbs such as *Alpinia hainanensis*, with canopy gaps invaded by exotic weeds such as *Leucaena leucocephala*, the exotic climber *Ipomoea cairica* and *Mikania micrantha*. This woodland comprises of high diversity of mature native plant species. Together with its good linkage with the natural hillside habitats behind the hospital, LR1-1 is considered to have high amenity value with high sensitivity.

<u>LR2 Vegetated Engineered Slope</u>

7.5.3. LR2 refers to the vegetated engineered slope. It is only observed on the western side of the Project site interspersed with the natural woodland on the north-eastern side of Pamela Youde Nethersole Eastern Hospital (LR1-1):

- LR2-1 On the north-eastern side of Pamela Youde Nethersole Eastern Hospital: these areas are approximately 4.00ha in size and refer to the engineered slopes scattered with the natural woodlands (LR1-1) along the north-eastern boundary of Pamela Nethersole Eastern Hospital. There are approximately 800 trees in this LR with heights mainly range from 8m to 12m. Exotic species such as *Bauhinia sp.*, *Casuarina equisetifolia*, *Delonix regia*, *Eucalyptus citriodora* and *Pinus elliottii* have been planted in the area. As described in LR1, it interspersed with the native secondary woodland tree species and herbaceous species such as *Blechnum orientale*, *Miscanthus chinensis*, *Neyraudia reynaudiana* with canopy gaps invaded by exotic weeds. According to the species composition, the area is changing from exotic plantation to young secondary woodland, which is more sensitive to changes or disturbances as compared with exotic plantings. Together with the good linkage with other woodland habitats in the adjacent Tai Tam Country Park, LR2-1 is considered to have high amenity value with high sensitivity.

<u>LR3 Park/Recreation</u>

7.5.4. LR3 refers to the public parks or public rest gardens, playgrounds, sport grounds, and sitting-out areas within the study area:

- LR3-1 Chai Wan Park: This area covers small portion of Chai Wan Park that includes a football field and its adjacent plantation area. Only 0.48ha of the Park area falls within the assessment area. There are approximately 50 trees in this LR that are within the study area with heights mainly range from 11m to 16m. It comprises of mature species dominated by *Lagerstroemia speciosa* and shrub species of *Thryallis gracilis*. Since the area is generally well-vegetated and is rare in the study area, LR3-1 is considered to have high amenity value with high sensitivity.
- LR3-2 Wing Tai Road Garden: Wing Tai Road Garden is a public park/rest garden adjacent to Chai Wan Park and is approximately 1.61ha in size. There are approximately 150 trees in this LR with heights mainly range from 5m to 14m. The area is dominated by mature species of *Acacia confusa*, *Bauhinia* sp., *Philodendron selloum* and *Thryallis gracilis*. Together with Chai Wan Park, it offers a continuous well-vegetated recreational area to the public in Chai Wan. Hence, LR3-2 is considered to have high amenity value with high sensitivity.
- LR3-3 Tsui Wan Estate Playgrounds, Tennis Court and Sitting-Out Area: These areas offer well-vegetated recreational grounds and provide good greenery environment to the residents of Tsui Wan Estate. This LR is mature and is approximately 0.51ha in size. There are approximately 200 trees in this LR with heights mainly range from 4m to 10m. The dominant species in the area include *Acacia confusa* and *Ficus microcarpa* and shrub species of *Thryallis gracilis*. LR3-3 is considered to have high amenity value with high sensitivity.
- LR3-4 Yue Wan Estate Playgrounds: This resource refers to a small portion of the playground with well-vegetated areas and sitting-out areas that is covered by the study area and is approximately 0.01ha in size. This LR is mature and has approximately 30 trees with heights mainly range from 9m to 14m. It is dominated by *Acacia confusa*, *Delonix regia*, *Ficus microcarpa* and *Melaleuca quinquenervia*.

This LR provides high amenity recreational ground to the residents of Yue Wan Estate and the public. LR3-4 is considered to have high amenity value with high sensitivity.

- LR3-5 Heng Fa Chuen Playgrounds, Football Field and Sitting-Out Area: This LR is approximately 0.97ha in size and offers well-vegetated sitting-out areas and high amenity recreational ground to the residents of Heng Fa Chuen and the public. It is semi-mature and has approximately 150 trees with heights mainly range from 5m to 14m. LR3-5 is considered to have high amenity value with high sensitivity.

LR4 Roadside Planting

7.5.5. LR4 refers to all the roadside plantings areas within the study area with tree heights mainly range from 5m to 11m. The roadside plantings are mainly dominated by common exotic species or ornamentals (dominant species including *Bombax ceiba*, *Spathodea campanulata*, *Ficus microcarpa* and a few planted ornamentals such as *Alpinia zerumbet ‘Variegata’* and *Chrysalidocarpus lutescens*). The species are in generally fair to good health condition with young to semi-mature age due to regular maintenance. However, it is anticipated that the species composition may be changed frequently during regular maintenance. Disturbances to LR4 are considered reversible as it can be reinstated through re-vegetation. LR4 includes the following:

- LR4-1 Along Island Eastern Corridor (0.83ha in size with 200 trees approximately);
- LR4-2 Along Shun Tai Road (0.05ha in size with 20 trees approximately);
- LR4-3 Along Wing Tai Road (0.45ha in size with 150 trees approximately);
- LR4-4 Along Sheung On Street (0.01ha in size with 20 trees approximately);
- LR4-5 Along Chong Fu Road, Sheung Mau Street, Sheung Tat Street and Shing Tai Road (0.24ha in size with 70 trees approximately); and
- LR4-6 Along Ka Yip Street and Sun Yip Street (0.07ha in size with 40 trees approximately).

7.5.6. These roadside planting areas provide greenery to soften the urban environment, especially the main transport routes within the study area. LR4s are considered to have medium amenity value with medium sensitivity.

LR5 Residential/Architectural Planting

7.5.7. LR5 refers to the landscape planting area within residential development of the study area with tree heights mainly range from 7m to 16m (dominant species including *Acacia confuse*, *Delonix regia*, *Ficus microcarpa* and a few planted ornamentals such as *Alpinia zerumbet ‘Variegata’* and *Philodendron selloum*). There are approximately 600 trees in this LR with heights mainly range from 7m to 16m. These landscape plantings are mainly dominated by common exotic tree species or ornamentals of young to semi-mature age, and generally in fair to good health conditions due to regular maintenance. Disturbances to LR5 are considered reversible as it can be reinstated through re-vegetation. LR5 includes the following:

- LR5-1 At Tsui Wan Estate (0.66ha in size with 300 trees approximately);
- LR5-2 At Yue Wan Estate (0.08ha in size with 40 trees approximately);
- LR5-3 At Tsui Lok Estate (0.02ha in size with 10 trees approximately);
- LR5-4 On the roof of Hang Tsui Court Carpark (0.11ha in size with 50 trees approximately);
- LR5-5 At Heng Fa Chuen (0.29ha in size with 150 trees approximately); and
- LR5-6 At Hong Kong Institute of Vocational Education (Chai Wan) (0.13ha in size with 60 trees approximately).

7.5.8. These areas offer well-vegetated area adjoining the recreational ground or facilities of the residential developments, and help soften the density built-up area such as roads and buildings. LR5s are considered to have high amenity value with medium sensitivity.

<u>LR6 Open Space/Vacant Land</u>

7.5.9. LR6 is developed areas with a size of approximately 1.31ha. It refers to the unused open space or vacant land without or lacking vegetation in the study area, including:

- LR6-1 Bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road; and
- LR6-2 Bounded by Shing Tai Road, Sheung Tat Street, and Sheung Mau Street.

7.5.10. These areas are not yet occupied or used as temporary construction work sites or car parks and can be re-created easily. LR6 is considered of low amenity value with low sensitivity.

<u>LR7 Open Space Vegetation</u>

7.5.11. Unlike LR6, LR7 refers to the naturally-established vegetation of developed areas (dominant species including *Carica papaya*, *Ficus hispida*, *Macaranga tanarius* and weedy species *Leucaena leucocephala*) and a few planted ornamentals (e.g. planted ornamentals such as *Ficus benjamina* and *Ligustrum sinense*) within the unused open space, vacant land or temporary construction work sites in the study area. This LR is semi-mature and is approximately 0.57ha in size with tree heights mainly range from 4m to 12m. These plants are believed to be opportunistic and highly tolerant to environmental stresses within the degraded urban landscape. LR7 includes the following:

- LR7-1 Bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road (approximately 30 trees in this LR);
- LR7-2 Bounded by Shing Tai Road, Sheung Tat Street, Sheung Mau Street and Sheung On Street (including the Project site) (approximately 20 trees in this LR); and
- LR7-3 Near the intersection of Shing Tai Road and Chong Fu Road (approximately 3 trees in this LR).

7.5.12. Although LR7 are generally resilient to disturbances and can be regenerated easily under undesirable environment, such as lack of soil and moisture, it offers some greenery to the densely-built areas. LR7 are considered to have medium amenity value with low sensitivity.

LR8 Cargo Handling Basin

7.5.13. LR8 is approximately 33.56ha in size. It refers to the sea area bounded by reclaimed land adjoining Sheung On Street and Ka Yip Street, including

- LR8-1 Chai Wan Cargo Handling Basin.

7.5.14. Although the basin area belongs to natural resources and cannot be re-created, its coastline has been straightened to form the cargo handling area and is trafficked by container ships. LR8 is considered to have medium amenity value with high sensitivity.

7.5.15. Sensitivity of the existing landscape resources are listed in ***Table 7.3***.

Landscape Resources (LRs) with Planned Development

7.5.16. A planned THEi New Campus will nearly be established when the construction of the proposed Project commences in mid-2016 tentatively. However, as no design detail of the Campus is available during the course of report, the landscape resource would be assessed under the current condition of the area as LR6-1, i.e. open space or vacant land bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road, in baseline assessment.

Table 7.3 Summary of Existing LRs and their Sensitivity and Amenity Values

ID	Components	Amenity Value	Sensitivity
LR1 Natural Woodland			
LR1-1	North-eastern side of Pamela Youde Nethersole Eastern Hospital	High	High
LR2 Vegetated Engineered Slope			
LR2-1	North-eastern side of Pamela Youde Nethersole Eastern Hospital	High	High
LR3 Park/Recreation			
LR3-1	Chai Wan Park	High	High
LR3-2	Wing Tai Road Garden	High	High
LR3-3	Tsui Wan Estate Playgrounds, Tennis Court and Sitting-Out Area	High	High
LR3-4	Yue Wan Estates Playground	High	High
LR3-5	Heng Fa Chuen Playgrounds, Football Field and Sitting-Out Area	High	High
LR4 Roadside Plantings			

ID	Components	Amenity Value	Sensitivity
LR4-1	Island Eastern Corridor	Medium	Medium
LR4-2	Shun Tai Road	Medium	Medium
LR4-3	Wing Tai Road	Medium	Medium
LR4-4	Sheung On Street	Medium	Medium
LR4-5	Chong Fu Road, Sheung Mau Street, Sheung Tat Street and Shing Tai Road	Medium	Medium
LR4-6	Ka Yip Street and Sun Yip Street	Medium	Medium
LR5 Residential/Architectural Planting			
LR5-1	Tsui Wan Estate	High	Medium
LR5-2	Yue Wan Estate	High	Medium
LR5-3	Tsui Lok Estate	High	Medium
LR5-4	Roof of Hang Tsui Court Carpark	High	Medium
LR5-5	Heng Fa Chuen	High	Medium
LR5-6	Chai Wan IVE	High	Medium
LR6 Open Space/Vacant Land			
LR6-1	Bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road	Low	Low
LR6-2	Bounded by Shing Tai Road, Sheung Tat Street, and Sheung Mau Street	Low	Low
LR7 Open Space Vegetation			
LR7-1	Bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road	Medium	Low
LR7-2	Bounded by Shing Tai Road, Sheung Tat Street, Sheung Mau Street and Sheung On Street	Medium	Low
LR7-3	Near the intersection of Shing Tai Road and Chong Fu Road	Medium	Low
LR8 Cargo Handling Basin			
LR8-1	Chai Wan Cargo Handling Basin	Medium	High

Landscape Character Areas (LCAs)

7.5.17. A total of seven landscape character areas (LCAs) formed by various broadly homogenous units of similar landscape characters were identified within the 500m study area, as shown in ***Figure 7.2***. These areas include:

LCA1 – Hillside Landscape

7.5.18. LCA1 is approximately 8.12ha in size. It refers to the natural hillside woodland surrounding Pamela Youde Nethersole Eastern Hospital and its adjoining vegetated engineered slope connected to the natural hillside woodland of Tai Tam Country Park. In LCA1, the vegetated engineered slope consists of both native woodland and plantation, while most of the natural woodland is dominated by native secondary woodland tree species, including *Alangium chinense*, *Bridelia tomentosa*, *Ficus hispida*, *Litsea* *glutinosa*, *Macaranga tanarius*, *Mallotus paniculatus*, *Sapium discolor*, *Sterculia lanceolata*, and woody climbers such as *Byttneria aspera*, understory herbs such as *Alpinia hainanensis*, with canopy gaps invaded by exotic weeds such as *Leucaena leucocephala*, the exotic climber *Ipomoea cairica* and *Mikania micrantha*. LCA1 is the type of LCA that is very sensitive to disturbances due to its naturalness of native woodland and good linkage with the natural hillside habitats and the Tai Lam Country Park. Therefore, LCA1 is considered to have high amenity value with high sensitivity.

<u>LCA2 – Community/Residential Urban Landscape</u>

7.5.19. LCA2 is approximately 28.97ha in size. It refers to the built up and densely populated area in Chai Wan District dominated by high-rise residential buildings and medium to high-rise buildings of community services such as schools and hospitals, flyovers and roads trafficked by vehicles. It is considered as the largest LCA within the study area and is one the most common landscape character in Hong Kong. It consists of roadside plantings and residential plantings with dominant tree species of *Acacia confuse, Bombax ceiba, Delonix regia, Ficus microcarpa, Spathodea campanulata, Ficus microcarpa* and dominant ornamental shrubs such as *Alpina zerumbet, Chrysalidocarpus lutescens* and *Philodendron selloum.* Although the landscape quality in LCA2 is fair to good in general due to regular maintenance, it comprises of human-created landscape feature only and can be re-created easily. As a result, LCA2 is considered to have low to medium amenity value with medium sensitivity.

<u>LCA3 – Park Landscape</u>

7.5.20. LCA3 is approximately 3.15ha in size. It refers to the rest gardens and other sitting-out areas in the study area that provides recreational open space to the public. As described in *Section 7.5.4* for LR3, it is dominated by mature species, including *Acacia confusa*, *Bauhinia* sp., *Ficus microcarpa, Lagerstroemia speciosa* and *Melaleuca quinquenervia*, and planted ornamentals, such as *Philodendron selloum* and *Thryallis gracilis*, in good health conditions with high amenity values. Although LCA3 comprises of the human-created landscape features and can be re-created easily, this type of LCA is uncommon in the study area and is therefore considered to have high sensitivity.

<u>LCA4 – Industrial Urban Landscape</u>

7.5.21. LCA4 is approximately 9.50ha in size. It refers to the built-up area dominated by industrial buildings along the coast of Chai Wan Public Cargo Working Area. It is a common landscape character in Chai Wan district and Hong Kong. Since LCA4 comprises of man-made features that are highly resilient to changes of disturbances, it is considered to have low sensitivity.

<u>LCA5 – Railway Viaduct Landscape</u>

7.5.22. LCA5 is approximately 5.65ha in size. It refers to the MTR viaduct connecting Chai Wan MTR Station and Heng Fa Chuen MTR Station. It is a very common man-made feature that forms a prominent visual obstruction to viewers and is highly resilient to changes or disturbances. LCA5 is considered to have low amenity value with low sensitivity.

LCA6 – Marine Landscape

7.5.23. LCA6 is approximately 33.84ha in size. It refers to the cargo handling basin and its adjoining designated cargo handling area bounded by Sheung On Street and Ka Yip Street. It is only partially visible to travellers on Sheung On Street and Ka Yip Street due to the existing screens and fencing. However, it becomes prominent to viewers at medium to high level, such as the viewers from adjacent buildings. The water bodies of LCA6 are natural landscape resources and cannot be re-created. Therefore, LCA6 is considered to have medium amenity value with high sensitivity.

LCA7 – Open Car Parks/Maintenance Workshops/Vacant Land Landscape

7.5.24. LCA7 is approximately 6.48ha in size. It refers to the uncovered car parks, vacant lands and open space for use as temporary work sites/maintenance workshops/bus depots along Sheung On Street, including the Project site. Naturally-established vegetation could be found within the area with dominant species of *Carica papaya*, *Ficus hispida*, *Macaranga tanarius*, *Leucaena leucocephala* and a few planted ornamentals such as *Ficus benjamina* and *Ligustrum sinense*. This type of LCA is common in urban areas throughout Hong Kong and comprises human-created landscape feature only. LCA7 is considered to have low amenity value with low sensitivity.

Landscape Character Areas (LCAs) with Planned Development

7.5.25. As discussed in *Section 7.5.16*, the vacant land at the junction of Wing Tai Road and Shing Tai Road will be occupied by the planned THEi New Campus. Since the Campus will nearly be established when the construction of the proposed Project commences in mid-2016, this area would be categorized as LCA2 in the baseline assessment. The sensitivity of existing landscape character areas are listed in ***Table 7.4***.

Table 7.4 Summary of LCAs and their Sensitivity

	Description	Sensitivity
LCA1	Hillside Landscape	High
LCA2	Community/Residential Urban Landscape	Medium
LCA3	Park Landscape	High
LCA4	Industrial Urban Landscape	Low
LCA5	Railway Viaduct Landscape	Low
LCA6	Marine Landscape	Medium
LCA7	Open Car Parks/Maintenance Workshops/Vacant Land Landscape	Low

Existing Trees within Project Site

7.5.26. A total of 37 tree species were identified within or close to the Project site boundary as included in ***Appendix 7.1***. 36 numbers of the surveyed trees were non-native species such as *Bombax ceiba* and *Carica papaya*, while 1 number of native species, *Broussonetia papyrifera*, was found at the Eastern corner within the Project site. Of the total 37 trees, 6 trees (or ~16% of the surveyed trees) were found to have poor tree form but generally in fair health condition, 9 trees (or ~25% of the surveyed trees) were found to be in poor health and tree forms, and 6 trees (or ~16% of the surveyed trees) were found in generally fair health and tree form. The 16 remaining trees (or ~ 43% of the surveyed trees), which are *Bombax ceiba* located just outside the South-western and North-western boundary of the Project site, were found in good health and form. ***Table 7.5*** summarises the tree species composition within the survey area.

Table 7.5 Tree Species Composition within Survey Area

Scientific Name	Chinese Common Name	Species Origin	No. of Trees	% of Trees
Bombax ceiba	木棉	Exotic	18	48.7%
Broussonetia papyrifera	構樹	Native	1	2.7%
Callistemon viminalis	串錢柳	Exotic	1	2.7%
Carica papaya	木瓜	Exotic	6	16.2%
Melaleuca quinquenervia	白千層	Exotic	4	10.8%
Spathodea campanulata	火焰木	Exotic	7	18.9%
		Total	**37**	**100.0%**

7.5.27. No registered or potential Old and Valuable Trees (OVT) were recorded during the tree survey and no rare or protected species were encountered. Detailed information of the surveyed trees is presented in the Tree Assessment Schedule in ***Appendix 7.1***.

7.5.28. Of the total 37 trees surveyed, 12 trees would be of direct conflict with the proposed Project, including 9 trees located within the Project footprint. Among these 9 trees, 6 trees belong to the exotic tree species, *Carica papaya*, that are common with low amenity value, 2 trees belong to the exotic tree species, *Bombax ceiba*, that are poor in health with low amenity value due to the deformed tree form, and 1 tree belong to the native species, *Broussonetia papyrifera*, that is in poor form and health due to inadequate maintenance. The remaining 3 trees are *Spathodea campanulata* located outside the South-eastern boundary of the Project site. ***Table 7.6*** summarises the number of trees for each type of recommended treatment. The tree recommendation for all surveyed trees is shown in ***Figure 7.3***.

7.5.29. According to DEVB TC(W) No. 10/2013, these trees are undesirable for transplanting and thus proposed for felling due to the low post-transplanting survival rate and low amenity value.

Table 7.6 Summary of Proposed Action for Surveyed Trees

Proposed Action	Fell	Retain
Number of Trees	12	25

7.5.30. In addition to the 37 trees surveyed, the proposed Project will be of direct conflict with 2 additional plants located outside the Eastern corner of the Project boundary. However, the two plants are not considered as trees in accordance with DEVB TC(W) No. 10/2013 as their trunk diameters are less than 0.95m at the height of 1.3m above ground level. Hence, they are excluded from the survey.

Existing Visual Context

Visual Envelop (VE) and Zone of Visual Influence (ZVI)

7.5.31. For the purposes of the assessment, the visual envelop (VE) of the proposed Project is divided into Primary VE and Secondary VE. The Secondary VE comprises of areas that are far from the Project site but the site visible with naked eyes, i.e. across the harbour. Although there will be a direct line of sight of the Project site within the Secondary VE in a small number of cases, these VSRs should not be able to detect perceptible changes from the proposed Project due to the long viewing distance. Therefore, the magnitude of change from these VSRs and the resulting visual impact should be "negligible" and "insubstantial" respectively.

7.5.32. As compared to Secondary VE, the Primary VE comprises of areas that are relatively closer to the Project site and is defined as the zone of visual influence (ZVI). The ZVI is largely confined by Pamela Youde Nethersole Eastern Hospital on the West, Tsui Wan Estate and Chai Wan Industrial Estate on the South, the industrial buildings along Ka Yip Street on the East, and the NWFB Depot on the North. The assessment area is focused within the Primary VE (i.e. ZVI).

7.5.33. The coverage of Primary and Secondary VEs are shown in ***Figure 7.4a***.

Visual Character and Resources

7.5.34. The proposed Project is located in an area that is densely built with medium to high-rise industrial buildings and residential developments. The Project site is immediately surrounded by vacant lands, parking spaces, bus depots and cargo handling basin. Hence, the proposed Project is compatible with character of the surrounding environment.

7.5.35. The key visual characters and resources within the ZVI or 500m from the boundary of the Project site are indicated in ***Figure 7.4b*** and includes:

- Industrial buildings;
- Residential developments;
- Ridgelines;
- Open space (i.e. parks);
- Open carparks/ vacant lands;
- Roadside vegetation/ green slopes;
- MTR viaducts; and
- Cargo handling basin/ harbour area.

7.5.36. Among the identified key visual resources, ridgelines and cargo handling basin/ harbour area are considered as the most sensitive resources and have high amenity value to the VSRs. However, visual intrusion from the development of the proposed Project is not anticipated since the proposed Project has a building height that is similar to the building height of the adjacent NWFB Depot as mentioned in *Section 3.8.2*. The visual system between VSRs and the visual resources, such as the sensitivity and the ability to accommodate change, of the proposed Project is assessed in *Section 7.7* and *7.9*.

<u>Key Visual Sensitive Receivers (VSRs)</u>

7.5.37. Within ZVI, the key VSRs are grouped according to the settlement of developments, travellers and occupational receivers of similar nature. The selected VSRs are representatives of views available to viewers at each of the following location:

- Visible area with residential VSRs:
  - VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House);
  - VSR-R2: Residents of Knight Court; and
  - VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G.
- Visible area with occupational VSRs:
  - VSR-O1: Staff of Chai Wan Industrial City (Phase I and II), Cornell Centre;
  - VSR-O2: Staff of Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre Blocks A and B;
  - VSR-O3: Staff of Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan);
  - VSR-O4: Staff of Marine Department Chai Wan Public Cargo Working Area;
  - VSR-O5: Staff of Pamela Youde Nethersole Eastern Hospital – East Block; and
  - VSR-O6: Staff and Students of Hong Kong Institute of Vocational Education (Chai Wan).
- Visible area with travelling VSRs:
  - VSR-T1: Travellers at Sheung On Street;
  - VSR-T2: Travellers at Sheung Mau Street;
  - VSR-T3: Travellers at Sheung Tat Street;
  - VSR-T4: Travellers at Shing Tai Road; and
  - VSR-T5: Travellers at Ka Yip Street.
- Visible area with both travelling and occupational VSRs:
  - VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station.

7.5.38. ***Figure 7.5*** shows the locations of the identified VSRs as described as follows:

VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)

7.5.39. In Tsui Wan Estate, the residents at medium to high level have a partially obstructed view of the Project site that is dominated by the building structures at the foreground with the harbour area and the natural hill slope across the harbour visible in background, while the views of the Project site at low level is dominated by the vegetation on Wing Tai Road and is substantially blocked the existing Citybus Depot. Since the sensitive receivers are residents, the sensitivities of these VSRs are considered to be **high**. ***Figure 7.6*** displays the existing views and the photomontages showing the views of the Project site from Tsui Shou House (VP3).

VSR-R2: Residents of Knight Court

7.5.40. These VSRs include the residents of Knight Court. The residents at medium to high level have a partially obstructed view of the Project site that is dominated by the building structures at the foreground with the harbour area in background, while the residents at low level is dominated and substantially obstructed by the existing roadside vegetation on Shing Tai Road and the MTR viaduct. Since the sensitive receivers are residents with partial to substantial obstruction of view of the Project area, the sensitivities of these VSRs are considered to be **high**.

VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G

7.5.41. These VSRs have a slightly obstructed distant view of the Project site by the Hong Kong Institute of Vocational Education (Chai Wan) and the Citybus Depot. The existing view of these VSRs is dominated by the building structures at the foreground with the harbour area and the natural hill slope across the harbour in background. In consideration of residential nature of these VSRs and the relatively long viewing distance, the sensitivities of these residential VSRs are considered to be **medium**. ***Figure 7.6*** displays the existing views and the photomontages showing the views of the Project site from ground level of Block E of Senior Civil Servants Quarters (Vantage Point 1).

VSR-O1: Chai Wan Industrial City (Phase I and II), Cornell Centre

7.5.42. These VSRs include the occupational receivers on the North-western and North-eastern side of the building. The existing view is dominated by the cargo handling basin at the foreground with the Project site visible in background. The existing view of the Project site is substantially blocked by the existing settlement and vessels in the cargo handling area, but the visual obstruction is reduced when viewing from medium to high level. However, as these VSRs are mostly workers, their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, they are considered to be of **low** sensitivity to visual change to the Project site.

VSR-O2: Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)

7.5.43. These VSRs are occupational receivers on the North-western side of the buildings. The existing view is dominated by the cargo handling basin at the foreground with the Project site visible in background. The existing view of the Project site is substantially blocked by the existing settlement and vessels in the cargo handling basin, but the visual obstruction is reduced when viewing from medium to high level. As VSR-O2 are mostly workers, their visual perceptions are not very important and do not have a significant effect on their quality of life., Therefore, these VSRs are considered to have **low** sensitivity to visual change.

VSR-O3: Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)

7.5.44. Similar to VSR-O1 and VSR-O2, these occupational VSRs have an existing view that is dominated by the cargo handling basin at the foreground with the Project site visible in background. These VSRs have a relatively unobstructed view of the Project site except the partial blockage by the existing settlement at low level. As these VSRs are mostly workers, their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, the sensitivities of these VSRs are considered to be **low**.

VSR-O4: Marine Department Chai Wan Public Cargo Working Area

7.5.45. The existing view of these VSRs is dominated by the cargo handling basin at the foreground with the Project site visible in background. Their views of the Project site are substantially obstructed by the existing fencing of their work area and the vessels in the cargo handling basin. With consideration that these VSRs are mostly workers, their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, their sensitivities to visual change are considered to be **low**.

VSR-O5: Pamela Youde Nethersole Eastern Hospital – East Block

7.5.46. The existing view of these VSRs is dominated by the building structures at the foreground with the harbour area and the natural hill slope across the harbour in background. Their views of the Project site are partially blocked by the existing roadside vegetation and the Citybus Depot. As these VSRs are mostly workers, their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, the sensitivities of these VSRs are considered to be **low**.

VSR-O6: Hong Kong Institute of Vocational Education (Chai Wan)

7.5.47. These VSRs are the occupational users on the Eastern side of the buildings with existing views dominated by roadside vegetation and MTR tracks and viaduct. Views of the Project site from these VSRs are partially to significantly blocked by the MTR viaduct and the existing roadside vegetation on Shing Tai Road. As these VSRs are mostly students and staffs who are expected to have fewer chances to view the Project site when they are in class, their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, the sensitivities of these VSRs are considered to be **low**. ***Figure 7.6*** displays the existing views and the photomontages showing the views of the Project site from the Hong Kong Institute of Vocational Education (Chai Wan) (VP2).

VSR-T1: Travellers at Sheung On Street

7.5.48. These VSRs represent transient passers that comprise frequent travellers including mainly workers from the cargo handling area and the bus depots on Sheung On Street, and occasional travellers from elsewhere. At location where the Project area is the most clear, the existing view of the Project site, which is dominated by building structures of the bus depots and roadside vegetation, is partially obstructed by roadside vegetation. Given that VSR-T1 are travellers and their views are transient in nature, the sensitivities of these VSRs to visual change to the Project site are considered to be **low**. ***Figure 7.6*** displays the existing views and the photomontages showing the views of the Project site from travellers on Sheung On Street near the intersection with Sheung Mau Street (VP1).

VSR-T2: Traveller at Sheung Mau Street

7.5.49. These VSRs represent transient passers that comprise frequent travellers including mainly the users of the ExxonMobil Petrol-cum-LPG Filling Station, staffs of NWFB Depot, and occasional travellers from elsewhere. At location where the Project area is the most clear, the existing view of the Project site is dominated and partially obstructed by the roadside vegetation on Sheung Mau Street. Although these VSRs may experience partial to full views of the Project site when they are travelling along Sheung Mau Street. With consideration that these VSRs are transient in nature, their sensitivities to visual change are considered to be **low**.

VSR-T3: Travellers at Sheung Tat Street

7.5.50. These VSRs represent transient passers that comprise frequent travellers mainly from the staffs of NWFB Depot. At location where the Project area is the most clear, the existing view of the Project site, which is dominated by the building structures of NWFB Depot and roadside vegetation, is partially obstructed by the roadside vegetation. Given that the VSRs are transient in nature, their sensitivities to visual change are **low**.

VSR-T4: Travellers at Shing Tai Road

7.5.51. These VSRs represent transient passers travelling along Shing Tai Road. At location where the Project area is the most clear, the existing view of the Project site is dominated and partially obstructed by the roadside vegetation along Shing Tai Road and Sheung Mau Street. Given that the VSRs are transient in nature, their sensitivities to visual change are **low**.

VSR-T5: Travellers at Ka Yip Street

7.5.52. These VSRs comprise mainly transient passers including workers of the cargo handling area and the adjacent industrial buildings, and occasional travellers from elsewhere. At location where the Project area is the most clear, the existing view of the Project site, which is dominated by building structures and the fencing of the cargo handling area, is substantially obstructed by the fencing and vessels in the cargo handling basin. With consideration of its transient nature and the substantial blockage of view, these VSRs are considered to have **low** sensitivities to visual change.

VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station

7.5.53. These VSRs comprise staffs of the ExxonMobil Petrol-cum-LPG Filling Station and occasional users who are considered to be transient passers-by in these areas. The existing views of these VSRs are dominated by the existing roadside vegetation along Sheung Mau Street, which partially obstructed their views of the Project site. Users of the gas station are considered as travellers and their views are transient in nature. Staffs of the Station are expected to have few chances to view the Project site during work and their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, these VSRs are considered to have **low** sensitivities.

Visual Context of Planned Development

VSR-O7: Planned THEi New Campus

7.5.54. Since the planned college will be in operation tentatively from the third quarter of 2016, VSR-O7 will nearly be established when the construction of the proposed Project commences and is therefore included in the baseline assessment.

7.5.55. These VSRs represents the occupational users on the Northern side of the planned college. The existing views of these VSRs are dominated by the building structures at the foreground with the harbour area and the natural hill slope across the harbour in background. Their views of the Project site at high level are partially obstructed by roadside vegetation, while the views from medium to low levels are substantially blocked by the Citybus Depot. As these VSRs are mostly students and staffs that are expected to have fewer chances to view the Project site when they are in class, their visual perceptions are not very important and do not have a significant effect on their quality of life. Therefore, VSR-O7 is considered to have **low** sensitivity to visual change.

7.5.56. Based on the best available information at the time of the EIA study, no major change in the existing environmental condition is anticipated in the future in the absence of the proposed Project.

7.5.57. ***Table 7.7*** summarises the identified VSRs and their sensitivity to change.

Table 7.7 Identified VSRs and their Sensitivity to Change

ID	Description	Value & Quality of Existing View	Availability and Amenity of Alternate Views	Degree of Visibility	Estimated population of Viewers	Frequency of View	Sensitivity to Change
Visible Area with Residential VSRs							
VSR-R1	Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)	Fair to Good	Yes, High	Low to Medium	Intermediate	Intermittent	High
VSR-R2	Residents of Knight Court	Fair to Good	Yes, High	Low to Medium	Few	Intermittent	High
VSR-R3	Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G	Fair to Good	Yes, High	High	Intermediate	Intermittent	Medium
Visible Area with Occupational VSRs							
VSR-O1	Staff of Chai Wan Industrial City (Phase I and II), Cornell Centre	Fair to Good	Yes, High	Low to Medium	Intermediate	Occasional	Low
VSR-O2	Staff of Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)	Good	Yes, High	Low to Medium	Intermediate	Occasional	Low
VSR-O3	Staff of Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)	Fair to Good	Yes, High	Medium to High	Intermediate	Occasional	Low
VSR-O4	Staff of Marine Department Chai Wan Public Cargo Working Area	Good	Yes, High	Low	Intermediate	Occasional	Low
VSR-O5	Staff of Pamela Youde Nethersole Eastern Hospital – East Block	Fair to Good	Yes, High	Medium	Intermediate	Rare	Low
VSR-O6	Staff and Students of Hong Kong Institute of Vocational Education (Chai Wan)	Fair to Good	Yes, High	Low to Medium	Intermediate	Occasional	Low

ID	Description	Value & Quality of Existing View	Availability and Amenity of Alternate Views	Degree of Visibility	Estimated population of Viewers	Frequency of View	Sensitivity to Change
VSR-O7	Staff and Students of Planned THEi New Campus	Fair to Good	Yes, High	Low to Medium	Intermediate	Occasional	Low
Visible Area with Travelling VSRs							
VSR-T1	Travellers at Sheung On Street	Fair	Yes, High	Medium	Few	Rare	Low
VSR-T2	Travellers at Sheung Mau Street	Fair to Good	Yes, High	Medium	Few	Rare	Low
VSR-T3	Travellers at Sheung Tat Street	Fair	Yes, High	Medium	Few	Rare	Low
VSR-T4	Travellers at Shing Tai Road	Fair	Yes, High	Medium	Few	Rare	Low
VSR-T5	Travellers at Ka Yip Street	Fair to Good	Yes, High	Medium	Intermediate	Rare	Low
Visible Area with both Travelling and Occupational VSRs							
VSR-P1	Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station	Fair to Good	Yes, High	Medium	Few	Occasional	Low

7.6. LANDSCAPE IMPACT ASSESSMENT

Construction Phase

7.6.1. The potential sources of landscape impact during construction phase are mainly arisen from site clearance including removal of existing vegetation.

7.6.2. According to the tree survey, 12 trees would be of direct conflict with the proposed Project. Transplanting is considered undesirable due to the low post-transplanting survival rate and low amenity value according to DEVB TC(W) No. 10/2013.

7.6.3. The proposed tree felling involves 9 trees within the Project site (i.e. LR7-2) and 3 trees at the South-eastern boundary of the Project site (i.e. LR4-4), along which there are other existing large trees surrounding the Project site to be retained that provides screening effect to the Project site as illustrated in the photomontage at VP2 in ***Figure 7.6***. The resulting magnitude of landscape change from the proposed tree felling is considered as small at both LR4-4 and LR7-2. Hence, slight adverse impact is anticipated at LR4-4 and LR7-2 during construction phase.

7.6.4. For other LRs, the magnitude of change is considered as negligible since there is no direct change on landscape resources due to the construction activities of the proposed Project. Therefore, the overall landscape impact arisen from the proposed Project during construction phase is considered as insubstantial for all LRs except LR4-4 and 7-2.

7.6.5. Since the proposed Project will be built on lands with a landscape character of maintenance workshop (LCA7), it is consistent and compatible with the current landscape character of the Project site, but would have a small magnitude of change due to a minor loss of greenery within the Project site and at the site boundary, i.e. the felling of 9 trees in LCA7 and 3 trees in LCA2. As a result of low sensitivity and small magnitude of change, slight adverse impact is anticipated at LCA 2 and LCA7 during the construction of the proposed Project.

7.6.6. Similar to LRs, there is no direct change to the setting and landscape character of all LCAs other than LCA 2 and LCA7 due to the construction activities of the proposed Project. The significance of landscape impact arisen from the proposed Project during construction phase is considered as insubstantial for all LCAs except LCA2 and LCA7.

Operation Phase

7.6.7. The sources of impact during operation phase are mainly the presence of the permanent structure of the proposed Project and its operation.

7.6.8. A small portion of the landscape resources of LR4-4 and LR7-2 will be occupied by the driveway and the permanent structure of the proposed Project. However, there are still other existing large trees surrounding the Project site, such as LR4-4 and LR4-5 as illustrated in the photomontage at VP2 in ***Figure 7.6***. Hence, the magnitudes of change for LR4-4 and LR7-2 during operation phase are considered as small due to the screening by the retained trees along the Project site boundary. Therefore, the impacts arisen from the proposed Project during operation phase at LR4-4 and LR7-2 are considered as slightly adverse.

7.6.9. For other LRs, the magnitude of change is considered as negligible since there is no direct conflict of the operation of the proposed Project with all landscape resources. Therefore, the significance of landscape impact arisen from the proposed Project during operation phase is considered as insubstantial for all LRs other than LR4-4 and LR7-2.

7.6.10. As the proposed land use of the Project site would be in line with other maintenance workshops in the vicinity and is compatible with the current landscape character of the Project site (i.e. LCA7), the magnitude of change of LCA7 during operation phase is considered as small. Due to the loss of greenery from the proposed tree felling in LCA2 is considered minor in nature, the magnitude of change of LCA2 is also considered as small. As a result, slight adverse impact is anticipated at LCA2 and LCA7 during operation phase.

7.6.11. Similar to construction phase, the magnitude of change of all other LCAs, i.e. LCA1, LCA3, LCA4, LCA5 and LCA6, during operation phase is considered as negligible since there is no direct change on the landscape character areas due to the operation of the proposed Project. Therefore, the significance of landscape impact arisen from the proposed Project during operation phase is considered as insubstantial for all LCAs except LCA2 and LCA7.

7.6.12. ***Table 7.8*** and ***Table 7.9*** summarise the significant threshold of landscape impact on LRs and LCAs of the proposed Project respectively. The mapping of significant threshold of landscape impact is shown in ***Figure 7.7***.

7.7. VISUAL IMPACT ASSESSMENT

Visual Impact without Mitigation during Construction Phase

<u>VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)</u>

7.7.1. The existing view of the Project site, which is dominated by building structures, roadside vegetation and harbour area, will change to a construction site that remains partially blocked by the existing Citybus Depot and roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the distant views of the harbour area and natural hillslope will not be blocked by the proposed Project and are more prominent with much higher amenity value as compared to that of the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **moderately adverse** during construction phase.

<u>VSR-R2: Residents of Knight Court</u>

7.7.2. The existing view of the Project site, which is dominated by building structures and harbour area, will change to a construction site that remains partially blocked by the MTR viaduct and roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the distant view of the harbour area will not be blocked by the proposed Project and is more prominent with much higher amenity value as compared to that of the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **moderately adverse** during construction phase.

VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G

7.7.3. The existing view of the Project site, which is dominated by building structures, harbour area and natural hill slope across the harbour, will change to a construction site that is slightly obstructed by the Hong Kong Institute of Vocational Education (Chai Wan) and the Citybus Depot. In addition, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the harbour area and the hill slope landscape that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-O1: Chai Wan Industrial City (Phase I and II), Cornell Centre

7.7.4. The existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site that has partial to substantial obstruction by the existing settlement and vessels in the cargo handling basin. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O2: Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)

7.7.5. The existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site that has partial to substantial obstruction by the existing settlement and vessels in the cargo handling area. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O3: Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)

7.7.6. The existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site that has slight to partial obstruction by the existing settlement. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed

Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O4: Marine Department Chai Wan Public Cargo Working Area

7.7.7. The existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site that is substantially obstructed by the existing fencing of their work area and vessels in the cargo handling basin. In addition, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the sea view of the cargo handling basin will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change of these VSRs is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O5: Pamela Youde Nethersole Eastern Hospital – East Block

7.7.8. The existing view of the Project site, which is dominated by the building structures, harbour area and the natural hill slope, will change to a construction site that is partially obstructed by the existing roadside vegetation and the Citybus Depot. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the harbour area and the hill slope landscape that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O6: Hong Kong Institute of Vocational Education (Chai Wan)

7.7.9. The existing view of the Project site, which is dominated by roadside vegetation and MTR tracks and viaduct, will change to a construction site that has partial to substantial obstruction by the MTR viaduct and the roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the roadside vegetation on Shing Tai Road that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, with consideration of their close proximity to the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T1: Travellers at Sheung On Street

7.7.10. The existing view of the Project site, which is dominated by the building structures of bus depots and roadside vegetation, will change to a construction site that remains partially obstructed by the existing roadside vegetation. Although 3 roadside trees on Sheung On Street are proposed to be felled due to direct conflict with the proposed Project,, there are a variety of alternative views that will not be blocked by the proposed Project and are considered to be more prominent with higher amenity value than that of the Project site, i.e. the remaining roadside vegetation and sea view of the cargo handling basin. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T2: Traveller at Sheung Mau Street

7.7.11. The existing view of the Project site, which is dominated by existing roadside vegetation, will change to a construction site that remains partially obstructed by the roadside vegetation. Due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs will be easily distracted by roadside trees and the sea view of the cargo handling basin that will not be blocked by the proposed Project and have higher amenity values. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T3: Travellers at Sheung Tat Street

7.7.12. The existing view of the Project site, which is dominated by the building structures of the NWFB Depot and roadside vegetation, will change to a construction site that remains partially blocked by the existing roadside vegetation. The views will still be obstructed and easily distracted by the roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the Project site. The magnitude of change is **adversely large** and the resulting visual impact is **moderately adverse** during construction phase.

VSR-T4: Travellers at Shing Tai Road

7.7.13. The existing view of the Project site, which is dominated by the roadside vegetation along Shing Tai Road and Sheung Mau Street, will change to a construction site that remains partially blocked by the existing roadside vegetation. Since their views are obstructed and easily distracted by roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the Project site, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-T5: Travellers at Ka Yip Street

7.7.14. The existing view of the Project site, which is dominated by the building structures and the fencing of the cargo handling area, will change to a construction site that is substantially blocked by the fencing and vessels in the cargo handling basin. In addition, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the sea view of the cargo handling basin will not be blocked by the proposed Project and is more prominent than that from the Project site. Therefore, the magnitude of change is **negligible** and the resulting visual impact is **insubstantial** during construction phase.

VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station

7.7.15. The existing view of the Project site, which is dominated by the roadside vegetation along Sheung Mau Street, will change to a construction site that remains partially obstructed by the existing roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the roadside vegetation on Shing Mau Street and the sea view of the cargo handling basin that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

<u>VSR-O7: Planned THEi New Campus</u>

7.7.16. The predicted view of the Project site, which is dominated by building structures, harbour area and natural hill slope, will change to a construction site that has partial to substantial obstruction by the roadside vegetation and Citybus Depot. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the harbour area that will not be blocked by the proposed Project and is more prominent with much higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

Visual Impact without Mitigation during Operation Phase

<u>VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)</u>

7.7.17. The existing view of the Project site, which is dominated by building structures, roadside vegetation and harbour area, will be replaced by the hard structure of the proposed Project. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, the corridor of open harbour view, which is of much higher amenity value as compared to that of the Project site, is not be affected. As the hard structure of the proposed Project remains partially blocked by the existing Citybus Depot and roadside vegetation, the magnitude of change is **adversely small** and the resulting visual impact is **moderately adverse** during operation phase.

<u>VSR-R2: Residents of Knight Court</u>

7.7.18. The existing view of the Project site, which is dominated by building structures and harbour area, will be replaced by the hard structure of the proposed Project. However, the proposed Project, which is on the Southeast of these VSRs, has no significant blockage on the view corridor of the open harbour view, which is on the Northeast of these VSRs and is of much higher amenity value and more attractive as compared to that of the Project site. As the hard structure of the proposed Project is built with a building height as similar to the adjacent developments and is partially blocked by the MTR viaduct and roadside vegetation and, the magnitude of change is **adversely small** and the resulting visual impact is **moderately adverse** during operation phase.

<u>VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G</u>

7.7.19. The existing view of the Project site, which is dominated by building structures, harbour area and natural hill slope across the harbour, will be replaced by the hard structure of the proposed Project. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, the view corridors of the open harbour and hill slope, which are of much higher amenity value as compared to that of the Project site, are not be affected. As the hard structure of the proposed Project remains slightly obstructed by the Hong Kong Institute of Vocational Education (Chai Wan) and the Citybus Depot, and these VSRs are easily distracted by the view of harbour area and hill slope landscape, the magnitude of change is **adversely small** and the resulting visual impact is **slightly or moderately adverse** during operation phase.

<u>VSR-O1: Chai Wan Industrial City (Phase I and II), Cornell Centre</u>

7.7.20. The existing view of the Project site, which is dominated by the sea view of the cargo handling basin, will be replaced by the hard structure of the proposed Project that has partial to substantial obstruction by the existing settlement and vessels in the cargo handling basin. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

<u>VSR-O2: Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)</u>

7.7.21. The existing view of the Project site, which is dominated by the sea view of the cargo handling basin, will be replaced by the hard structure of the proposed Project that has partial to substantial obstruction by the existing settlement and vessels in the cargo handling basin. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

<u>VSR-O3: Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)</u>

7.7.22. The existing view of the Project site, which is dominated by the cargo handling basin, will be replaced by the hard structure of the proposed Project that has slight to partial obstruction by the existing settlement and vessels in the cargo handling basin. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

VSR-O4: Marine Department Chai Wan Public Cargo Working Area

7.7.23. The existing view of the Project site, which is dominated by the sea view of the cargo handling area, will be replaced by the hard structure of the proposed Project that is substantially obstructed by the existing fencing of their work area and vessels in the cargo handling basin. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

VSR-O5: Pamela Youde Nethersole Eastern Hospital – East Block

7.7.24. The existing view of the Project site, which is dominated by the building structures, harbour area and the natural hill slope, will be replaced by the hard structure of the proposed Project that is partially obstructed by the existing roadside vegetation and the Citybus Depot. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, the view corridors of harbour area and hill slope, which are of much higher amenity value as compared to that of the Project site, are not be affected. As the hard structure of the proposed Project remains partially obstructed by the existing roadside vegetation and the Citybus Depot, and these VSRs are easily distracted by the view of harbour area and hill slope landscape, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

VSR-O6: Hong Kong Institute of Vocational Education (Chai Wan)

7.7.25. The existing view of the Project site, which is dominated by roadside vegetation and MTR tracks and viaduct, will be replaced by the hard structure of the proposed Project that has partial to substantial obstruction by the MTR viaduct and the roadside vegetation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. Nonetheless, these VSRs are easily distracted by the roadside vegetation on Shing Tai Road that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, with consideration of their close proximity to the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during operation phase.

VSR-T1: Travellers at Sheung On Street

7.7.26. The existing view of the Project site, which is dominated by the building structures of bus depots and roadside vegetation, will be replaced by the hard structure of the proposed Project that remains partially obstructed by the existing roadside vegetation. However, there are a variety of alternative views, such as the sea view of the cargo handling basin, that will not be blocked by the proposed Project and are considered to be more prominent with higher amenity value than that of the hard structure of the proposed Project. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during operation phase.

VSR-T2: Traveller at Sheung Mau Street

7.7.27. The existing view of the Project site, which is dominated by existing roadside vegetation, will be replaced by the hard structure of the proposed Project that remains partially obstructed by the roadside vegetation. These VSRs will be easily distracted by roadside trees and the sea view of the cargo handling basin that will not be blocked by the proposed Project and have higher amenity values. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during operation phase.

VSR-T3: Travellers at Sheung Tat Street

7.7.28. The existing view of the Project site, which is dominated by the building structures of the NWFB Depot and roadside vegetation, will be replaced by the hard structure of the proposed Project that remains partially blocked by the existing roadside vegetation. Their views are easily distracted by roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the hard structure of the proposed Project when travelling along Sheung Tat Street. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during operation phase.

VSR-T4: Travellers at Shing Tai Road

7.7.29. The existing view of the Project site, which is dominated by the roadside vegetation along Shing Tai Road and Sheung Mau Street, will be replaced by the hard structure of the proposed Project that remains partially blocked by the existing roadside vegetation. Their views are easily distracted by roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the hard structure of the proposed Project when travelling along Shing Tai Road. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

VSR-T5: Travellers at Ka Yip Street

7.7.30. The existing view of the Project site, which is dominated by the building structures and the fencing of the cargo handling area, will be replaced by the hard structure of the proposed Project that is partially blocked by the fencing and vessels in the cargo handling basin. In addition, due to the small scale of the proposed Project and its existing low amenity value, the sea view of the cargo handling basin will not be blocked by the proposed Project and is more prominent than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station

7.7.31. The existing view of the Project site, which is dominated by the roadside vegetation along Sheung Mau Street, will be replaced by the hard structure of the proposed Project that remains partially obstructed by the existing roadside vegetation. However, these VSRs are easily distracted by the roadside vegetation on Sheung Mau Street and the sea view of the cargo handling basin that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during operation phase.

VSR-O7: Planned THEi New Campus

7.7.32. The predicted view of the Project site, which is dominated by building structures, harbour area and natural hill slope, will be replaced by the hard structure of the proposed Project that has partial to substantial obstruction by the roadside vegetation and Citybus Depot. Since the proposed Project is built with a building height as similar to the adjacent bus depots, the view corridors of harbour area and hill slope landscape, which are of much higher amenity value as compared to that of the hard structure of the proposed Project, are not affected and will be more attractive to these VSRs. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during operation phase.

Potential Visual Impact without Mitigation

7.7.33. The potential visual impact without mitigation measures for individual VSRs are derived from the sensitivities and magnitude of changes in accordance with ***Table 7.2*** and summarised in ***Table 7.11***. The mapping of significant threshold of visual impact is shown in ***Figure 7.8***.

7.8. MITIGATION MEASURES

7.8.1. The identification of landscape and visual impacts highlights the potential sources of impacts and their magnitude of change caused to LRs, LCAs and VSRs. Corresponding mitigation measures are proposed to avoid and reduce the identified impacts and to remedy and compensate unavoidable impact as well as providing potential landscape and visual enhancement.

Mitigation Measures during Construction

CM1 – Construction Site Hoarding

7.8.2. Hoardings should be provided with aesthetic treatment and designed to be subtle and camouflaged. It should be compatible with the surrounding landscape and visually “impermeable” to block the view of construction activities from VSRs. The visual quality and amenity value of the Project site would be enhanced as compared to the existing condition of the Project site that consists of temporary works area surrounded by grey hoarding.

CM2 – Temporary Landscape Treatment

7.8.3. Temporary landscape treatment, such as the provision of temporary planting around the Site office in ornamental pots and application of green roof for Site office, should be considered during construction phase. Landscape planting in movable planters should also be considered as a temporary greening measure for the Project area (i.e. along Site hoarding). Design of the green roof and the type of species to be used shall be reviewed and confirmed during detailed design stage. The visual quality and amenity value of the Project site is considered to be enhanced by the provision of a more greenery view to the neighbourhood as compared to the existing condition of the Project site that consists of temporary works area with exposed soil and trees in poor health condition.

<u>CM3 – Preservation of Existing Vegetation</u>

7.8.4. Disturbance to existing vegetation should be avoided as far as practicable. Where possible, the construction programme should retain all trees in situ that are not in direct conflict with the development proposals. Subject to the detailed design of the proposed Project, a review shall be carried out before commencement of construction phase to assess the potential conflict of the construction activities with existing roadside trees and the need of corresponding measures. Proper protective fencing should be provided by the Contractor to protect the preserved trees before commencement of any works within the Project site. The protective fencing should be erected along or beyond the perimeter of the tree protection zone of each individual tree.

Mitigation Measures during Operation

<u>OM1 – Compensatory Planting</u>

7.8.5. Compensatory planting should be provided in the landscape area on Level 1 for the 12 trees that are proposed to be felled. The planting would follow the requirements as stipulated in DEVB TC(W) No. 10/2013, such as the provision of compensatory trees of heavy-standard size in a ratio of 1:1 in terms of number and aggregate diameter at breast height (DBH). A preliminary compensatory planting plan is provided in ***Figure 7.9***. The planting location and the type of compensatory plant species will be reviewed and confirmed during detailed design stage. The planting should be commenced during construction stage and be completed before the completion of construction stage to ensure the measure will be implemented on Day 1 of operation stage. Vegetation maintenance should be provided by the Operator. A compensatory tree planting proposal should be submitted together with tree removal application for approval by authorities in later stage. The compensatory planting would provide screening of the Project’s operation together with the retained roadside vegetation and softens the impact of the permanent structure of the proposed Project. The planting would also create a more greenery view with healthy vegetation to the neighbourhood and enhance the visual quality and the amenity value of the surrounding environment as compared to the existing condition of the Project site that consists of temporary works area with exposed soil and trees in poor health condition with low amenity value.

<u>OM2 – Landscape Planting near Pedestrian Zone</u>

7.8.6. Landscape areas should be provided along the Site boundary on Level 1 to soften the built structure of the proposed Project. An approximate of $700m^2$ of trees, shrubs or groundcovers shall provide year-round streetscape amenity as well as enhancing visual interest at street level. A mix of native and ornamental trees, shrubs or groundcovers shall be planted to articulate the spatial arrangements as well as to further add to the visual amenity. The type of species to be used will be confirmed during detailed design stage. The planting should be commenced during construction stage and be completed before the completion of construction stage to ensure the measure will be implemented on Day 1 of operation stage. Vegetation maintenance should be provided by the Operator. The planting further enhances the screening effect together with the compensatory trees, which would create a more greenery view with healthy vegetation to the neighbourhood and enhance the visual quality and the amenity value of the surrounding environment as compared to the existing condition of the Project site that consists of temporary works area with exposed soil and trees in poor health condition with low amenity value.

<u>OM3 – Green Roof</u>

7.8.7. A multi-patch of landscape area should be provided on the roof of the proposed building to soften the impact of the built structure. An area of approximately $2600m^2$ of shrub, which comprises of a mix of native and ornamental species, is proposed to be provided to enhance the aesthetics of views for those viewing the roof. The type of shrub species will be confirmed during detailed design stage. The planting should be commenced during construction stage and be completed before the completion of construction stage to ensure the measure will be implemented on Day 1 of operation stage. Vegetation maintenance should be provided by the Operator. The planting would create a more greenery view with healthy vegetation to the neighbourhood, particularly for the sensitive receivers where the roof of the proposed Project is visible, and enhance the visual quality and the amenity value of the surrounding environment as compared to the existing condition of the Project site that consists of temporary works area with exposed soil and trees in poor health condition with low amenity value.

<u>OM4 – Hard Landscape Feature and Lighting Design</u>

7.8.8. In order to blend in with the surrounding environment, the exterior of the permanent structure of the proposed Project should use non-reflective external finishes in light colour that is visually unobtrusive with surrounding context. Non-reflective paving materials should be considered to reduce potential glare from surface reflectance. Sample colours of the hard structures of the proposed Project are provided in ***Figure 7.10*** for indicative purpose. The finishing material and colour will be reviewed and confirmed during detailed design stage.

7.8.9. Lighting should be efficiently designed so that minimum amount of lighting is required for safety and security. The design may make reference to the *Guidelines on Industry Best Practices for External Lighting Installations* by Environmental Bureau, EPD and EMSD. The mounting height and direction of exterior lighting fixtures shall be designed and arranged to point away from sensitive receivers where possible. Specification of lighting operation schedule shall be formed by the operator to impose restriction on lighting operation after business hours, such as limiting the operation of lighting except for security lighting only, and in areas with necessary night-time operation where applicable.

7.8.10. The operator should provide regular maintenance for the proposed mitigation measures to ensure the effectiveness of the measures. The mitigation measures are illustrated in the preliminary master landscape plan in ***Figure 7.11a*** and ***7.11b***.

7.9. RESIDUAL IMPACTS AFTER MITIGATION

Landscape Impact during Construction Phase

7.9.1. During the construction phase, 12 trees that are in direct conflict with the driveway and the permanent structure of the proposed Project are proposed to be felled with compensation in compliance with DEVB TC(W) No. 10/2013. Since the proposed Project is in limited scale and the existing use of the Project site is for temporary works with exposed soil and machinery already, LR4-4, LR7-2, LCA2 and LCA7 will experience insubstantial residual impact from the proposed tree felling and construction activities with proper implementation of the proposed mitigation measures, such as control of construction programme and erection of site hoarding to screen-off construction activities. Therefore, the impacts on LR4-4, LR7-2, LCA2 and LCA7 are considered insubstantial as the construction phase is temporary in nature and the impact will be eliminated.

Landscape Impact during Operation Phase

7.9.2. Except for the 12 trees that are in direct conflict with the proposed Project, the remaining landscape resources in the study area, which are considered having high amenity value to the sensitive receivers in the vicinity of the proposed Project in general, will be retained. The proposed Project will also be in line with other maintenance workshops in the vicinity to preserve the current landscape character of the Project site (i.e. LCA7) to minimise the magnitude of change and potential visual impact to VSRs. Although a minor loss of existing trees, which are in poor form and health with low amenity value, will result from the proposed Project, the landscape quality is anticipated to be enhanced as the compensatory planting will provide healthy trees to compensate for the felled trees that are in poor health with low amenity value. In addition, the existing temporary works area with exposed soil within the Project site will also be replaced by the proposed Project that consists of multi-patches of vegetation on pedestrian level and roof floor to further improve the landscape and visual quality. The preservation of existing landscape character area and the minor destruction of the existing landscape resources, which are in poor form and health with low amenity value, are considered as beneficial in general.

7.9.3. As stated in *Section 7.8.5* to *7.8.7*, trees, shrubs or groundcovers will be provided in the landscape area on Level 1 and roof floor. Compensatory planting will also be provided on Level 1 for the 12 trees that are proposed to be felled in accordance with DEVB TC(W) No. 10/2013. When the planting becomes mature in Year 10, the magnitude of change at LR4-4, LR7-2, LCA2 and LCA7 will be reduced to negligible. Therefore, and residual landscape impact in operation phase is insubstantial when the mitigation measures are established.

Visual Impact during Construction Phase

<u>VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)</u>

7.9.4. With mitigation, the existing view of the Project site, which is dominated by building structures, roadside vegetation and harbour area, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain partially blocked by the existing Citybus Depot and roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the distant views of the harbour area and natural hillslope will not be blocked by the proposed Project and are more prominent than that from the Project site, which are considered to have much higher amenity value as compared to that of the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **moderately adverse** during construction phase.

<u>VSR-R2: Residents of Knight Court</u>

7.9.5. With mitigation, the existing view of the Project site, which is dominated by building structures and harbour area, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain partially blocked by the MTR viaduct and roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the distant view of the harbour area will not be blocked by the proposed Project and is more prominent than that from the Project site, which is considered to have much higher amenity value as compared to that of the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **moderately adverse** during construction phase.

<u>VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G</u>

7.9.6. With mitigation, the existing view of the Project site, which is dominated by building structures, harbour area and natural hill slope across the harbour, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain slightly obstructed by the Hong Kong Institute of Vocational Education (Chai Wan) and the Citybus Depot. In addition, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the harbour area and the hill slope landscape that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

<u>VSR-O1: Chai Wan Industrial City (Phase I and II), Cornell Centre</u>

7.9.7. With mitigation, the existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would have partial to substantial obstruction by the existing settlement and vessels in the cargo handling basin. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O2: Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)

7.9.8. With mitigation, the existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would have partial to substantial obstruction by the existing settlement and vessels in the cargo handling basin. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O3: Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)

7.9.9. With mitigation, the existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would have slight to partial obstruction by the existing settlement. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O4: Marine Department Chai Wan Public Cargo Working Area

7.9.10. With mitigation, the existing view of the Project site, which is dominated by the cargo handling basin, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain substantially obstructed by the existing fencing of their work area and vessels in the cargo handling basin. In addition, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the sea view of the cargo handling basin will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change of these VSRs is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O5: Pamela Youde Nethersole Eastern Hospital – East Block

7.9.11. With mitigation, the existing view of the Project site, which is dominated by the building structures, harbour area and the natural hill slope, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain partially obstructed by the existing roadside vegetation and the Citybus Depot. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the sea view of the cargo handling basin and the hill slope landscape that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-O6: Hong Kong Institute of Vocational Education (Chai Wan)

7.9.12. With mitigation, the existing view of the Project site, which is dominated by roadside vegetation and MTR tracks and viaduct, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would have partial to substantial obstruction by the MTR viaduct and the roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the roadside vegetation on Shing Tai Road that will not be blocked by the proposed Project and is more prominent with higher amenity value than that from the Project site. Therefore, with consideration of their close proximity to the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T1: Travellers at Sheung On Street

7.9.13. With mitigation, the existing view of the Project site, which is dominated by the building structures of bus depots and roadside vegetation, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain partially obstructed by the existing roadside vegetation. Although 3 roadside trees on Sheung On Street are proposed to be felled, there are a variety of alternative views that will not be blocked by the proposed Project and are considered to be more prominent with higher amenity value than that of the Project site, i.e. the remaining roadside vegetation and sea view of the cargo handling basin. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T2: Traveller at Sheung Mau Street

7.9.14. With mitigation, the existing view of the Project site, which is dominated by existing roadside vegetation, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs site would remain partially obstructed by the roadside vegetation. Due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs will be easily distracted by roadside trees and the sea view of cargo handling basin that will not be blocked by the proposed Project and have higher amenity values. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T3: Travellers at Sheung Tat Street

7.9.15. With mitigation, the existing view of the Project site, which is dominated by the building structures of the NWFB Depot and roadside vegetation, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would be partially blocked by the existing roadside vegetation. Since their views will be obstructed by site hoarding and are easily distracted by roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly or moderately adverse** during construction phase.

VSR-T4: Travellers at Shing Tai Road

7.9.16. With mitigation, the existing view of the Project site, which is dominated by the roadside vegetation along Shing Tai Road and Sheung Mau Street, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain partially blocked by the existing roadside vegetation. Since their views are obstructed and easily distracted by roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the Project site when travelling along Shing Tai Road, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

VSR-T5: Travellers at Ka Yip Street

7.9.17. With mitigation, the existing view of the Project site, which is dominated by the building structures and the fencing of the cargo handling area, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site from these VSRs would remain substantially blocked by the fencing and vessels in the cargo handling basin. In addition, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, the sea view of the cargo handling basin will not be blocked by the proposed Project and is more prominent than that from the Project site. Therefore, the magnitude of change is **negligible** and the resulting visual impact is **insubstantial** during construction phase.

VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station

7.9.18. With mitigation, the existing view of the Project site, which is dominated by the roadside vegetation along Sheung Mau Street, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site would remain partially obstructed by the existing roadside vegetation. However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the roadside vegetation on Sheung Mau Street and the sea view of the cargo handling basin that will not be blocked by the proposed Project and are more prominent with higher amenity value than that from the Project site. Therefore, with consideration of their occasionally view of the Project site, the magnitude of change is **adversely intermediate** and the resulting visual impact is **slightly to moderately adverse** during construction phase.

VSR-O7: Planned THEi New Campus

7.9.19. With mitigation, the predicted view of the Project site, which is dominated by building structures, harbour area and natural hill slope, will change to a construction site with screen hoarding and temporary landscape planting. The view of the Project site would have partial to substantial obstruction by the roadside vegetation and Citybus Depot.

However, due to the small scale of the proposed Project and the existing use of the Project site as temporary work site with low visual amenity value, these VSRs are easily distracted by the harbour area that will not be blocked by the proposed Project and is more prominent with much higher amenity value than that from the Project site. Therefore, the magnitude of change is **adversely small** and the resulting visual impact is **slightly adverse** during construction phase.

Visual Impact during Operation Phase

VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)

7.9.20. With mitigation, the existing view of the Project site, which is dominated by building structures, roadside vegetation and harbour area, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, the corridor of open harbour view, which is of much higher amenity value and more attractive as compared to that of the Project site, is not be affected. The visual impacts on these VSRs are **moderately adverse** in Day 1 of operation. As the landscape plantings of the proposed Project matures in Year 10 of operation, thereby having better screening effect on the hard structures together with the partial viewing blockage by the existing Citybus Depot and roadside vegetation, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-R2: Residents of Knight Court

7.9.21. With mitigation, the existing view of the Project site, which is dominated by building structures and harbour area, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. However, the proposed Project, which is on the Southeast of these VSRs, has no significant blockage on the corridor of the open harbour view, which is on the Northeast of these VSRs and is of much higher amenity value and more attractive as compared to that of the Project site. The visual impacts on these VSRs are **moderately adverse** in Day 1 of operation. As the landscape plantings of the proposed Project matures in Year 10 of operation, thereby having better screening effect on the hard structures together with the partial viewing blockage by the MTR viaduct and roadside vegetation, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G

7.9.22. With mitigation, the existing view of the Project site, which is dominated by building structures, harbour area and natural hill slope across the harbour, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, the view corridors of the open harbour and hill slope, which are of much higher amenity value and more attractive as compared to that of the Project site, are not be affected. The visual impacts on these VSRs are **slightly or moderately adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project together with the slight viewing blockage by the Hong Kong Institute of Vocational Education (Chai Wan) and the Citybus

Depot. Given the relatively long viewing distance, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-O1: Chai Wan Industrial City (Phase I and II), Cornell Centre

7.9.23. With mitigation, the existing view of the Project site, which is dominated by the sea view of the cargo handling basin, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. When the landscape planting matures, the hard structures of the proposed Project will still be partially visible even with the partial to substantial viewing blockage by the existing settlement and vessels in the cargo handling area. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value. The visual impact will remain **slightly adverse** in Year 10 of operation.

VSR-O2: Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)

7.9.24. With mitigation, the existing view of the Project site, which is dominated by the sea view of cargo handling basin, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. When the landscape planting matures, the hard structures of the proposed Project will still be partially visible even with the partial to substantial obstruction by the existing settlement and vessels in the cargo handling basin. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value. The visual impact will remain **slightly adverse** in Year 10 of operation.

VSR-O3: Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)

7.9.25. With mitigation, the existing view of the Project site, which is dominated by the sea view of cargo handling basin, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. When the landscape planting matures, the hard structures of the proposed Project will still be partially visible even with the slight to partial obstruction by the existing settlement and vessels in the cargo handling basin. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value. The visual impact will remain **slightly adverse** in Year 10 of operation.

VSR-O4: Marine Department Chai Wan Public Cargo Working Area

7.9.26. With mitigation, the existing view of the Project site, which is dominated by the sea view of cargo handling basin, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. When the landscape planting matures, the hard structures of the proposed Project will still be slightly visible even with the substantial obstruction by the existing fencing of their work area and vessels in the cargo handling basin. Nonetheless, these VSRs are easily distracted by the sea view of the cargo handling basin that will not be blocked by the proposed Project and is more prominent with higher amenity value. The visual impact will remain **slightly adverse** in Year 10 of operation.

VSR-O5: Pamela Youde Nethersole Eastern Hospital – East Block

7.9.27. With mitigation, the existing view of the Project site, which is dominated by the building structures, harbour area and the natural hill slope, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, the view corridors of open harbour and hill slope, which are of much higher amenity value and more attractive as compared to that of the Project site, are not be affected. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project together with the partial viewing blockage by the existing roadside vegetation and the Citybus Depot. Given the relatively long viewing distance, the visual impact is expected to be **insubstantial** in Year 10 of operation.

VSR-O6: Hong Kong Institute of Vocational Education (Chai Wan)

7.9.28. With mitigation, the existing view of the Project site, which is dominated by roadside vegetation and MTR tracks and viaduct, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent NWFB Depot, no visual intrusion is anticipated. The visual impacts on these VSRs are **slightly or moderately adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project together with the partial to substantial viewing blockage by the MTR viaduct and the roadside vegetation, which will not be blocked by the proposed Project. The visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-T1: Travellers at Sheung On Street

7.9.29. With mitigation, the existing view of the Project site, which is dominated by the building structures of bus depots and roadside vegetation, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. The visual impacts on these VSRs are **slightly or moderately adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project, which will still be partially visible by these VSRs, complementing the partial viewing blockage by the existing roadside vegetation. Since the views from these VSRs are on occasional basis and there are a variety of alternative views, such as the sea view of the cargo handling basin, that will not be blocked by the proposed Project and are considered to be more prominent with higher amenity value than that of the hard structure of the proposed Project, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-T2: Traveller at Sheung Mau Street

7.9.30. With mitigation, the existing view of the Project site, which is dominated by existing roadside vegetation, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. The visual impacts on these VSRs are **slightly or moderately adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project, which will still be partially visible by these VSRs, complementing the partial viewing blockage by the existing roadside vegetation. Since the views from these VSRs are on occasional basis and these VSRs are easily distracted by roadside trees and the sea view of the cargo handling basin that will not be blocked by the proposed Project and are more prominent with higher amenity value, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-T3: Travellers at Sheung Tat Street

7.9.31. With mitigation, the existing view of the Project site, which is dominated by the building structures of the NWFB Depot and roadside vegetation, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. The visual impacts on these VSRs are **slightly or moderately adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project, which will still be partially visible by these VSRs, complementing the partial viewing blockage by the existing roadside vegetation. Since the views from these VSRs are on occasional basis and these VSRs are easily distracted by the roadside vegetation that will not be blocked by the proposed Project and has higher amenity value, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-T4: Travellers at Shing Tai Road

7.9.32. With mitigation, the existing view of the Project site, which is dominated by the roadside vegetation along Shing Tai Road and Sheung Mau Street, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. Although their views are easily distracted by roadside trees that will not be blocked by the proposed Project and have higher amenity value than that of the hard structure of the proposed Project, the hard structures of the proposed Project will still be partially visible even with the partial obstruction by existing roadside vegetation and the matured landscape planting. The visual impact will remain **slightly adverse** in Year 10 of operation.

VSR-T5: Travellers at Ka Yip Street

7.9.33. With mitigation, the existing view of the Project site, which is dominated by the building structures and the fencing of the cargo handling area, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. Although the sea view of the cargo handling basin will not be blocked by the proposed Project and is more prominent than that from the Project site, the hard structures of the proposed Project will still be partially visible even with the partial obstruction by the fencing and vessels in the cargo handling basin. The visual impact will remain **slightly adverse** in Year 10 of operation.

VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station

7.9.34. With mitigation, the existing view of the Project site, which is dominated by the roadside vegetation along Sheung Mau Street, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. The visual impacts on these VSRs are **slightly or moderately adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project together with the partial viewing blockage by the existing roadside vegetation on Sheung Mau Street. Nonetheless, these VSRs are easily distracted by roadside vegetation on Sheung Mau Street and the sea view of the cargo handling basin that will not be blocked by the proposed Project and are more prominent with higher amenity value. Given that the views from these VSRs are on occasional basis, the visual impact is expected to be **slightly adverse** in Year 10 of operation.

VSR-O7: Planned THEi New Campus

7.9.35. With mitigation, the predicted view of the Project site, which is dominated by building structures, harbour area and natural hill slope, will be replaced by the hard structure of the proposed Project with pre-mature landscape planting and green roofs in Day 1 of operation. Since the proposed Project is built with a building height as similar to the adjacent bus depots, the view corridors of the open harbour and hill slope landscape, which are of much higher amenity values as compared to that of the hard structure of the Project, are not affected and will be more attractive to these VSRs. The visual impacts on these VSRs are **slightly adverse** in Day 1 of operation. In Year 10 of operation, the matured planting will further screen off the hard structures of the proposed Project, which will still be slightly to partially visible due to the partial to substantial viewing blockage by the roadside vegetation and Citybus Depot. The visual impact will remain **slightly adverse** in Year 10 of operation.

7.9.36. The residual impacts for LRs, LCAs and VSRs after implementation of mitigation measures are summarised in ***Table 7.8***, ***Table 7.9***, ***Table 7.10*** and ***Table 7.11***. The mapping of significant threshold of landscape and visual impact are shown in ***Figure 7.7*** and ***7.8*** respectively.

7.10. Cumulative Impact

7.10.1. Cumulative landscape and visual impacts during the construction and operation phase of the proposed Project with other projects in the vicinity is assessed. According to the latest Chai Wan OZP, potential developments shall be anticipated at the vacant land at the junction of Shing Tai Road and Sheung Mau Street and the public open parking space located at the junction of Shing Tai Road and Chong Fu Road, which are zoned as "Government, Institution or Community (G/IC(2))". However, there is no programme of the two potential developments during the course of the report and is thus not assessed in this study of cumulative impact of the proposed Project. Therefore, it is identified that the planned THEi New Campus is the only planned project in the vicinity.

7.10.2. According to ***Table 3.3***, the planned THEi New Campus will be in operation from the third quarter of 2016, which is approximately three months after the tentative commencement of the construction of the proposed Project in mid-2016. During the interfacing time, the anticipated works of the planned THEi New Campus are interior fitting-out and users moving-in according to ***Table 5.11***. Therefore, the planned THEi New Campus would be completed and would not have landscape and visual impact when interfacing with the proposed Project.

7.10.3. With consideration that the planned THEi New Campus is established during construction phase and operation phase of the proposed Project, the Campus forms part of the landscape and visual baseline and has been included in the impact assessment.

7.10.4. Relevant Outline Development Plans, neighbouring OZP planning brief have also been reviewed. No other committed or planned development is identified.

7.11. Environmental Monitoring and Audit

Construction Phase

7.11.1. No substantial impact is anticipated on LRs and LCAs, while slight to moderate visual impact is anticipated during construction phase. The impact will be minimised by the implementation of the mitigation measures as mentioned in *Section 7.8.2* to *7.8.4*, such as the preservation of existing vegetation and provision of construction site hoarding. The implementation of mitigation measures shall be checked via regular environmental site audit as part of the EM&A procedures as detailed in the EM&A Manual.

Operation Phase

7.11.2. The proposed Project will result in the felling of 9 trees within the Project site and 3 trees on the South-eastern boundary of the Project site. The landscape design as described in *Section 7.8.5* to *7.8.9* will be adopted as mitigation measures to compensate for the proposed tree felling as well as softening the visual impact arisen from the permanent structure of the proposed Project. A Tree Preservation and Removal Proposal (TPRP) should be prepared during detailed design stage in accordance with DEVB TC(W) No. 10/2013 to seek for approval of tree felling from relevant responsible department including the Lands Department, and the compensatory planting would be completed before completion of construction phase of the proposed Project. Therefore, EM&A work is considered not necessary in general. Subject to the tree felling approval conditions as required by the approval authorities, monitoring of the compensatory planting after establishment will be conducted, if required.

7.12. CONCLUSIONS

7.12.1. A landscape and visual impact assessment covering a 500m study area for assessment of landscape impacts and the visual envelop for assessment of visual impacts has been conducted.

7.12.2. The potential sources of landscape impact of the proposed Project during construction and operation phase mainly arisen from site clearance (i.e. removal of existing vegetation) and the presence of the permanent structure and its operation respectively.

7.12.3. The potential sources of visual impacts from the proposed Project during construction and operation phase mainly arisen from the operation of site works (i.e. site clearance work, stockpiling of construction equipment, etc.) and the presence of permanent structure of the proposed Project respectively.

7.12.4. The proposed Project would have no impact on any landscape resources and landscape character area within the study area except for the 12 trees that are of direct conflict with the proposed Project and therefore proposed to be felled. The impacts are slightly adverse due to the minor loss of greenery. With proper implementation of the proposed mitigation measures, such as the provision of landscape area and compensatory planting, the magnitude of change would be minimised and therefore the residual landscape impact would be insubstantial.

7.12.5. The anticipated visual impacts from the proposed Project are generally slightly to moderately adverse during construction phase mainly due to slightly to partially obstructed views of construction activities. Following the completion of construction activities, the landscape planting and green roof of the proposed Project act as visual screen to visual sensitive receivers as well as enhance the visual quality and amenity value by the provision of a more greenery view to the neighbourhood as compared to the existing condition of the Project site, which consists of temporary works area with exposed soil and trees in poor health condition. The residual visual impact in operation phase is slightly adverse to insubstantial in general.

7.12.6. Comparing the original setting of the Project site prior to the proposed Project, where trees in poor health and form with low amenity value are located, the overall landscape character and visual quality of the Project site would be improved with the provision of landscape design, including the incorporation of hard landscape design and the provision of landscape planting on Level 1 and green roof. Therefore, the landscape character and visual quality of the Project site have been complemented and the landscape and visual impact from the proposed Project is considered as acceptable with mitigation measures.

Table 7.8 Magnitude of Change of LRs and Significance of Landscape Impacts during Construction and Operation Phase

LR ID	Landscape Resources	Sensitivity	Reversibility of Change	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
				Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
LR1 Natural Woodland											
LR1-1	North-eastern side of Pamela Youde Nethersole Eastern Hospital	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR2 Vegetated Engineered Slope											
LR2-1	North-eastern side of Pamela Youde Nethersole Eastern Hospital	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR3 Park/Recreation											
LR3-1	Chai Wan Park	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR3-2	Wing Tai Road Garden	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR3-3	Tsui Wan Estate Playgrounds, Tennis Court and Sitting-Out Area	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR3-4	Yue Wan Estates Playground	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial

LR ID	Landscape Resources	Sensitivity	Reversibility of Change	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
				Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
LR3-5	Heng Fa Chuen Playgrounds, Football Field and Sitting-Out Area	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR4 Roadside Plantings											
LR4-1	Island Eastern Corridor	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR4-2	Shun Tai Road	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR4-3	Wing Tai Road	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR4-4	Sheung On Street	Medium	Irreversible	Small	Small	Slight	Slight	CM1; CM2; CM3; OM1; OM2; OM3	Insubstantial	Insubstantial	Insubstantial
LR4-5	Chong Fu Road, Sheung Mau Street, Sheung Tat Street and Shing Tai Road	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR4-6	Ka Yip Street and Sun Yip Street	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR5 Residential/Architectural Planting											
LR5-1	Tsui Wan Estate	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR5-2	Yue Wan Estate	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR5-3	Tsui Lok Estate	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial

LR ID	Landscape Resources	Sensitivity	Reversibility of Change	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
				Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
LR5-4	Roof of Hang Tsui Court Carpark	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR5-5	Heng Fa Chuen	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR5-6	Chai Wan IVE	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
<u>LR6 Open Space/Vacant Land</u>											
LR6-1	Bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road	Low	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LR6-2	Bounded by Shing Tai Road, Sheung Tat Street, and Sheung Mau Street	Low	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
<u>LR7 Open Space Vegetation</u>											
LR7-1	Bounded by Shing Tai Road, Sheung Ping Street, Sheung On Street and Wing Tai Road	Low	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial

LR ID	Landscape Resources	Sensitivity	Reversibility of Change	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
				Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
LR7-2	Bounded by Shing Tai Road, Sheung Tat Street, Sheung Mau Street, and Sheung On Street	Low	Irreversible	Small	Small	Slight	Slight	CM1; CM2; CM3; OM1; OM2; OM3	Insubstantial	Insubstantial	Insubstantial
LR7-3	Near the intersection of Shing Tai Road and Chong Fu Road	Low	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
<u>LR8 Cargo Handling Basin</u>											
LR8-1	Chai Wan Cargo Handling Basin	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial

Table 7.9 Magnitude of Change for LCAs and Significance of Landscape Impacts during Construction and Operation Phase

LR ID	Landscape Resources	Sensitivity	Reversibility of Change	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
				Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
LCA1	Hillside Landscape	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LCA2	Community/ Residential Urban Landscape	Medium	Irreversible	Small	Small	Slight	Slight	CM1; CM2; CM3; OM1; OM2; OM3	Insubstantial	Insubstantial	Insubstantial
LCA3	Park Landscape	High	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LCA4	Industrial Urban Landscape	Low	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LCA5	Railway Viaduct Landscape	Low	n/a	Negligible	Negligible	Insubstantial	Insubstantial	/	Insubstantial	Insubstantial	Insubstantial
LCA6	Marine Landscape	Medium	n/a	Negligible	Negligible	Insubstantial	Insubstantial		Insubstantial	Insubstantial	Insubstantial
LCA7	Open Car Parks/ Maintenance Workshops/ Vacant Land Landscape	Low	Irreversible	Small	Small	Slight	Slight	CM1; CM2; CM3; OM1; OM2; OM3	Insubstantial	Insubstantial	Insubstantial

Table 7.10 Magnitude of Change for VSRs during Construction and Operation Phase

Visual Sensitive Receivers	Compatibility of the proposed Project with Surrounding Landscape	Duration of Impact		Scale of Development in relation to Surrounding Baseline Conditions	Reversibility of Change	Shortest Viewing Distance (m)	Potential Blockage of View	Magnitude of Change	
		Construction Phase	Operation Phase					Construction Phase	Operation Phase
Visible Area with Residential VSRs									
VSR-R1: Residents of Tsui Wan Estate (Tsui Shou House, Tsui Hong House, Tsui Fuk House)	High	Medium	Long	Small	Irreversible	345	Slight	Adversely Small	Adversely Small
VSR-R2: Residents of Knight Court	High	Medium	Long	Small	Irreversible	161	Partial to Substantial	Adversely Small	Adversely Small
VSR-R3: Residents of Pamela Youde Nethersole Eastern Hospital – Blocks E, F, G	High	Medium	Long	Small	Irreversible	414	Slight	Adversely Small	Adversely Small
Visible Area with Occupational VSRs									
VSR-O1: Staff of Chai Wan Industrial City (Phase I and II), Cornell Centre	High	Short	Short	Small	Irreversible	300	Substantial	Adversely Small	Adversely Small
VSR-O2: Staff of Yiko Industrial Building, Paramount Building, Ming Pao Industrial Centre (Block A and B)	High	Short	Short	Small	Irreversible	397	Substantial	Adversely Small	Adversely Small

Visual Sensitive Receivers	Compatibility of the proposed Project with Surrounding Landscape	Duration of Impact		Scale of Development in relation to Surrounding Baseline Conditions	Reversibility of Change	Shortest Viewing Distance (m)	Potential Blockage of View	Magnitude of Change	
		Construction Phase	Operation Phase					Construction Phase	Operation Phase
VSR-O3: Staff of Chivas Godown, Safety Godown Industrial Building, Kerry Godown (Chai Wan)	High	Short	Short	Small	Irreversible	273	Partial	Adversely Small	Adversely Small
VSR-O4: Staff of Marine Department Chai Wan Public Cargo Working Area	High	Short	Short	Small	Irreversible	16	Substantial	Adversely Small	Adversely Small
VSR-O5: Staff of Pamela Youde Nethersole Eastern Hospital – East Block	High	Short	Short	Small	Irreversible	444	Partial	Adversely Small	Adversely Small
VSR-O6: Staff and Students of Hong Kong Institute of Vocational Education (Chai Wan)	High	Short	Short	Small	Irreversible	147	Substantial	Adversely Intermediate	Adversely Intermediate
VSR-O7: Staff and Students of Planned THEi New Campus	High	Short	Short	Small	Irreversible	167	Partial to Substantial	Adversely Small	Adversely Small

Visual Sensitive Receivers	Compatibility of the proposed Project with Surrounding Landscape	Duration of Impact		Scale of Development in relation to Surrounding Baseline Conditions	Reversibility of Change	Shortest Viewing Distance (m)	Potential Blockage of View	Magnitude of Change	
		Construction Phase	Operation Phase					Construction Phase	Operation Phase
Visible Area with Travelling VSRs									
VSR-T1: Travellers at Sheung On Street	High	Short	Short	Small	Irreversible	Immediate	Partial	Adversely Intermediate	Adversely Intermediate
VSR-T2: Travellers at Sheung Mau Street	High	Short	Short	Small	Irreversible	Immediate	Partial	Adversely Intermediate	Adversely Intermediate
VSR-T3: Travellers at Sheung Tat Street	High	Short	Short	Small	Irreversible	Immediate	Partial	Adversely Large	Adversely Intermediate
VSR-T4: Travellers at Shing Tai Road	High	Short	Short	Small	Irreversible	70	Partial	Adversely Small	Adversely Small
VSR-T5: Travellers at Ka Yip Street	High	Short	Short	Small	Irreversible	238	Substantial	Negligible	Adversely Small
Visible Area with both Travelling and Occupational VSRs									
VSR-P1: Users/Staffs of ExxonMobil Petrol-cum-LPG Filling Station	High	Short	Short	Small	Irreversible	20	Substantial	Adversely Intermediate	Adversely Intermediate

Table 7.11 Significance of Visual Impacts during Construction and Operation Phase

Visual Sensitive Receivers	Sensitivity of VSRs	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
		Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
Visible area with residential VSRs									
VSR-R1	High	Adversely Small	Adversely Small	Moderately Adverse	Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Moderately Adverse	Moderately Adverse	Slightly Adverse
VSR-R2	High	Adversely Small	Adversely Small	Moderately Adverse	Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Moderately Adverse	Moderately Adverse	Slightly Adverse
VSR-R3	Medium	Adversely Small	Adversely Small	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	Slightly Adverse
Visible area with occupational VSRs									
VSR-O1	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Slightly Adverse
VSR-O2	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Slightly Adverse
VSR-O3	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Slightly Adverse
VSR-O4	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Slightly Adverse

Visual Sensitive Receivers	Sensitivity of VSRs	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
		Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
VSR-O5	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Insubstantial
VSR-O6	Low	Adversely Intermediate	Adversely Intermediate	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	Slightly Adverse
VSR-O7	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Slightly Adverse
<u>Visible area with travelling VSRs</u>									
VSR-T1	Low	Adversely Intermediate	Adversely Intermediate	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	Slightly Adverse
VSR-T2	Low	Adversely Intermediate	Adversely Intermediate	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	Slightly Adverse
VSR-T3	Low	Adversely Large	Adversely Intermediate	Moderately Adverse	Slightly/ Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	Slightly Adverse
VSR-T4	Low	Adversely Small	Adversely Small	Slightly Adverse	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly Adverse	Slightly Adverse	Slightly Adverse

Visual Sensitive Receivers	Sensitivity of VSRs	Magnitude of Change		Significance of Impact (Unmitigated)		Mitigation Measures	Significance of Impact (Mitigated)		
		Construction Phase	Operation Phase	Construction Phase	Operation Phase		Construction Phase	Day 1 of Operation	Year 10 of Operation
VSR-T5	Low	Negligible	Adversely Small	Insubstantial	Slightly Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Insubstantial	Slightly Adverse	Slightly Adverse
Visible area with both travelling and occupational VSRs									
VSR-P1	Low	Adversely Intermediate	Adversely Intermediate	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	CM1; CM2; CM3; OM1; OM2; OM3; OM4	Slightly/ Moderately Adverse	Slightly/ Moderately Adverse	Slightly Adverse

8. WASTE MANAGEMENT IMPLICATION ASSESSMENT

8.1. INTRODUCTION

8.1.1. This section identifies the types of waste that may arise from the construction and operation phases of the proposed Project.

8.1.2. This assessment has based on the criteria and guidelines stated in Annexes 7 and 15 of the EIAO-TM and scope outlined in clause 3.4.8 and Appendix E1 of the EIA Study Brief (No. ESB-267/2014) for evaluating and assessing waste management implications.

8.2. RELEVANT ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

8.2.1. The following legislations governing waste management and disposal in Hong Kong are considered in assessing potential waste management implications:

- The Waste Disposal Ordinance (Cap.354) and subsidiary legislation such as the Waste Disposal (Chemical Waste) (General) Regulation and Waste Disposal (Charges for Disposal of Construction Waste) Regulation that set out requirements for the storage, handling and transportation of all types of wastes;
- Environmental Impact Assessment Ordinance (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), Annexes 7 and 15;
- Public Health and Municipal Service Ordinance (Cap. 132), Public Cleansing and Prevention of Nuisance Regulation;
- Buildings Ordinance (Cap. 123);
- Dumping at Sea Ordinance (Cap. 466); and
- Land (Miscellaneous Provisions) Ordinance (Cap. 28).

8.2.2. Other relevant documents and guidelines that are applicable to waste management and disposal in Hong Kong include:

- Development Bureau Technical Circular (Works) (TC(W)) No. 6/2010, Trip Ticket System for Disposal of Construction & Demolition Materials;
- Development Bureau TC(W) No. 8/2010 Enhanced Specification for Site Cleanliness and Tidiness;
- ETWB TC(W) No. 34/2002, Management of Dredged/Excavated Sediment;
- ETWB TC(W) No. 19/2005, Environmental Management on Construction Sites;
- ETWM TC(W) No. 22/2003 and 22/2003A, Additional Measures to Improve Site Cleanliness and Control Mosquito Breeding on Construction Sites;

- ETWB TC(W) No. 33/2002, Management of Construction and Demolition Material Including Rock;
- Works Bureau TC No. 12/2002, Specification Facilitating the Use of Recycled Aggregates;
- Works Bureau TC Nos. 25/99, 25/99A and 25/99C, Incorporation of Information on Construction and Demolition Material Management in Public Works Sub-committee Papers; and
- Works Bureau TC No. 2/93, Public Dumps.

Construction Waste

8.2.3. The Waste Disposal Ordinance (WDO) prohibits the unauthorized disposal of wastes. Construction waste is defined under Waste Disposal (Charges for Disposal of Construction Waste) Regulation as any substance, matter or thing that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screenings or matter removed in or generated from any desludging, desilting or dredging works. It is specified under the WDO that wastes can only be disposed of at designated waste disposal facilities (e.g. landfill, public fill, etc.) licensed by EPD. For construction work with a value of more than HK$1 million, the main contractor is required to establish a billing account at EPD prior to transporting any construction waste to the designated waste disposal facilities. The vessels for delivering construction waste to the public fill reception facilities require prior approval from the Public Fill Committee (PFC). Any violation to these regulations may lead to fine and/or imprisonment.

8.2.4. Land (Miscellaneous Provisions) Ordinance provides control on dumping at public fill. It is specified that the inert portion of construction waste (also called public fill) may be taken to public fill reception facilities which are operated by the Civil Engineering and Development Department (CEDD). The Ordinance requires dumping licenses to be obtained by individuals or companies who deliver inert C&D materials to public filling areas. The CEDD issues the licences under delegated powers from the Director of Lands. Under the licence conditions, public fill reception facilities will only accept inert earth, soil, sand, rock, boulder, rubble, brick, tile, concrete, asphalt, masonry or used bentonite. The PFC will advise on the acceptance criteria for disposal of inert C&D materials at public fill reception facilities in accordance with Development Bureau Technical Circular (Works) (TC(W)) No. 6/2010.

Chemical Waste

8.2.5. Chemical wastes may pose environmental, health and safety hazards. These hazards may include:

- Toxic effects to workers;
- Adverse effects on air quality, water quality and land contamination due to spillage;
- Hazards of fire; and

- Disruption of downstream sewage treatment works if the chemical waste enters the sewerage system.

8.2.6. Waste Disposal (Chemical Waste) (General) Regulations provides for control of all aspects of chemical waste disposal, including handling, storage, collection, transportation and disposal of waste. Chemical waste is defined by the Regulations as any substance or thing being scrap material, effluent, or an unwanted substance or by-product arising from the application of or in the course of any process or trade activity, and which is or contains any substance or chemical specified in the prescribed schedule if such substance or chemical occurs in such form, quantity or concentration so as to cause pollution and constitute danger to health or risk of pollution to the environment.

8.2.7. Under the regulations, all producers of chemical waste must register with EPD or else it will be an offence and is liable to fine and/or imprisonment. The regulations require waste producers to arrange proper packaging, labelling and storage of chemical waste before they are transported off-site to disposal facilities, in order to safeguard the health and safety of workers and the general public and to minimise potential hazards arising from improper handling of chemical waste. These requirements apply also to temporary storage of chemical waste prior to on-site or in-house treatment. Registered chemical waste producers must treat their waste at on-site plant licensed by EPD or by licensed waste collector to transport the wastes to a licensed facility.

8.3. ASSESSMENT METHODOLOGY

8.3.1. The criteria and methodologies for assessing waste management implications from the handling, storage, collection, transportation and disposal of waste material generated from the proposed Project are outlined in Annex 7 and Annex 15 of the EIAO-TM respectively.

8.3.2. The waste management hierarchy has been applied in the assessment and development of mitigation measures for waste arising from the proposed Project. The waste management hierarchy is a concept which shows the desirability of various waste management methods and comprises the following in order of preference:

(a) Avoidance;

(b) Minimisation;

(c) Recycling/reuse;

(d) Treatment; and

(e) Disposal.

8.3.3. All opportunities for reducing waste generation have been assessed based upon the following factors:

- Avoiding or minimising waste generation throughout design, construction and operation phase;
- Reusing and recycling C&D materials on site or other project; and

- Adopting better management practices to promote sorting of C&D materials.

8.3.4. In accordance with Appendix E1 of the EIA Study Brief, the quantity, quality and timing of waste arising as a result of the construction and operation activities of the proposed Project and associated works have been estimated, based on their sequence and duration. Design, general layout, construction methods and programme to minimise the generation of public fill/inert C&D materials have been considered.

8.3.5. The assessment includes the following tasks:

- Estimation of the types and quantities of waste generated;
- Evaluation of potential impacts from the handling, storage, collection, transportation and disposal of waste; and
- Proposal of mitigation measures for waste management.

8.4. IDENTIFICATION AND EVALUATION OF ENVIRONMENTAL IMPACTS

Construction Phase

8.4.1. The construction activities to be carried out for construction of the proposed Project would generate a variety of wastes that can broadly be divided into distinct categories based on their composition and ultimate disposal methods. The identified waste types include:

- Construction and demolition (C&D) materials (including excavated materials);
- Construction and demolition (C&D) wastes;
- Chemical waste; and
- General refuse.

<u>Construction and Demolition (C&D) Materials</u>

8.4.2. Construction and demolition (C&D) materials that comprise inert materials, such as rock, rubble, boulder, earth, soil, sand, concrete, asphalt, brick, tile, masonry or used bentonite, should be reused on-site or as pubic fill as much as possible.

8.4.3. C&D materials will be minimised through careful planning during detailed design and good site practice during construction.

8.4.4. Since the Project site was formed by reclamation, levelling of land and excavation by cutting into slope will not be required for site formation. Also, underground basement floor is chosen to be excluded from the design of the proposed Project. Hence, majority of the C&D materials of the proposed Project will be from the construction of the building and associated structures.

8.4.5. Conventional steel-H piling is proposed as the piling method of the proposed Project, which in turn minimises the waste to be generated from excavation via drilling. Since deep excavation from piling works is not anticipated, no excavated sediment is expected to be generated.

8.4.6. The major source of C&D materials from the proposed Project will be excavated fill materials from topsoil and broken concrete from the removal of previously paved ground. Construction of 3m-deep pile caps, ground beams, underground utilities, etc. will lead to excavation of 21,018m^3 topsoil. One quarter of which (5,254m^3) is expected to be reused on site whereas the remaining 15,764m^3 of which will be recycled at public fill bank. 2,102m^3 of broken concrete will also be generated during site formation. The type and quantity of C&D materials that is anticipated to be diverted to public fill reception facilities during construction phase of the proposed Project is summarised in ***Table 8.1*** below:

Table 8.1 Summary of C&D Materials Arising from the Proposed Project

Material Type and Potential Sources	Estimated Quantity	Proposed Waste Management
Excavated topsoil for 3m-deep pile cap	15,764m^3	To be disposed of at public fill reception facilities
	5,254m^3	To be reused on site with proper sorting
Broken concrete from the removal of previously paved ground with a depth of 0.3 m during site formation	2,102m^3	To be disposed of at public fill reception facilities
Total	**23,120m^3**	

8.4.7. The inert C&D materials to be disposed of at public filling reception facilities shall be materials consisting of soil, concrete, etc. The materials shall be free from plastics, chemical waste, industrial metals and other materials that are considered as C&D wastes.

8.4.8. Two-third of excavated topsoil and broken concrete as mentioned in ***Table 8.1*** are proposed to be delivered to the Tseung Kwan O Area 137 Fill Bank through the Chai Wan Public Fill Barging Point (PFBP) at 11 Ka Yip Street, Chai Wan, Hong Kong. ***Figure 8.1*** shows the shortest transportation route from the Project site to the barging point. This route will be adopted by the dump trucks during construction period.

8.4.9. The transportation of C&D materials will be undertaken over a 29-month construction period. Given an average truck capacity of 7.5m^3, approximately 2,380 dump trucks would be required throughout the construction period. As C&D materials are expected to be exported on a regular basis, a maximum of 4 trips per day is therefore anticipated. In view of the estimated number of dump trucks arising from transportation of C&D materials, the impacts from transportation off-site is expected to be limited.

8.4.10. The Project Proponent / Main Contractor should timely notify the estimated volumes of excavated materials to be generated and make agreement with the PFC on the disposal of inert C&D Materials. C&D Materials should be segregated from other wastes to avoid contamination and to ensure acceptability at public fill reception facilities and other construction sites.

8.4.11. All C&D materials will need to be carefully stockpiled if it cannot be reused or removed directly to avoid dust and other nuisance impacts. A designated temporary storage area of C&D materials must be provided on site. No construction work is allowed to proceed until all issues on management of C&D materials have been resolved and all relevant arrangements have been agreed between the responsible Government departments and contractors.

Construction and Demolition (C&D) Waste

8.4.12. Construction and Demolition (C&D) waste comprises non-inert materials, including mixture of topsoil and dead vegetative materials, timber, glass, steel and plastics, etc. arising from construction and demolition that are not suitable for backfilling.

8.4.13. The Contractor should separate C&D waste from inert C&D materials on-site. All segregated recyclable materials (e.g. metal) should be collected by reputable licensed recyclers. The remaining C&D waste will require disposal of at SENT Landfill through Island Eastern Corridor (IEC) by dump trucks.

8.4.14. The estimated quantity of C&D waste (e.g. timber formwork, maintenance and packaging waste, other construction debris, etc.) to be generated would be small and the quantity of which is expected to be $5{,}700m^3$, given careful design, planning, site management and control of ordering procedure.

8.4.15. Given an average truck capacity of $7.5m^3$, approximately 760 dump trucks would be undertaken over a 29-month construction period. As C&D waste is expected to be exported on a regular basis, a maximum of 2 trips per day is anticipated. In view of the estimated number of dump trucks arising from transportation of C&D waste, the impacts arising from increased traffic loading would be limited.

8.4.16. All C&D wastes will need to be carefully stockpiled to avoid dust and other nuisance. A designated temporary storage area of C&D wastes must be provided on site. No construction work is allowed to proceed until all issues on management of C&D wastes have been resolved and all relevant arrangements have been agreed between the responsible Government departments and contractors.

Chemical Waste

8.4.17. Chemical waste that is likely to arise from the construction activities for the proposed Project includes:

- Scrap batteries or acid / alkali from construction plant maintenance activities;
- Used paints, engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils / cleansing fluids from machineries; and

- Spent solvent / solutions, some of which may be halogenated, from equipment cleansing activities.

8.4.18. The amount of chemical waste to be generated throughout construction phase is estimated to be approximately 100 L on average, depending on the degree of Contractor's on-site maintenance practices and the number of mechanical plant and vehicles utilised on site. However, it is anticipated that the quantity of chemical waste arising during the construction of the proposed Project would be very small given the small scale of the proposed Project. Given that the chemical waste generated are to be handled, stored, transported and disposed of in an appropriate manner, impacts such as potential hazard and spillage will not be anticipated.

8.4.19. Nevertheless, the Contractor should register to the EPD as a Chemical Waste Producer in strict accordance with the Waste Disposal (Chemical Waste) (General) Regulation. Chemical waste has to be stored on-site with suitable containers so that leakage or spillage is prevented during the handling, storage, and subsequent transportation. The chemical waste should be collected by licensed collectors for subsequent disposal at licensed chemical waste disposal facilities, e.g. the Chemical Waste Treatment Centre (CWTC) at Tsing Yi or other licensed facilities by licensed collectors.

<u>General Refuse</u>

8.4.20. General refuse such as waste papers, plastic packaging, food wastes, etc. will be generated by the construction workforce during construction phase of the proposed Project.

8.4.21. Since no information regarding the number of on-site workers is available at this stage of the proposed Project, it has been assumed that a maximum of 100 workers will work simultaneously at the Project site during construction phase of the proposed Project. Quantity of general refuse to be generated per day is therefore estimated to be 65 kg (assuming a waste generation rate of 0.65 kg per person per day).

8.4.22. General refuse will have to be temporarily stored in enclosed bins or compaction units and will be collected on a regular basis. With proper on-site handling and storage as well as regular disposal of the wastes, no adverse impact is envisaged.

8.4.23. General refuse shall be stored in enclosed bins or compaction units separated from excavated and inert C&D materials to minimise odour nuisance. The Contractor shall employ a licensed waste collector to separate general refuse from C&D materials and remove general refuse from the site to WENT Landfill through Island East Refuse Transfer Station in Chai Wan.

Operation Phase

<u>General Refuse</u>

8.4.24. The operation phase of the proposed Project involves office activities and vehicle repair / testing activities. The quantity of general refuse arising from the future operation of the proposed Project is expected to be insignificant.

Chemical Waste

8.4.25. The key concern of waste type arising from the operation of the proposed Project is expected to be chemical waste. Chemical waste from vehicle repair / testing activities, which includes scrap batteries, used engine oils, lubricating and hydraulic fluids and spent mineral oils / cleaning fluids from mechanical machinery are anticipated.

8.4.26. The type and quantity of chemical waste that is anticipated to arise from the operation of the proposed Project is summarised in ***Table 8.2*** below. Other than the abovementioned chemical waste, oily substances will accumulate inside oil / petrol interceptors in the vehicle washing and repair / testing areas.

Table 8.2 Summary of Chemical Waste Arising from the Proposed Project

Chemical Type	Estimated Quantity
Used lubrication oil	10,000 L/year
Used batteries	800 nos./year
Non-halogenated solvents	1,500 L/year
Halogenated solvents	700 L/year
Acid waste	3,400 L/year

8.4.27. Provided that proper management procedures can be followed according to the Waste Disposal (Chemical Waste) (General) Regulation and the Code of Practice of the Packaging, Labelling and Storage of Chemical Waste, significant impacts such as potential hazard and spillage would not be anticipated.

8.4.28. All chemical waste arising from the operation of the proposed Project will be regularly removed and transported away by licensed collectors for subsequent disposal of at Tsing Yi Chemical Waste Treatment Centre or other licensed chemical waste disposal facilities.

8.5. MITIGATION MEASURES

Construction and Operation Phases

8.5.1. Adverse impact from waste management is not expected with the strict implementation of good site practices. Recommendations for good site practices during the construction activities include:

Good Site Practices

- The Contractor shall prepare a Waste Management Plan (WMP) in accordance with the requirements set out in the ETWB TCW No. 19/2005, Waste Management on Construction Site, for the Engineer's Representative approval. The WMP shall include monthly and yearly Waste Flow Tables that indicate the amounts of waste generated, recycled and disposed of (including final disposal site);

- The Contractor’s waste management practices and effectiveness shall be audited by the Engineer's Representative on regular basis;
- The Contractor shall provide training for site staff for the concept of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycling;
- The Contractor shall ensure sufficient waste disposal points and regular collection of waste;
- The Contractor shall use trucks with covering for the open-box bed and enclosed container shall be used to minimise windblown litter and dust during transportation of waste; The Contractor shall implement regular cleaning and maintenance programme for drainage systems, pumps and oil interceptors;
- Separation of chemical wastes for special handling and appropriate treatment at a Chemical Waste Treatment Facility (CWTF);
- Encourage collection of aluminium cans, paper and plastic bottles by providing separate labelled bins to enable these wastes to be segregated from other general refuse generated by the workforce;
- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;
- Wheel washing facilities shall be used by all trucks leaving the site to prevent transfer of mud onto public roads;
- Make provisions in contract documents to allow and promote the use of recycled aggregates where appropriate;
- No waste shall be burnt on-site;
- A recording system for the amount of wastes generated, recycled and disposed (including disposal sites) should be proposed;
- Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste; and
- Adequate numbers of portable toilets should be provided for on-site workers. Portable toilets should be maintained in reasonable states, which will not deter the workers form utilizing them. Night soil should be regularly collected by licensed collectors.

<u>C&D Materials / Waste</u>

- Use standard formwork or pre-fabrication as far as practicable so as to minimise the C&D Materials arising;
- Consider the use of more durable formwork or plastic facing for construction works;
- Avoid the use of wooden hoardings and substitute with metal hoarding to facilitate recycling;

- Purchase of construction materials should be carefully planned in order to avoid over-ordering and wastage;
- Establish a trip-ticket system in accordance with DevB TC(W) No. 6/2010 and Waste Disposal (Charges for Disposal of Construction Waste) Regulation in order to monitor the disposal of inert C&D Materials at public fill and the remaining C&D Waste to landfills, and control fly-tipping;
- Design foundation works to minimise the amount of excavated material to be generated;
- Sort construction debris and excavated materials on-site to recover reusable/recyclable portions (i.e. soil, broken concrete, metal, etc.) for backfilling and reinstatement;
- Segregate and store different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;
- Specify in design & build contract the use of recycled aggregates where appropriate;
- Plan and stock construction materials carefully to minimise the amount of waste to be generated and to avoid unnecessary generation of waste; and
- Recommend the use of metal fencing or building panels, which are more durable than wooden panels, for the erection of construction site hoarding.

Chemical Waste

- Chemical waste producers should be registered with the EPD;
- Chemical waste should be handled in accordance with the “Code of Practice on the Packaging, Handling and Storage of Chemical Wastes” including but not limited to the followings:
  - Good quality containers compatible with the chemical wastes should be used and maintained in good conditions and securely closed, with incompatible chemicals be stored separately.
  - Appropriate labels should be securely attached on each chemical waste container in English and Chinese according to the instructions prescribed in Schedule 2 of the Regulations.
  - A licensed collector to transport and dispose of the chemical wastes should be employed by the Contractor, to either the Chemical Waste Treatment Centre at Tsing Yi, or any other licensed facilities.
- Waste oils, chemicals or solvents should not be discharged to drain; and
- Routine cleaning and maintenance programme for drainage systems, sumps and oil interceptors during operation.

General Refuse

- Sufficient dustbins should be provided for storage of waste as required under the Public Cleansing and Prevention of Nuisances By-laws;
- Sufficient enclosed bins should be provided for general refuse, food and beverage waste to reduce odour, pest and litter impacts;
- General refuse arising on-site should be stored in enclosed bins or compaction units separately from C&D and chemical wastes;
- A reliable waste collector should be employed to clear general refuse from the construction site on a daily basis and disposed of to the licensed landfill or refuse transfer station;
- Office wastes can be reduced by recycling of paper if such volume is sufficiently large to warrant collection. Participation in a local collection scheme by the Contractor should be advocated; and
- Waste separation facilities for paper, aluminium cans, plastic bottles, etc. should be provided on-site and collected by individual collectors should be encouraged.

8.6. RESIDUAL IMPACTS

8.6.1. The proposed Project is likely to result in the generation of a variety of wastes and require management and disposal of C&D material, chemical waste and general refuse. However, the associated impacts are considered as temporary. Provided that different waste types are managed by implementing all the recommended measures, no unacceptable adverse environmental impacts arising from the handling, storage, transportation or disposal of the wastes generated by the proposed Project would be envisaged.

8.7. ENVIRONMENTAL MONITORING AND AUDIT

8.7.1. It is recommended that regular auditing by an Environmental Team should be carried out during the construction phase of the proposed Project to ensure waste are being managed with the appropriate procedures or practices in accordance to relevant legislation and waste management guidelines as well as those recommended in this EIA Report. The audits will examine all aspects of waste management including waste generation, storage, recycling, transport and disposal.

8.7.2. A WMP, as part of EMP, should be prepared in accordance with ETWB TC(W) No.19/2005 and submitted to the Project / Site Engineer for approval. The recommended mitigation measures should form the basis of the WMP. The monitoring and auditing requirement stated in ETWB TC(W) No.19/2005 should be followed with regard to the management of C&D Materials.

8.8. CONCLUSIONS

Construction Phase

8.8.1. The type, quantity and timing for the generation of waste during the construction phase have been assessed.

8.8.2. Building form and construction methods to minimise waste generation are adopted. Recommendations have been made for the Contractor for implementation of measures during the construction period to minimise waste generation and any off-site disposal.

8.8.3. Provided that the recommendations set out in this section are properly implemented, adverse residual impact is not anticipated during the construction phase of the proposed Project.

Operation Phase

8.8.4. The types and quantities of waste that will be generated during the operation phase have been assessed. Recommendations have been made to ensure proper handling, storage, collection, transportation and disposal of waste.

8.8.5. Provided that the recommendations set out in this section are properly implemented, adverse residual impact is not anticipated during the operation phase of the proposed Project.

9. LAND CONTAMINATION ASSESSMENT

9.1. INTRODUCTION

9.1.1. This section identifies the potential land contamination that may arise during construction and operation phases of the proposed Project. The potential environmental impacts associated with land contamination will also be assessed in accordance with the criteria and guidelines as given in Section 3.1 and 3.2 of Annex 19 of the EIAO-TM as well as clause 3.4.9 and Appendix E2 of the EIA Study Brief (No. ESB-267/2014).

9.2. RELEVANT ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

9.2.1. The following three EPD publications provide guidance in relation to land contamination assessment:

- Guidance Note for Contaminated Land Assessment and Remediation (Guidance Note);
- Guidance Manual for use of Risk-based Remediation Goals (RBRGs) for Contamination Land Management (Guidance Manual); and
- Practice Guide for Investigation and Remediation for Contaminated Land (Practice Guide).

9.2.2. The Guidance Note sets out the requirements for proper assessment and management of potentially contaminated sites, provides guidelines on how site assessment should be conducted and suggests remedial measures for the clean-up of contaminated sites.

9.2.3. The Guidance Manual presents the background of RBRGs and the application of RBRGs in land contamination assessment.

9.2.4. The Practice Guide presents the standard investigation methods and remediation strategies for the range of potentially contaminated sites and contaminants typically encountered in Hong Kong.

9.3. DESCRIPTION OF THE ENVIRONMENT

9.3.1. The proposed Project is planned to be constructed on a piece of land which is currently allocated as a works and staging area of the Drainage Services Department (DSD). It is surrounded by Sheung Tat Street to the northwest, the Sheung Mau Street to the southwest and Sheung On Street to the southeast.

9.3.2. Existing facilities nearby include the New World First Bus Chong Fu Road Permanent Depot (NWFB) to the northeast, ExxonMobil Petrol-cum-LPG Filling Station immediate to the southwest and Citybus Depot further to the southwest.

9.3.3. Based on the best available information at the time of the EIA study, no major change in the existing environmental condition is anticipated in the future in the absence of the proposed Project.

9.4. ASSESSMENT METHODOLOGY

9.4.1. The land contamination assessment was conducted with reference to the Practice Guide issued by EPD. The general procedures of the assessment include:

- Carrying out site appraisal (information collection);
- Designing site investigation and preparing Contamination Assessment Plan (CAP) for EPD's approval;
- Conducting site investigation;
- Interpreting results and preparing Contamination Assessment Report (CAR) for EPD's approval;
- Planning, designing remediation measures and preparing Remediation Assessment Plan (RAP) for EPD's approval; and
- Preparing Remediation Report (RR) for EPD's endorsement.

9.5. SITE APPRAISAL

9.5.1. A site appraisal had been conducted to review the existing and historical land uses that may impact the Project site in order to identify the potential contamination sources, if any, within the Project site and its surroundings due to past and current uses.

9.5.2. The following sources of information have been collected and reviewed to ascertain the potential on-site and off-site activities that can contribute to land contamination at the Project site:

- Aerial photographs from Lands Department (LandsD) taken twice every five years between 1975 – 2013;
- Acquisition of information related to potential land contamination from the Environmental Compliance Division of EPD, Fire Services Department (FSD), District Lands Office (DLO) and NWFB Depot;
- Ground investigation records near the Project site; and
- Records and photographs from site walkover.

Review of Site History

9.5.3. Historical aerial photographs from 1975 to 2013 (***Figure 9.1***) available in the Survey and Mapping Office at LandsD have been reviewed to identify the potential historical activities that could result in contamination of site.

9.5.4. Aerial photographs taken in 1975, 1979 and 1984 indicate that land reclamation of the Project site and other sites along Sheung On Street was still in progress.

9.5.5. Aerial photographs in 1989 and 1994 reveal that the Project site became temporary housing area. As indicated in the aerial photograph taken in 1999 and 2004, the temporary housing area was demolished and the Project site was further developed into a public carpark. The Project site has no undergone much change since then.

9.5.6. Land use summary from 1988 to present were also obtained from the DLO as shown in ***Table 9.1***. The development history of the Project site confirms with that shown in aerial photographs as discussed above. The Project site recently served as a temporary works and staging area for the DSD.

9.5.7. Record of land use history prior to 1988 at the Project site cannot be traced, as formal confirmed by the DLO and Port Works Division of the Civil Engineering and Development Department (CEDD). As discussed in *Section 9.5.4* above, land reclamation of the Project site and other sites on Sheung On Street was still in progress.

Table 9.1 Summary of Historical and Current Land Uses

Period	Previous / Existing Use
1984 - 1988	Land Reclamation in Progress(1)
1988 - 1997	Sheung On Temporary Housing Area (THA)
2001 - 2002	Temporary works area for road construction project in Chai Wan Reclamation Area
2003 - 2004	Fee-paying public car park
2005 - Present	Temporary works area for Drainage Maintenance and Construction in Hong Kong Islands and Islands Districts

Note:

[1] Refer to aerial photographs taken in 1975, 1979 and 1984

Review of Environmental Information from Local Authorities

9.5.8. Correspondences with local authorities regarding the past land use history in relation to any possible land contamination issue are provided in ***Appendix 9.1***.

9.5.9. Information regarding current and past registration of dangerous goods (DGs) records was requested from FSD for review. According to the information provided by FSD, there has not been record of dangerous goods storage within the Project site since 1990 and fire and special services incident in the past three years.

9.5.10. According to the information provided by the Environmental Compliance Division of EPD, there are no registered chemical waste producers at the Project site. Furthermore, no record of chemical spillage within the past 5 years has been identified.

9.5.11. As confirmed by New World First Bus Services Ltd., there has not been any land contamination issues arising from the adjacent NWFB Depot since it came into operation in 2001. A similar reply from New World First Bus Services Ltd. also confirmed that there has been no reported incident of land contamination caused by Citybus Depot since its operation in April 2004.

9.5.12. Written correspondences from EPD and FSD were obtained to confirm that no record of incidents of spillage / leakage of chemical and dangerous goods was found at the aforesaid ExxonMobil Petrol-cum-LPG Filling Station and nearby bus depots within the past 5 years.

9.5.13. Written reply from District Lands Office confirmed that the current user of the Project site, the Director of Drainage Services, is required to reinstate the Project site and hand back the Project site to the District Lands Office free of structure/debris and cleared of all occupation.

Review of Ground Investigation (GI) Records

9.5.14. Ground investigation (GI) was conducted in 1990 at a site approximately 100m to the northeast of the Project site which was further turned into NWFB Depot. A total of five vertical drill holes and two trial pits were drilled to study the general sequence of strata. The maximum depth of vertical holes drilled was 69.92m below ground level. According to the GI records, fill materials ranged in a thickness from 13m to 16m below ground level. Directly underneath the fill materials lie the marine deposit / alluvium. Copies of the drill holes and trial pit records are provided in ***Appendix 9.2***.

9.5.15. As no major earthworks are required for site formation works of the proposed Project, the anticipated amount of excavated materials to be generated is limited to topsoil only. In view of the above findings, it is expected that the construction phase of the proposed Project will not lead to any potential land contamination issue.

Site Walkover

9.5.16. Site walkover was carried out on 28th October 2013 at the Project site with the participation of an authorized representative from Welcome Construction Co., Ltd. (term contractor of DSD). Checklist of the site walkover is provided in ***Appendix 9.3***.

9.5.17. It was observed from the site walkover that the whole site was paved by concrete and the pavement was in good condition (no oil stains and cracks). There was parking of contract vehicles and storage of construction materials such as aggregate, drainage pipes, manhole covers, cement, milled asphalt, etc. No storage of diesel and oils except a few sealed containers of lubricant were identified within the site boundary during the site walkover. Designated waste disposal area for temporary storage of excavated materials from drainage maintenance works was also identified. Since the Project site was paved, infiltration of any oils / chemical from spillage / leakage incidents were found to be unlikely.

9.5.18. It is noteworthy that past environmental inspection records from DSD's term contractor revealed that there were temporary on-site storage of 2 to 3 drums of diesel / gasoline in the past at location as shown in ***Appendix 9.4*** for refilling plants and vehicles under very rare occasion. However, no crack / stain was observed and documented at the concerned storage area by DSD's term contractor. In addition, there has also been no record of chemical spillage / leakage at the Project site according to DSD's term contractor and local authorities as summarised in *Section 9.5.8* to *9.5.12* above. The potential land contamination issue attributed to the temporary storage of diesel/gasoline in the past is therefore not anticipated.

Conclusion from Site Appraisal

9.5.19. The site appraisal reveals that the present land use of the Project site is not anticipated to have caused spillage and leakage of chemical and dangerous goods, and the concrete-paved ground is expected to have minimised possible land contamination. Moreover, no potential contamination arising from the past activities at the site was identified. Therefore, it is concluded that subsequent soil and groundwater sampling and remediation at the construction phase (i.e. Step 3 to 6 of the land contamination assessment) is considered not necessary for the Project site in this EIA study.

9.6. PREVENTIVE MEASURES

9.6.1. Since no potential contamination arising from the past activities at the site was identified as mentioned in *Section 9.5*, mitigation measure is not required. Nonetheless, preventive measures are recommended to be implemented.

Potential Land Contamination Sources in Operation Phase

9.6.2. The Guidance Note identifies the following industries as having potential for causing land contamination:

- Oil installations (e.g. oil depots, petrol filling stations);
- Gas works;
- Power plants;
- Shipyard / boatyards;
- Chemical manufacturing / processing plants;
- Steel mills / metal workshops;
- Car repairing / dismantling workshop; and
- Scrap yards.

9.6.3. In view of the nature of the proposed Project, the potential sources of land contamination during operation are identified as follows:

- Vehicle washing bays;
- Vehicle repair / testing areas;
- DGs and chemical storage areas; and
- Chemical waste storage areas.

9.6.4. A total of approximately $20m^2$ designated areas will be provided to store DGs. The quantity of on-site storage of DGs due to daily operation of the GL Specialist Laboratory is as follows:

- DGs Category 2: 10 cylinders per month
- DGs Category 3: 20kg and 100L per month
- DGs Category 5 (Division 1): 160L per month
- DGs Category 5 (Division 2): 210L per month

Preventive and Precautionary Plan

Designated Storage Areas

9.6.5. Chemical waste will be stored in designated storage areas in accordance with EPD's Waste Disposal (Chemical Waste) (General) Regulation and Code of Practice on the Packaging, Labelling and Storage of Chemical Waste;

9.6.6. The proposed Project will be covered, except the landscape area on Level 1 and the roof floor, and properly paved by concrete. The storage area for liquid chemical waste containers should have an impermeable floor or surface made of suitable materials. The storage area should be kept clean and dry;

9.6.7. Where the storage area is not located within the premises in which chemical waste is produced, the storage area should be kept secured with an appropriate door/gate and locked at all time;

9.6.8. Containers should be checked for leakage or spillage before use; and

9.6.9. Drainage management system such as oil/petrol interceptors will be incorporated in the proposed Project for on-site treatment and removal of DGs, chemical and waste.

Procedures for Waste Disposal

9.6.10. Chemical wastes will be regularly removed from the proposed Project in accordance with Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. The contractor of the chemical waste treatment centre (CWTC) is expected to collect waste chemical from the laboratory on a weekly basis.

Emergency Procedures

9.6.11. Any spillage and / or leakage incident must be reported to the future operator of the proposed Project who should attend to the spillage and initiate any immediate actions required to protect workers and to confine and clean up the spillage.

Spillage / Leakage of Liquid Chemical / Waste at Storage Area

9.6.12. Where the spillage / leakage is contained in the enclosed storage area, the material should be transferred to suitable containers by appropriate equipment, e.g. hand-operated pumps, scoops or shovels. If the spillage / leakage quantity is small, it should be covered and mixed with suitable absorbing materials. The resultant slurry should be treated as chemical waste and transferred to suitable containers for disposal.

9.6.13. Areas that have been contaminated by chemical waste spillage/leakage should be cleaned. While water is a suitable solvent for aqueous chemical wastes and water soluble organic waste, kerosene or turpentine should be used for organic chemical wastes that are not soluble in water. The waste from the cleanup operation should be treated and disposed of as chemical waste.

9.6.14. In incidents where the spillage/leakage may result in significant contamination of an area or risk of pollution, the EPD should be informed immediately.

Spillage / Leakage at Other Areas

9.6.15. For spillage/leakage in other areas, immediate action is required to contain the spillage/leakage. Suitable liquid absorbing materials such as tissue paper, dry soft sand or vermiculite should be used to cover the spill. The resultant slurry should be treated as chemical waste and transferred into containers for proper disposal.

Record of Incidents

9.6.16. An incident logbook detailing the estimated amount of each spillage and / or leakage incident shall be compiled and maintained by future operator of the proposed Project. The incident logbook will be used to evaluate the corresponding environmental impacts arising from each specific spillage and / or leakage incident.

9.7. RESIDUAL IMPACTS

9.7.1. Since no significant land contamination impacts are predicted during the construction and operation phases of the proposed Project, adverse residual impacts will not be anticipated.

9.8. ENVIRONMENTAL MONITORING AND AUDIT

9.8.1. As the land contamination at the Site was identified to be insignificant during construction and operation phases with the implementation of good site practice and design, no EM&A for land contamination is recommended.

9.9. CONCLUSIONS

9.9.1. The land contamination assessment was undertaken by reviewing historical and current land uses and site reconnaissance. With reference to the findings of the site appraisal, there is no sign of land contamination due to past and current activities at the Project site.

9.9.2. The operation of the proposed Project is not anticipated to lead to quantifiable adverse land contamination impacts with proper site practice for handling, storage, transportation, collection and disposal of DGs, chemical and chemical waste.

9.9.3. However, since the construction works of the proposed Project will only commence in Mid 2016 the earliest, land contamination assessment and any necessary remediation work will be required to be carried out by the contractor if there is any sign of land contamination issue identified prior to or during the construction phase of the proposed Project. The land contamination assessment and associated remediation works must be in accordance with EPD publications as summarised in *Section 9.2*.

10. HAZARD TO LIFE ASSESSMENT

10.1. INTRODUCTION

General

10.1.1. The proposed Project comprises the construction of a new 6 storeys vehicle depot-cum-office building at Chai Wan for the Hong Kong Police Force (HKPF), Food and Environmental Hygiene Department (FEHD), Electrical and Mechanical Services Department (EMSD) and Government Laboratory (GL). Construction of the proposed Project will tentatively be commenced in period from Mid 2016 to Mid 2017, depending on the design process.

10.1.2. As stated in Clause 3.4.4 of the EIA Study Brief (No. ESB-267/2014), hazard assessments are required for the construction stage and operation stage of the proposed Project that associated with DG processes, storage facilities and any potentially hazardous sources in the neighbourhood of the proposed Project, including but not limited to the Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations, a LPG wagon parking site, NWFB Depot, Citybus Depot and the future DG stores in the proposed Project. The locations of the Project site and the hazardous sources are presented in ***Figure 10.1***.

Scope and Objectives

10.1.3. The Hazard to Life Assessment is prepared in accordance with the technical requirements as set out in Appendix B of the EIA Study Brief. The technical requirements are replicated below:

Construction Phase

10.1.4. The Applicant shall carry out hazard assessment to evaluate the risk to construction workers of the proposed Project due to the neighbouring DGs processing and storage facilities (including but not limited to Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations operated by ExxonMobil at Sheung Mau Road and Sinopec at Chong Fu Road respectively, LPG wagon parking site at junction of Sheung On Street and Sheung Ping Street, as well as any nearby potentially hazardous sources). The hazard assessment shall include the following:

(a) Identify hazardous scenarios associated with the neighbouring DG processing and storage facilities with a view to determining a set of relevant scenarios to be included in a Quantitative Risk Assessment (QRA);

(b) Execute a QRA of the set of hazardous scenarios determined in item (a), expressing population risks in both individual and societal terms;

(c) Compare individual and societal risks with the criteria for evaluating hazard to life stipulated in Annex 4 of the TM; and

(d) Identify and assess practicable and cost-effective risk mitigation measures.

Operation Phase

10.1.5. The Applicant shall carry out hazard assessment to evaluate the off-site population risk due to the operation of the proposed Project, and the on-site risk to project workers from neighbouring DG processing and storage facilities (including but not limited to Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations operated by ExxonMobil at Sheung Mau Road and Sinopec at Chong Fu Road respectively, LPG wagon parking site at junction of Sheung On Street and Sheung Ping Street, as well as any nearby potentially hazardous source). The hazard assessment shall include the following :

(a) Identify hazardous scenarios associated with the operation of the proposed Project, and the neighbouring DG processing and storage facilities (including but not limited to Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations operated by ExxonMobil at Sheung Mau Road and Sinopec at Chong Fu Road respectively, LPG wagon parking site at junction of Sheung On Street and Sheung Ping Street, as well as any nearby potentially hazardous source), with a view to determining a set of relevant scenarios to be included in a QRA;

(b) Execute a QRA of the set of hazardous scenarios determined in item (a), expressing population risks in both individual and societal terms;

(c) Compare individual and societal risks with the criteria for evaluating hazard to life stipulated in Annex 4 of the TM; and

(d) Identify and assess practicable and cost-effective risk mitigation measures.

10.1.6. The Applicant shall conduct cumulative risk assessment of DG to evaluate the risk due to operation of the proposed Project and the neighbouring DG processing and storage facilities (including but not limited to Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations operated by ExxonMobil at Sheung Mau Road and Sinopec at Chong Fu Road respectively, LPG wagon parking site at junction of Sheung On Street and Sheung Ping Street, as well as any nearby potentially hazardous source).

10.1.7. The methodology to be used in the hazard assessment shall be consistent with previous studies having similar issues. (e.g. NWFB Depot at Chai Wan, ESB-034/1999 and Proposed Headquarters and Bus Maintenance Depot in Chai Wan ESB-065-2001).

Risk Legislation and Guidelines

10.1.8. A Hazard Assessment shall be conducted for projects if, and only if, risk to life is a key issue with respect to Hong Kong Government Risk Guidelines as specified in Section 12 of the Environmental Impact Assessment Ordinance Technical Memorandum (EIAO-TM). The estimated risk levels of hazardous sources are compared with the risk guidelines stipulated in the EIAO-TM Annex 4 to determine the acceptability. As set out in the EIAO-TM Annex 4, the risk guidelines comprise the following two components:

10.1.9. **Individual Risk**: the maximum level of off-site individual risk should not exceed 1×10^{-5} / year, i.e. 1 in 100,000 per year.

10.1.10. **Societal Risk**: it can be presented graphically as in ***Figure 10.2***. The Societal Risk Guideline is expressed in terms of lines plotting the frequency (F) of N or more fatalities in the population from accidents at the facility of concern. In the figure, ALARP means As Low As Reasonably Practicable. Risk in this region should be mitigated to As Low As Reasonably Practicable.

10.2. HAZARD ASSESSMENT METHODOLOGY

Study Approach

10.2.1. A hazard assessment is conducted to evaluate:

- the risk to construction workers associated with the Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations, a LPG wagon parking site, as well as any nearby potentially hazardous sources;
- the risk to project workers in the proposed Project due to the Sinopec HK (Ex-CRC) Oil Terminal Chai Wan, two petrol-cum-LPG filling stations, a LPG wagon parking site, the DGs within the proposed Project, as well as any nearby potentially hazardous sources; and
- the risk to off-site population due to the operation of the proposed Project.

10.2.2. The methodology of the hazard assessment consists of the following tasks that are presented in ***Figure 10.3***:

- Data / Information Collection: collects relevant data / information which is necessary for the hazard assessment.
- Hazard Identification: identifies hazardous scenarios associated with the operation of the potentially hazardous sources and its associated facilities by conducting HAZID workshops with facilities operators and reviewing historical accident database, such as MHIDAS, and relevant similar studies. A set of relevant scenarios are then determined to be included in a hazard to life assessment.
- Frequency Assessment: assesses the likelihood of occurrence of the identified hazardous scenarios by reviewing historical accident data, previous studies or using Fault Tree Analysis. Event Tree Analysis is adopted to determine the possible outcome from the identified hazardous events and to estimate the frequencies.
- Consequence Assessment: establishes consequence assessment for every outcome developed from initial event by using internationally well recognised consequence model – PHAST in the SAFETI Package, to assess the impacts from gas leaks, fires, explosions, toxicity and other process hazards.
- Risk Assessment: evaluates the risks level, in terms of individual risk and societal risk, associated with the identified hazardous scenarios. The overall risk level is compared with the criteria as stipulated in Annex 4 of the TM to determine their acceptability. Mitigation measures will be identified where the risk is considered in the ALARP (As Low As Reasonably Practicable) region or above. The reduction in

risk achievable by these means will then be quantified. The cost-effectiveness and the practicable of these measures will also be assessed.

10.2.3. The construction of the proposed Project will tentatively be commenced in period from Mid 2016 to Mid 2017 depending on the design process and will last for about 29 months. The hazard assessment covers five scenarios as listed below:

- Case 1 – Construction Stage in Year 2016 without construction workers. This case aims to assess the risk to the surrounding population in Year 2016 that acts as the baseline to Case 2;
- Case 2 – Construction Stage in Year 2016 with construction workers. This case studies the risk impact on the construction workers of the proposed Project;
- Case 3 – Operation Stage in Year 2018 without Project workers. To study the risk to the future population in Year 2018 due to potential hazardous sources;
- Case 4 – Operation Stage in Year 2018 with Project workers only. To study the risk to the proposed Project population only in Year 2018 due to the potential hazardous sources; and
- Case 5 – Operation Stage in Year 2018 with Project workers and all off-site population. It determines the accumulated risk to the future population due to all potential hazardous sources and the DG stores in the proposed Project.

Data / Information Collection

10.2.4. The Project site is located at Chai Wan and is currently allocated as a works and staging area by the Drainage Services Department (DSD). The neighbouring lands of the Project site are mainly government institutes, outdoor car parks and industrial buildings. The nearest residential building is around 160 m from the Project site.

10.2.5. Besides the potential hazardous sources mentioned in Section 3.4.4.2 of the EIA Study Brief, two bus depots adjacent to the Project site are also identified due to the possible hazards arose from handling and transferring of diesel for bus maintenance works. ***Table 10.1*** below lists out the potential hazardous sources to be assessed.

Table 10.1 List of Potential Hazardous Source

Potential Hazardous Source	Location
Sinopec HK Oil Terminal Chai Wan	Chong Fu Road
Sinopec Petrol-cum-LPG Filling Station	Chong Fu Road
ExxonMobil Petrol-cum-LPG Filling Station	Sheung Mau Road
LPG Wagon Parking Site	At the junction of Sheung On Street and Sheung Ping Street
Diesel Storage in NWFB Depot	At the junction of Chong Fu Road and Sheung On Street
Diesel Storage in Citybus Depot	Shing Tai Road
DGs Storage in the Proposed Project	Sheung On Street

10.2.6. The following data / information is collected:

- Details of the potential hazardous sources:
- Population
- Meteorological data
- Source of ignition
- Construction and operation activities

Sinopec HK Oil Terminal Chai Wan

10.2.7. The Sinopec HK Oil Terminal Chai Wan is about 170m to the north of the Project Site. According to the site surveys conducted by the Consultants in July 2014, September 2014 and February 2015, the oil terminal was under maintenance and there was temporarily no schedule to resume operation. Nevertheless, it is assumed that the oil terminal will be in full operation during the construction and operation of the proposed Project in this study.

10.2.8. The oil terminal consists of the storage of diesel oil, kerosene and LPG cylinder storage as well as bulk filling of diesel oil according to the previous EIA report *New World First Bus Permanent Depot at Chai Wan* (AEIAR-029/2000) (hereinafter referred as the New World Depot EIA), the following table summarizes the details of the facility according to the report:

Table 10.2 Details of Sinopec HK Oil Terminal Chai Wan

Item	Description	
Fuel Storage	Automotive diesel oil (ADO)	Max. Capacity: 1000m^3 per tank (2 tanks)
	Industrial diesel oil (IDO)	Max. Capacity: 1000m^3 per tank (2 tanks)
	Kerosene	Max. Capacity: 500m^3 (1 tank)
	LPG (in cylinder)	Max. Capacity: 12 tonnes
Site Dimension	Approximate 55m × 54m	
Bund Wall Dimension	Approximate 25m × 25m × 2m	
Fuel Transport	ADO, IDO and kerosene by barges LPG cylinders by trucks	
Fire Wall	150mm thick and 2.5m high R.C wall	
Fire Fighting System	Manual operated foam injection and water spray at top of tanks	
Bulk Filling Operation	ADO / IDO filling for road tanker, 6000 visits per year	
	IDO and kerosene filling for drum truck, 60 visits per day	

10.2.9. The information listed in ***Table 10.2*** above refers to the situations in 1999, further updates are therefore required in order to reflect the current status of the oil terminal. An information request package has been issued to Sinopec (Hong Kong) Ltd. to collect up-to-date information, which includes any change in the fuel storage type and capacity, as well as the size and frequency of fuel barge for unloading.

10.2.10. The most obvious change to the oil terminal when comparing the current layout to that in 1999, is the inclusion of a petrol-cum-LPG filling station and the demolition of one side wall for access from the Chong Fu Road. An underground LPG vessel is presumed to be installed in the oil terminal area according to the site surveys.

10.2.11. Fire Services Department (FSD) has also been consulted to acquire the information about the DG licence holding by the oil terminal.

10.2.12. It is however due to the sensitivity of the data, information requests from both Sinopec (Hong Kong) Ltd. and FSD were turned down. The data adopted for the hazard assessment on the Sinopec HK Oil Terminal Chai Wan in this study is therefore based on the New World Depot EIA with justifications.

<u>Sinopec and ExxonMobil Petrol-cum-LPG Filling Station</u>

10.2.13. The Sinopec and ExxonMobil Petrol-cum-LPG Filling stations are around 170 m to the north and 20m to the southwest of the Project site respectively.

10.2.14. The following information is necessary for the study:

- Layout plan of the LPG filling station;
- Number of underground LPG vessel and its capacities;
- Number of road tanker per day for unloading;

- Number of LPG vehicles per day; and
- Safety provision and firefighting system.

10.2.15. Information requests have been made to Sinopec (Hong Kong) Ltd. and ExxonMobil Hong Kong Limited to collect the aforementioned information for this study. Given the sensitivity of the operation data, both Sinopec and ExxonMobil did not provide the information required.

10.2.16. Three site surveys were conducted in July 2014, September 2014 and February 2015 to collect operation information of the two filling stations. For information not able to obtain directly through visual inspection, such as size and quantity of underground vessel, assumptions are made based on the best available information.

10.2.17. It is assumed that the underground LPG vessel to be filled up to a maximum level of approximately 85% (12 tonnes × 0.85 = 10.2 tonnes) and LPG will be delivered by a 9 tonne road tanker.

10.2.18. A summary of the data collected and the assumptions made are presented in ***Table 10.3*** below.

Table 10.3 Details of Sinopec and ExxonMobil Petrol-cum-LPG Filling Station

Item	Data Collected / Assumption	
	Sinopec Filling Station	ExxonMobil Filling Station
LPG vessels	Assume 1 × 12 tonnes vessel	Assume 2 × 12 tonnes vessel
LPG dispensers	2 × LPG dispensers	4 × LPG dispensers
Vehicles refuelling	44 LPG vehicles and 5 non-LPG vehicles per hour during peak hour	86 LPG vehicles and 34 non-LPG vehicles per hour during peak hour
LPG road tanker delivery [1]	1.7 tankers per day deduced from number of LPG vehicles refuelling	3.2 tankers per day deduced from number of LPG vehicles refuelling
Petrol road tanker delivery [2]	0.5 tankers per day deduced from number of non-LPG vehicles refuelling	1.7 tankers per day deduced from number of non-LPG vehicles refuelling
Petrol/diesel vessels	Assume 2 × 22,750L vessels	4 × 22,750L vessels[3]
Petrol/diesel dispensers	2 x petrol/diesel dispensers	4 x petrol/diesel dispensers

Note [1]: Assume each LPG taxi is refueled with 75% of a 109L fuel tank. And there are 2 peak hours during day and night time per day. The LPG vehicle handling volume at non-peak hour is 25% of that of peak hour. Each road tanker is fully loaded with 9 tonnes of LPG.

Note [2]: Assume each petrol vehicle consumes 40L[1]. And there are 12 peak hours in day time. The petrol vehicle handling volume at non-peak hour is 25% of that of peak hour (i.e. night time). Each petrol road tanker is fully loaded with 9 tonnes of petrol. Density of petrol is 0.75kg/L.

Note [3]: Information according to FSD

1 Kai Tak Development, Civil Engineering and Development Department, AEIAR-130/2009

<u>LPG Wagon Parking Site</u>

10.2.19. The following information is collected:

- Number of LPG cylinder stored at the site; and
- Size of each LPG cylinder stored at the site.

10.2.20. The outdoor LPG wagon parking site at the junction of Sheung On Street and Sheung Ping Street is one of the designated parking spaces available for parking cylinder wagons[2]. The parking site is approximately 300 m from the Project site.

10.2.21. The site is under a short term tenancy issued by the Lands Department (LandsD) and is at the same time overseen by the Gas Authority of EMSD. According to phone conversations with EMSD and Lands Department, there is no limit on the number of vehicles allowed in the site.

10.2.22. According to a site survey conducted in July 2014, there were 3 LPG cylinder wagons at the site and the area should be able to hold approximate 12 cylinder wagons at maximum. Each cylinder wagon was stored with approximate 150 to 250 number of 10.5kg domestic use LPG cylinders inside the cargo compartment. There were no indications on whether the LPG cylinders were filled or empty.

10.2.23. A fuel road tanker was also found parking at the site together with the LPG cylinder wagons. In a site survey conducted in February 2015, it was confirmed that the road tanker contained kerosene and diesel products for bulk transport purpose.

10.2.24. The parking site is an open space that is segregated from an outdoor car park and streets by corrugated steel sheets. There is no formal firefighting system except a fire extinguisher which was placed within the parking site according to the site survey.

<u>Diesel Storage in NWFB Depot and Citybus Depot</u>

10.2.25. The following information is collected:

- Number and storage capacities of diesel storage tanks;
- Number of road tankers per day;
- Number of vehicles refuelled per day; and
- Length of diesel distribution pipework.

10.2.26. The New World Depot EIA[3] has assumed 6 number of 22,500 L underground tanks for diesel storage and a total of 72,000L diesel delivery per day by 4 road tankers.

[2] Government News Archives, Parking spaces for vehicles carrying cylinder liquefied petroleum gas, 2010, http://www.info.gov.hk/gia/general/201004/28/P201004280178.htm
[3] New World First Bus Services Limited, New World First Bus Permanent Depot at Chai Wan, AEIAR-029/2000

10.2.27. An information request was made to the NWFB / Citybus to collect the operation data for this study in July 2014. ***Table 10.4*** below listed out the data of the bus depots according to the reply from both depot operators.

Table 10.4 Operation Data of NWFB and Citybus Depots

Item	Data Received	
	Citybus Depot	NWFB Depot
Size of underground tank	45,460L	22,500L
Tank max. filling percentage	93%	50%
No. of underground tank	4	10
Size of road tanker	16,000L	16,000L
Max. no. of road tanker per day	4	5
Duration of unloading	30 minutes	60 minutes
Tanker filling hose size	3 inches	3 inches
Bus refuelling rate per day	300	470
Duration of refuelling	70 seconds	80 seconds
Bus filling hose size	1 inch	1.5 inch
Equipped with firefighting system, isolation valves and ESD	Yes	Yes (Fire drencher, fire extinguisher, ESD, hose reel and sand bucket)
Any planned modification or development of the proposed Project	No	No

10.2.28. Information was received from the FSD on the DG licenses in the Citybus Depot and NWFB Depot. Other than diesel, other DGs were licensed for the DG stores of NWFB Depot as shown in ***Table 10.5*** below:

Table 10.5 Dangerous Goods License of NWFB Depot

Item	Quantity	Storage Method
Methyl Ethyl Ketone Peroxide (Cat. 10)	176 L	DG store on 1/F
Lacquer Thinner (Cat. 5)	216 L	DG store on 1/F
Acetone (Cat. 5)	251 L	DG store on 1/F
Paint (Cat.5)	704 L	DG store on 1/F
Sulphuric Acid (Cat. 3)	360 L	DG store on 1/F
Oxygen (Cat.2)	6.8 m^3 × 12 cylinders	DG store on 1/F
Acetylene	6.2 m^3 × 12 cylinders	DG store on 1/F
Refrigerant	1.75 m^3 × 8 cylinders	DG store on 1/F

Dangerous Goods Storage in the Proposed Project

10.2.29. The proposed Project is located at the junction of Sheung On Street and Sheung Mau Street. The following data regarding the DG storage are provided based on the estimation provided by the Project Team:

- There is no planned DG storage for the HKPF and FEHD; and
- DG stores are planned for the EMSD and GL that will have chemical waste, Cat. 2, Cat. 3 and Cat. 5 materials etc.

10.2.30. ***Table 10.6*** below presents the planned quantity of DGs in the future DG stores estimated by the Project Team:

Table 10.6 Dangerous Goods and Planned Quantities

Item	Planned Quantity	Planned Area
Waste Oil	6 × 200L	NA
DGs Cat. 2	10 cylinders	4m^2
DGs Cat. 3	20kg and 100L	4m^2
DGs Cat. 5 (Division 1)	160L	4m^2
DGs Cat. 5 (Division 2)	210L	4m^2
Battery	2000kg (Approx. 200 units)	9m^2

10.2.31. Other than the type and quantity of DGs in the DG stores, the following information are also collected and considered in the study:

- The configuration and operation of ventilation / exhaust gas system such as the presence of scrubber system and emergency shut down;
- Firefighting system; and
- Emergency response plan.

10.2.32. Hazard identification (HAZID) workshops were carried out in August 2014 with the ArchSD, HKPF, EMSD and GL to understand the standard handling procedure of DGs and normal operation activities in the existing facilities to identify the potential hazards involved. The meeting minutes and the identified hazards identified from the HAZID workshops are included in ***Appendix 10.3***.

Population Data

10.2.33. The Project site is located at Chai Wan. The nearest residential building is 160 m away from the boundary of the Project site. Most of the neighbouring developments are industrial buildings and outdoor car parks that the lands are either classified as Governmental, Institution or Community (GIC), Open Space (O) or Other Specified Uses (OU).

10.2.34. The New World Depot EIA that studied the risks associated with the Sinopec HK Oil Terminal Chai Wan did not specify the study area. On the other hand, the Citybus Depot EIA that studied the ExxonMobil Petrol-cum-LPG Filling Station has specified a 150 m radius study area. In this assessment, a study area of 225 m radius will be adopted for petrol-cum-LPG filling stations according to the worst consequence distance. The study areas considered are illustrated in ***Figure 10.4***.

10.2.35. For oil terminal and wagon parking site, the study areas will be determined based on the hazard distance of the worst case scenarios. The determination of hazard distances is further explained in *Section 10.4*.

10.2.36. Population to be considered in this study includes residential population, employment in commercial / industrial buildings and population using car park and playground, etc., whenever the area falls within the study areas.

10.2.37. Population data is obtained from statistic published by the Government as well as information request to the premises operators whenever applicable. Where official information is unavailable, population will be estimated based on site survey undertaken by the consultants.

- For residential buildings, figures are based on 2011 Population Census from the Census and Statistic Department. For those areas not covered by Population Census, figures are estimated from average household size using data of 2011 Territorial Population and Employment Data Matrices (TPEDM);
- Information on future development in the vicinity of the Project site is collected from Planning Department (PlanD);
- For schools, kindergartens and elderly homes, information is collected from the Education Department, Social Welfare Department and corresponding websites;
- For outdoor car parks and playgrounds, populations are estimated by surveys undertaken by the consultants; and
- For number of construction workers involved in the construction of the proposed Project, a maximum of 100 workers is assumed to work simultaneously during day time as estimated by the Project Team using a similar scale project.

10.2.38. This Hazard to Life Assessment assesses the risks in the construction (Year 2016) and operation stage (Year 2018) of the proposed Project. An average annual growth rate of -0.2% is obtained from the proposed Projection of Population Distribution 2013 – 2021[4], a zero growth rate in residential population between 2014 and 2018 will be assumed as a conservative approach. For employment population, the growth rate is calculated by considering the employment in the PDZ No. 34 of the 2011 TPEDM in between 2011 and 2021. The growth rate in between 2014 and 2016 is 0.3% and that in between 2016 and 2018 is 2.5%.

[4] Planning Department, Projection of Population Distribution 2013 – 2021

10.2.39. Traffic population in Year 2018 is estimated from the traffic flow in accordance with the traffic forecast conducted by Traffic Consultant and endorsed by Transport Department (TD). The traffic population is calculated using the following equation:

$$\text{Traffic Population (ppl)} = \frac{\text{Traffic Flow }(\text{vehicle}/\text{hr}) \times \text{ppl}/\text{vehicle}}{\text{Speed }(\text{km}/\text{hr})} \times \text{Road length (km)}$$

10.2.40. The traffic data is extracted from the traffic assessment and presented in ***Appendix 10.1***. The traffic flows of the road in “am” and “pm” are taken as the sum of maximum flows in day time and night respectively in both bounds.

10.2.41. The number of people per vehicle is estimated from the Coverage (B) Station No. 2215 Island Eastern Corridor in accordance with the Annual Traffic Census 2013.

10.2.42. Since the traffic flow is expected to increase from 2016 to 2018 due to the proposed Project, the traffic population in Year 2016 is conservatively taken as the same as that of Year 2018. For the details of calculation, they are shown in ***Appendix 10.1***.

10.2.43. For pedestrian population on the roads in the vicinity of the potentially hazardous sources, a conservative number of 50 people are assumed for each road based on the estimation from a site survey that there were around 10 people on the road.

10.2.44. For the section of MTR train falls into the study area, the population is calculated according to the information provided by the MTRC. The information provided and the calculations of MTR population are shown in ***Appendix 10.2***.

10.2.45. A presence factor is considered for different types of buildings to account for occupancies during different times of the day. References are made to the HATS2A EIA[5], Kai Tak Development EIA[6] and other EIAs approved by the EIAO. For open space areas, population are estimated based on site observation.

10.2.46. Site specific presence factors are adopted according to the population data given by the site premises operator such as the NWFB Depot and the proposed Project through information request.

10.2.47. Time period of the day will be divided into 4 sections, namely daytime and nighttime for both weekday and weekend to reflect temporal distribution of population. The temporal changes in population for different population categories are shown in ***Table 10.7*** below.

[5] Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment, Drainage Services Department, Hong Kong, AEIAR-121/2008

[6] Comprehensive Feasibility Study for the Revised Scheme of South East Kowloon Development EIA, Territory Development Department, Hong Kong, AEIAR-044/ 2001

Table 10.7 Temporal Changes in Population

Category	Time Period			
	Weekday Day (Mon-Fri 0700-1900 hrs)	**Weekday Night (Mon-Fri 1900-0700 hrs)**	**Weekend Day (Sat-Sun 0700-1900 hrs)**	**Weekend Night (Sat-Sun 1900-0700 hrs)**
Commercial[2]	100%	10%	40%	5%
Industrial[2]	100%	10%	40%	5%
Residential[2]	25%	100%	70%	100%
Recreational[2][3]	50%	5%	100%	5%
Car Park[1]	100%	10%	50%	10%
School[4]	100%	1%	100%	1%
Cargo Working Area[1]	100%	10%	100%	10%
Bus Depot[5]	100%	10%	100%	10%
Govt. Complex[5]	100%	19%	40%	18%
Govt. Logistics Centre[5]	100%	13%	50%	13%
EMSD Workshop[5]	100%	18%	100%	18%

Note:

[1] Based on site survey and judgment.

[2] Reference to HATS Stage 2A EIA.

[3] Reference to SEKD CFS EIA.

[4] Reference to CKR EIA[7].

[5] Based on information request.

10.2.48. An indoor ratio of 95% will be applied to the population in residential, commercial buildings and in schools considering the presence of outdoor activities. Passengers in vehicles on the roads and in trains of railway will be considered as 100% outdoors although vehicles and trains may provide certain protection. Population in the car park and the open leisure space will be considered as 100% outdoors. The populations identified are shown in ***Table 10.8***.

[7] Central Kowloon Route Environmental Impact Assessment, Highways Department, AEIAR-171/2013

Table 10.8 Population Data

ID	Description	Category	Population 2014	Population 2016	Population 2018	Indoor Fraction	No. of Storey	Remarks
1	Heng Fa Chuen Block 48, 49, & 50	Residential	1523	1523	1523	95%	22	2011 Population Census as per Centamap. 2538 for Block 46-50. Assume population is evenly distributed between 5 blocks.
2	Heng Fa Chuen Playground	Recreational	99	99	99	0%	0	An open space with an area of 9815 sq.m according to Outline Zoning Plan. Assume a density of 0.01 sq.m as per EIA-059/2001.
3	Seawater Pump House	Industrial	0	0	0	95%	1	Assume unmanned operation
4	Sinopec HK Oil Terminal Chai Wan	Industrial	20	21	23	95%	0	A conservative assumption
5	Sinopec Petrol-cum-LPG Filling Station	Filling Station	5	6	7	95%	0	A conservative assumption
6	Waste Recycling Workshop	Workshop	10	11	12	10%	0	Less than 5 people as per site inspection Assume 10 people as a conservative approach
7	Paper Recycling Workshop	Workshop	10	11	12	10%	1	Less than 5 people as per site inspection Assume 10 people as a conservative approach
8	Government Logistics Centre	Commercial	125	145	145	95%	17	In 2015, 110 staff + 15 visitors during day time and 5 security guards during night time. The Printing Division of GLD will move in but number of workers is not known. Assume 20 staff during day time and 1 staff during night time coming from this division. In 2018, 130 staff + 15 visitors during day time, 6 staff during night time. Information obtained from Governmental Logistic Department.

ID	Description	Category	Population 2014	Population 2016	Population 2018	Indoor Fraction	No. of Storey	Remarks
9	Car Park A	Car Park	37	37	37	0%	0	Approximate 120 parking slots as per site inspection Assume maximum 30% of car owners appear at the same time Assume 1 person per vehicle and 1 security guard
10	HKE Heng Fa Chuen Substation	Industrial	2	3	4	95%	7	The station is normally unmanned as per information from HKE. Assume 2 maintenance staff for emergency works.
11	Vacant Site	Others	0	0	0	10%	0	Current population as per site inspection. There is no information on future development.
12	NWFB Depot	Bus Depot	590	594	624	95%	5	As per information from NWFB
13	Construction Site / proposed Project	Commercial / Govt. Complex	50	100	240	10% / 95%	1 / 6	Currently a construction site occupied by Contractors of DSD Project. The proposed Project will begin construction in 2016 and operated in 2018. No. of construction workers in 2016 is assumed to be 100. Population data in the proposed Project in 2018 is according to information of Project Team.
14	ExxonMobil Petrol-cum-LPG Filling Station	Filling Station	20	21	23	0%	1	As per site inspection.
15	Citybus Depot	Bus Depot	350	353	371	95%	7	As per information from Citybus.
16	Planned THEi New Campus	Educational	123	4960	4960	95%	1	Currently a construction site. A Technological and Higher Education Institute of Hong Kong is planned to be operated in 2016. Information obtained from VTC.

ID	Description	Category	Population 2014	Population 2016	Population 2018	Indoor Fraction	No. of Storey	Remarks
17	Chai Wan Public Cargo Working Area Marine Department	Workshop	50	51	54	10%	0	Around 30 people working as per site survey Assume 50 people as a conservative approach
18	Hong Kong Institute of Vocational Education (Chai Wan)	Educational	5794	6227	6701	95%	8	According to VTC's website, there are 39622 full time students and 13291 part time students in 10 HKIVE schools in Year 2012. Assume number of student is equal among 10 schools, there were 5291 students in day time and 1329 students in night time in Year 2012. Assume 100 staff and an annual growth rate of 3.7% in the number of student. http://statistics.vtc.edu.hk/index.jsp
19	Knight Court	Residential	300	300	300	95%	25	Comprised 2 blocks with 25 floor each and there are 2 flats per floor Household size from TPEDM 2011: 3.0
20	MTR Chai Wan Depot	Industrial	100	101	107	95%	1	According to information received from MTRC
21	EMSD Workshop	Industrial	85	86	0	95%	1	Information according to approved EIA-202/2012: The operation time of the workshop is 0800 to 2100 Daily in/out traffic is 50 no. of vehicles and no. of staff in day time is 40, night time is 10 Tentative completion of operation is 2017 Assume 1 person per vehicle to be repaired and 45 no. of vehicles in day time and 5 no. of vehicles in night time for repair
22	Car Park B	Car Park	37	37	37	0%	0	Approximate 120 parking slot as per site inspection Assume maximum 30% of car owners appear at the same time Assume 1 person per vehicle and 1 security guard

ID	Description	Category	Population 2014	Population 2016	Population 2018	Indoor Fraction	No. of Storey	Remarks
23	Car park / Planned LCSD Pet Garden at Sheung On Street	Car Park / Recreational	10	16	16	0%	0	Currently a LPG wagon parking site and car park. A pet garden is planned to commence construction in 2015 by LCSD. Assume it will come into operation in 2018. Approximate site area is 1551 square meter. Assume 0.01 ppl/sq.m as per EIA-059/2001.
24	Chai Wan Industrial City, Phase II	Industrial	1873	1885	1980	95%	22	Floor area is approximate 1703 sq. meter each floor. http://www.sino-industry.com.hk/en/our-properties/chai-wan-industrial-city-phase-ii/ Population estimated according to HKPSG's Business Use worker density of 20 sq. meter/worker"
25	Chai Wan Industrial City, Phase I	Industrial	1902	1914	2010	95%	22	Floor area is approximate 1730 sq. meter each floor. http://www.sino-industry.com.hk/en/our-properties/chai-wan-industrial-city-phase-i/ Population estimated according to HKPSG's Business Use worker density of 20 sq. meter/worker"
26	Cornell Centre	Industrial	1390	1399	1469	95%	22	Floor area is approximate 1265 sq. meter each floor. http://www.sino-industry.com.hk/en/our-properties/cornell-centre/ Population estimated according to HKPSG's Business Use worker density of 20 sq. meter/worker"
27	Tsui Hong House, Tsui Wan Estate	Residential	1821	1821	1821	95%	31	2011 Population Census as per Centamap.
28	Tsui Shou House, Tsui Wan Estate	Residential	1758	1758	1758	95%	31	2011 Population Census as per Centamap.

ID	Description	Category	Population 2014	Population 2016	Population 2018	Indoor Fraction	No. of Storey	Remarks
29	Tsui Fuk House, Tsui Wan Estate	Residential	1912	1912	1912	95%	31	2712 people in Tsui Fuk House and Tsui Lok Estate as per 2011 Population Census There are 800 people in Tsui Lok Estate in 2014 as per HKHA website
30	Playground	Recreational	60	60	60	0%	0	Less than 20 people as per site survey Take 60 people in weekday as a conservative number
31	Hang Tsui Court Indoor Carpark	Residential	48	48	48	95%	6	153 parking slot as per site survey Assume 1 persons per car Assume maximum 30% of occupants appear at the same time Plus 2 security guards
32	Hang Tsui Court	Residential	2101	2101	2101	95%	34	2011 Population Census as per Centamap
33	TWGHs & LKWFSL Mrs Fung Yiu Hing Memorial Primary School	School	0	0	0	95%	1	The school is currently abandoned as per site survey The premises is reserved for educational purpose according to newspaper
34	Chai Wan Faith Love Lutheran School	School	367	367	367	95%	1	12 classes and 26 teachers as per Primary School Profile 2013 Assume 15 other staff Average class size in primary school is 27.1 in 2013 according to Education Bureau http://applications.chsc.hk/psp2013/sch_detail5.php?lang_id=2&sch_id=42
35	Chong Fu Road	Road	55	55	55	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast
36	Sheung Tat Street	Road	52	52	52	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast

ID	Description	Category	Population 2014	Population 2016	Population 2018	Indoor Fraction	No. of Storey	Remarks
37	Sheung Mau Street	Road	53	53	53	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast
38	Shing Tai Road	Road	80	80	80	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast
39	Sheung On Street	Road	58	58	58	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast
40	Sheung Ping Street	Road	52	52	52	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast
41	Wing Tai Road	Road	107	107	107	0%	0	50 pedestrian + population estimated from Traffic Flow Forecast
42	MTR Island Line	Railway	163	187	214	0%	0	Based on the information provided by MTRC

Notes:

[1] An annual growth rate of residential population is -0.2% for Eastern District between 2011 and 2021 referring to Table 5 of Projections of Population Distribution 2013-2021. As a conservative approach, it is assumed the population is identical between 2011 and 2018.

[2] For growth rate of primary schools, it shows a decreasing trend of the number of students in Year 2008 to 2014 according to Education Bureau website. As a conservative approach, it is assumed the number of students per class remains the same between 2014 and 2018.

[3] Employment population growth rates of 0.3% (2014-2016) and 2.5% (2016-2018) per year are estimated by interpolation of employment population data of 2011 and 2021 that are given in TPEDM 2011 Table 9.

[4] Annual growth rate of 6.9% is estimated from MTRC's Annual Report 2013. Details in Appendix 10.2.

Meteorological Data

10.2.49. Meteorological data is required for consequence modelling and risk calculation. Consequence modelling (i.e. dispersion modelling) requires wind speed and stability class to determine the degree of turbulent mixing potential whereas risk calculation requires frequencies for each combination of wind speed and stability class. The meteorological data from the North Point Weather Station in 2013 has been adopted in this assessment. The data are rationalised into a set of weather classes in accordance with TNO purple book[8] for daytime and night-time, and can be expressed in combination of wind speed and Pasquill stability classes. Pasquill stability classes (A to F) represent the atmospheric turbulence with Class A being the most turbulent class while Class F being the least turbulent class. The 6 most dominant sets of wind speed-stability classes combination for both daytime and nighttime are identified and the occurrence probability of each weather class is summarised in ***Table 10.9*** and ***Table 10.10***. The average ambient temperature adopted in the analysis is 23°C and relative humidity is 78%.

Table 10.9 Daytime Weather Condition

Wind Direction	3.5B	1.5D	4.0D	7.0D	2.5E	1.5F	Total
0	2.46	0.32	1.07	0.07	0.57	2.81	7.30
30	1.07	0.17	0.70	0.05	0.25	0.17	2.41
60	4.13	0.45	2.14	0.57	0.52	0.47	8.28
90	31.41	1.57	15.27	7.21	2.61	1.54	59.61
120	1.12	0.50	0.30	0.00	0.22	0.70	2.84
150	0.12	0.05	0.05	0.00	0.00	0.00	0.22
180	0.12	0.07	0.00	0.00	0.00	0.02	0.21
210	0.67	0.10	0.00	0.00	0.00	0.02	0.79
240	4.53	0.37	1.14	0.05	0.27	0.37	6.73
270	6.39	0.52	1.37	0.25	0.45	0.72	9.70
300	0.27	0.07	0.05	0.00	0.02	0.17	0.58
330	0.52	0.17	0.22	0.00	0.12	0.22	1.25
Total	**52.81**	**4.36**	**22.31**	**8.2**	**5.03**	**7.21**	**99.92**

[8] Guidelines for Quantitative Risk Assessment "Purple Book", CPR18E, Committee for the Prevention of Disasters, 2005

Table 10.10 Nighttime Weather Condition

Wind Direction	3.5B	1.5D	4.0D	7.0D	2.5E	1.5F	Total
0	0.00	0.02	1.59	0.00	1.90	11.99	15.50
30	0.00	0.00	0.87	0.05	1.23	0.91	3.06
60	0.00	0.00	3.56	0.46	2.12	2.48	8.62
90	0.00	0.00	24.52	7.20	11.84	8.95	52.51
120	0.00	0.00	0.43	0.00	1.37	3.20	5.00
150	0.00	0.00	0.00	0.00	0.10	0.19	0.29
180	0.00	0.00	0.00	0.00	0.02	0.10	0.12
210	0.00	0.00	0.05	0.00	0.10	0.34	0.49
240	0.00	0.00	1.52	0.17	1.28	2.45	5.42
270	0.00	0.00	2.21	0.19	2.24	2.50	7.14
300	0.00	0.00	0.12	0.00	0.10	0.19	0.41
330	0.00	0.00	0.26	0.00	0.51	0.67	1.44
Total	**0.00**	**0.02**	**35.13**	**8.07**	**22.81**	**33.97**	**100.00**

Source of Ignition

10.2.50. The presence of ignition sources in the study area is a primary concern in case of flammable gas release. Ignition sources other than on-site one, such as dwellings and vehicles along carriageways, contribute to delayed ignition in Vapour Cloud Explosion (VCE) and flash fire. The energy level, timing, location of ignition sources in the vicinity of the hazardous sources and hence the probability of ignition of gas cloud are reviewed and assessed.

10.2.51. Major ignition source is the surrounding road network. Traffic volume, travelling speed (speed limit) and length of a road are used to calculate the presence time.

10.3. REVIEW OF RELEVANT STUDIES AND HAZARDS

General

10.3.1. Potential hazardous scenarios associated with the transfer, storage and use of LPG, diesel oil and DGs in the potential hazardous sources are identified. Historical incidents and relevant studies are reviewed to identify possible hazardous scenarios in similar facilities. The consequences of the identified scenarios are then evaluated to confirm whether they will induce on-site risks of the proposed Project.

Review of Historical Accidents Database

10.3.2. Historical incidents related to the storage, transport and use of DGs and petroleum products in oil terminals, filling station, wagon parking site and facilities of similar nature are reviewed from database such as the Major Hazard Incident Data Services

(MHIDAS) database, eMARS[9] and FACTS[10] covering incidents in 1980 – 2012. Relevant incidents involved are grouped into different incident scenarios for further analysis.

10.3.3. Keywords “oil terminal” and “jetty” were searched to identify the incidents related to transfer and storage of fuel oil / petrol / crude oil. 21 out of 39 incidents related oil terminal resulted in fire and explosion that were caused by welding, lightning and over-pressurization during transfer, etc. Part of the incidents related to jetty were caused by misconnected loading arm, collision of vessel with jetty and overflow during unloading while only 22 out of 59 resulted in fire and explosion.

Table 10.11 Summary of Incidents Related to Oil Terminal and Jetty (1980-2012)

Incident Origin	No. of Cases	Number of Fatality Involved
Oil terminal	39	77
Jetty	59	15

10.3.4. 123 incidents have been identified by reviewing the database related to overfilling and over-pressurization of storage vessels and another 3 incidents are related to fire due to welding and heating. 116 people were killed in these incidents.

Table 10.12 Summary of Incidents Related to Overfilling Vessels (1980-2012)

Incident Origin	No. of Cases	Number of Fatality Involved
Storage vessel	126	116

10.3.5. Keywords “LPG cylinder” and “LPG wagon” were searched in the database to identify the incidents that are related to the loading / unloading and storage of LPG. 25 out of 30 incidents involving LPG cylinder resulted in fireball, flash fire and confined explosion. While 7 out of 12 of incidents involving LPG wagon resulted in fireball, BLEVE and explosion but all incidents happened during transportation instead of parking.

Table 10.13 Summary of Incidents Related to LPG Cylinder and LPG Wagon Parking Site (1980-2012)

Incident Origin	No. of Cases	Number of Fatality Involved
LPG cylinder	30	30
LPG wagon	12	1

10.3.6. Keywords “diesel underground tank” and “diesel road tanker” were searched in the database to identify the incidents related to diesel storage. For underground diesel tank incidents, no fire was resulted due to leakage. For diesel road tanker incidents, 5 out of

[9] Major Accident Reporting System, eMARS, https://emars.jrc.ec.europa.eu/
[10] Failure and Accidents Technical information System, FACTS, http://www.factsonline.nl/

12 incidents resulted in fire and explosion and only 1 related to unloading diesel to a depot. A summary of the incidents is shown in the table below.

Table 10.14 Summary of Incidents Related to Diesel Storage (1980-2012)

Incident Origin	No. of Cases	Number of Fatality Involved
Diesel underground tank	6	0
Diesel road tanker	12	0

10.3.7. The keyword "warehouse fire" was used to identify those incidents that may be similar to the DG storage of the proposed Project. 228 incidents are identified in which 124 people were killed. 198 out of the 228 incidents induced fireball, Boiling Liquid Expanding Vapour Explosion (BLEVE) and explosion while the remaining involved formation of gas cloud and pool of chemical.

Table 10.15 Summary of Incidents Related to Warehouse (1980-2012)

Incident Scenario	No. of Cases	Number of Fatality Involved
Warehouse	228	124

Review of Relevant Studies

10.3.8. Failure events and hazardous scenarios have been identified in relevant studies such as the approved EIA reports. The failure frequencies and identified hazards in those reports have been reviewed and adopted in this study whenever applicable:

- Permanent Aviation Fuel Facility for Hong Kong International Airport (PAFF EIA)[11]
  - This report evaluated the risks to the off-site population due to the storage of aviation fuel (Jet A1) in oil tanks and transportation of fuel through jetty. Hazardous scenarios and failure frequencies such as tank failure and rupture of loaded vessels have been reviewed;
- Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel (Kwai Tsing Channel EIA)[12]
  - A Hazard to Life Assessment that studied the hazards associated with the storage and operation of LPG and oil depot. It reviews the hazard distances of the release scenarios identified in the PAFF EIA[13]. The worst consequences are selected and further evaluated in this study;

[11] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007
[12] Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel, Civil Engineering and Development Department, AEIAR-156/2010
[13] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007

- New World First Bus Permanent Depot at Chai Wan (New World Depot EIA)[14]
    - The diesel oil and kerosene storage in the former CRC (now Sinopec) HK Oil Terminal Chai Wan, as well as the diesel storage of a bus depot were assessed to determine the risks to the off-site population in the surrounding and to the on-site population in the bus depot. The hazardous scenarios adopted in this report have been reviewed;
- Proposed Headquarters and Bus Maintenance Depot in Chai Wan (Citybus Depot EIA)[15]
    - The study assessed the risks on the bus depot associated with the operation of a planned Petrol-cum-LPG Filling Station;
- Kai Tak Development (Kai Tak Development EIA)[16]
    - The DG warehouses with flammable, toxic and compressed gases were studied to identify the hazardous scenarios and to determine the risk level to the off-site population. The methodology adopted in the assessment have been reviewed ; and
- Harbour Area Treatment Scheme Stage 2A (HATS2A EIA)[17] and South Island Line (SIL EIA)[18]
    - Both of the EIA reports evaluated the risk associated with the Shell LPG Depot. Hazardous scenarios, failure frequencies and event trees due to the storage of LPG cylinder and LPG vessels in wagons have been reviewed.

10.4. HAZARD IDENTIFICATION

Sinopec HK Oil Terminal Chai Wan

10.4.1. Diesel, kerosene and LPG storages were present according to the previous New World Depot EIA, their properties are summarised below:

- Properties of Petrol, Diesel, Kerosene and Dye Marker
    - Petrol, or gasoline, consists of hydrocarbons range from C4 to C12. Since the typical flash point of petrol is around – 40 ^{o}C, it forms an explosive air/vapour mixture at ambient temperature;
    - Kerosene is a mixture of hydrocarbons with range C9 to C16. It has a boiling point in a range of 150 – 300 ^{o}C and a flash point typically at 38 ^{o}C. Kerosene is categorized as CAT5 Class 2 DGs;
    - Diesel contains higher molecular weight compounds (C13 to C25) than kerosene and is less volatile. Its boiling point ranges from 220 – 350 ^{o}C. Due to

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[14] New World First Bus Services Limited, New World First Bus Permanent Depot at Chai Wan, AEIAR-029/2000
[15] Citybus Limited, Proposed Headquarters and Bus Maintenance Depot in Chai Wan, AEIAR-045/2001
[16] Kai Tak Development, Civil Engineering and Development Department, AEIAR-130/2009
[17] Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment, Drainage Services Department, Hong Kong, AEIAR-121/2008
[18] South Island Line, MTR Corporation Limited, AEIAR-155/2010

its relatively higher flash point (around 76 ^{o}C), a release of diesel will only present a hazard if exposed to excessive temperatures such as those resulting from a fire. Diesel is categorized as CAT5 Class 3 DGs;

- Dye marker shall be 1,4-dihydroxyanthraquinone according to the Dutiable Commodities (Marking and Colouring of Hydrocarbon Oil) Regulations. Typical 1,4-dihydroxyanthraquinone has a melting point of around 200^{o}C and a flash point in the range of 220 ^{o}C -250^{o}C. Dye marker is categorized as CAT 5 Class 3 DG.
- Kerosene and diesel are ignited only being heated above the flash points or open flame. Incomplete combustion will generate black smoke and carbon monoxides[19,20]; and
- Diesel, kerosene and dye marker do not pose flammable vapour hazard at ambient temperature in Hong Kong and therefore limits the hazards to liquid pool fire. Vapour cloud explosion and flash fire to off-site population can therefore be eliminated.

- Properties of LPG
  - LPG supplied in Hong Kong is a pressurized mixture of propane and butane (3:7 in mole ratio). Upon release to the ambient environment it vaporises and mixes with air, forming a dense flammable gas cloud which tends to flow and disperse close to the ground. The gas cloud may extend over a long distance until it gets too diluted or encounters ignition sources.

10.4.2. Various hazardous scenarios related to the storage of aviation fuel in an oil terminal have been identified in the PAFF EIA[21]. The hazard distance of those scenarios have been further studied in the Kwai Tsing Channel EIA[22]. Having considered the similarity of kerosene in the Sinopec HK Oil Terminal Chai Wan to the aviation fuel (aviation kerosene) in PAFF, as well as the similar oil storage tank nature of oil terminal, the scenarios in the PAFF EIA will be used a basis for this Hazard to Life Assessment.

10.4.3. Those release scenarios with the worst hazardous distances are reviewed in order to evaluate whether they can cause potential risks to the proposed Project.

10.4.4. The hazard distance of the release scenarios in PAFF EIA is reproduced in ***Table 10.16*** below.

Table 10.16 Summary of Hazardous Scenarios in PAFF EIA

Release Scenario	Hazard Distance (m)
Jetty Transfer	

[19] New World First Bus Services Limited, New World First Bus Permanent Depot at Chai Wan, AEIAR-029/2000
[20] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007
[21] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007
[22] Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel, Civil Engineering and Development Department, AEIAR-156/2010

Release Scenario	Hazard Distance (m)
Fire due to rupture/ leak of oil products from loaded vessel	236
Fire due to rupture/ leak of loading arm during unloading	69
Fire due to rupture/ leak of jetty equipment	236
Fire due to rupture/ leak of jetty riser	69
Fire due to rupture/ leak of submarine pipeline from jetty to tank farm ESD valve	148
Tank Farm Storage	
Fire due to discharge from tank vent	Not significant
Tank head fire or explosion in tank head space	Not significant
Multiple tank head fires	Not significant
Tank failure due to overpressure	Not significant
Explosion in empty tank (under maintenance)	Not significant
Bund fire	18
Fire outside bund due to rupture/ leak of pumps, pipework and fittings	4
Fire on sea due to release through drainage	219
Fire due to instantaneous tank wall failure, bottom seam failure	< 399
Fire due to instantaneous tank wall failure, unzipping	< 399
Aircraft impact	< 399
Fire due to multiple tank failure	399
Tank boilover	Not significant
Fire due to release from top of tank due to overfilling	Not significant
Vapour cloud explosion or flash fire	Not significant
Fire due to 10% instantaneous release from the top of a tank	39

10.4.5. Although the risks associated with LPG release are not considered in the New World Depot EIA, dispersion of LPG vapour cloud formed from the release can pose off-site risk. The failure of LPG cylinders in the Sinopec HK Oil Terminal Chai Wan is considered with reference to the failure cases in the SIL EIA.

Pool fire on sea

10.4.6. Pool fire on sea surface is possible following an ignition of hydrocarbon due to loss of containment from collision or grounding of marine vessels visiting the jetty of Sinopec HK Oil Terminal Chai Wan. The most severe release would be a multiple rupture of all oil tanks on a loaded vessel.

10.4.7. With reference to the approved EIA report of PAFF EIA, a cargo tank on a vessel is typically sub-divided into 14 tanks. With the use of marine pilots and tug boats, as well as protection from side on collisions by wing tanks and from groundings by double bottom construction, a release from a vessel would be restricted to a single tank of the cargo tank (1/14 = approximate 7%). The model of a multiple tank rupture assumes an instantaneous release of 7% of the vessel contents. The pool diameter is calculated using the equation below:

$$D = \sqrt{\frac{4M}{\pi t \rho}}$$

where

D = pool diameter (m);

M = release mass (kg);

t = average pool thickness (m); and

ρ = density (797.5kg/m^3 for kerosene / aviation fuel).

10.4.8. The average thickness of pool is assumed to be 10mm which is a minimum requirement for flame spread on sea and the thermal impact range for fatality for the releases on sea are taken as equivalent to the pool radius. The largest area covered in a multiple tank rupture is predicted to occur at the start of the release, an initial spill of 7% spread to a depth of 10mm is a conservative assumption for pool fire from multiple tank rupture[23].

10.4.9. Since information of the size of vessel visiting the Sinopec HK Oil Terminal Chai Wan is not available, the size is therefore predicted from the constraints of the jetty. According to the Berthing Guidelines of Marine Department[24], the maximum draft and LOA (overall length) of the Sinopec Chai Wan berth are 5 m and 65 m respectively. The jetty is able to accommodate a typical small port vessel of not more than 2000DWT with draft of 3.9 m and LOA of 75m[25]. Conservatively assume a 5000 DWT loaded vessel could be berthed and a multiple tank rupture could give a pool with 236m diameter. The proposed Project is around 250 m away from the jetty of the Sinopec HK Oil Terminal Chai Wan that hazards induced affecting the proposed Project are not significant. Nevertheless, the release scenario is included in the risk summation using a pool fire model on sea.

Instantaneous tank wall and multiple tank failure

10.4.10. The remaining release scenarios with the worst hazard distances come from the fire due to instantaneous tank wall failure and fire due to multiple tank failure, they are further analysed below.

10.4.11. An instantaneous tank wall failure considers a sudden unzipping or split open of a tank wall, releasing the entire content of a fuel tank. Considering an instantaneous release of 1000 m^3 kerosene in the Sinopec HK Oil Terminal Chai Wan, it is possible that part of the liquid be retained in the bund and part of the liquid overtops the bund due to splashing or momentum.

[23] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007
[24] Berthing Guidelines, Marine Department, HKSAR, 2014
[25] Manual for Deep Draft Navigation, National Economy Development, U.S. Army Engineer Institute for Water Resources, 2010

10.4.12. For a pool of fuel contained in a 25 m × 25 m × 2 m bund, a pool fire model using PHAST to simulate a 25 m diameter pool gives an effective distance of 51 m at a radiation level of 4 kW/m^2 (fatality is not anticipated for radiation level lower than 4 kW/m^2). Since the north boundary of the Project site is approximately 200 m from the bund wall, the hazard from a bund pool fire has no effect to the fatality of the Project construction worker and Project worker.

10.4.13. For the fuel overtopping the bund, the liquid will be directed to the sea, to the grated u-channels and outside the oil terminal since the site is surrounded by two solid walls on two sides. There is a 100mm kerb at the jetty according to the New World Depot EIA that could contain part of the spilled fuel inside the site. The fuel would also flow into the sea through the grated u-channels inside the oil terminal and the remaining fuel would flow outside the oil terminal to the public road.

10.4.14. The quantity of fuel overtopping the bund can be estimated by the correlation by *Thyer et al.*[13]:

$$Q = 0.044 - 0.229 \ln\left(\frac{h}{H}\right) - 0.116 \ln\left(\frac{r}{H}\right)$$

Where

h = bund wall height (m)

r = distance from the centre of the tank to the bund wall

H = tank liquid height including the tank foundation.

10.4.15. By the configuration of Sinopec HK Oil Terminal Chai Wan, h is 2 m, r is approximately 7.6 m (estimated from site layout) and H is approximately 14.2 m (100% fill level of 12.77 m plus assuming a 1.5 m tank foundation). The quantity of fuel overtopping the bund Q is calculated as 566 m^3. (The volume calculated by *Thyer et al.* was concluded to be 50% overestimated in the PAFF EIA. However given that the configurations of bund and tanks are different between PAFF and Sinopec HK Oil Terminal Chai Wan, 566 m^3 calculated from *Thyer et al.* is directly adopted)

10.4.16. Considering the kerb at the jetty, the area of oil terminal could hold up to about 235 m^3 of overtopped fuel ((54 m × 55 m – 25 m × 25 m) × 0.1 m), which is about 41% of the overtopped fuel. The road surface outside the oil terminal has a fall towards the oil terminal that the fuel will be collected by the u-channels. See ***Appendix 10.6*** for the illustration of falls and u-channels of the oil terminal. However, upon an instantaneous release of full inventory inside the fuel tank with a high momentum and large volume, the u-channels can only contain a small amount of spilled fuel. The u-channels are therefore ignored from the calculation and it is therefore conservatively assumed the remaining 59% of spilled fuel will flow outside the oil terminal and no spilled fuel is assumed to be directed to the sea by the u-channels.

10.4.17. By simulating an unbunded instantaneous release of 332 m^3 kerosene by PHAST 6.7 gives a maximum pool radius of 145 m, which will cover the road outside the oil terminal. Fire event due to overtopping of bund from instantaneous tank failure and spreading outside the oil terminal is further considered.

10.4.18. Hypothetically it is possible for multiple tanks to release the contents into the bund. The bund wall at Sinopec HK Oil Terminal Chai Wan has a volume of 1250 m^3 that is not designed to hold all contents (4500 m^3) in the oil terminal. The excess spill will flow into the sea to form a pool either directly from the site or through the u-channels at the site and at the same time to form a pool covering the entire oil terminal (a 55 m × 54 m area as shown in the layout plan in ***Figure 10.5***). A pool fire on the sea does not pose off-site risk to the proposed Project as discussed in previous section. While a pool fire formed within the oil terminal is further assessed.

10.4.19. By considering a confined pool fire within the oil terminal by modelling a 54m diameter pool fire, the result shows an effective distance of 89.8 m at a radiation level of 4 kW/m^2. Since the north boundary of the Project site is approximately 190 m from the oil terminal site boundary, the hazard to the Project site is insignificant.

10.4.20. Multiple fuel tank failure due to instantaneous rupture and rupture of tank interconnection pipe are possible, In an event of release from multiple fuel tank, the fuel could overtop the bund and at the same time overflow to the public road as considered in instantaneous single tank failure, which would involve a larger amount of fuel and cover a larger extent of spillage area. The scenarios are therefore further considered in *Section 10.5.12*.

<u>LPG Cylinder Failure</u>

10.4.21. LPG cylinders of sizes 10.5 kg, 16 kg and 45 kg are stored in the oil terminal and the maximum storage capacity in the terminal is 12 tonnes according to the New World Depot EIA[26].

10.4.22. Cold catastrophic rupture leading to instantaneous release and partial failure leading to continuous release of LPG are deemed to be possible, in which 45 kg is selected to represent the worst case.

10.4.23. Multiple BLEVE of LPG cylinders is also probable if the LPG cylinders are engulfed by pool fire outside the bund wall resulted from a multiple oil tank failure. LPG cylinders are equipped with pressure relief valves to release internal pressure during emergency conditions that not all cylinders will result in BLEVE under fire engulfment. Take a conservative assumption that 10% of total cylinders result in BLEVE[18], the consequence is shown below.

10.4.24. The failure cases and the corresponding consequences are summarised in ***Table 10.17***. It shows that no release scenario will cause potential hazard to the proposed Project due to a large separation between the LPG cylinder storage shed and the Project site.

[26] New World First Bus Services Limited, New World First Bus Permanent Depot at Chai Wan, AEIAR-029/2000

Table 10.17 Failure cases for LPG Cylinder in Sinopec HK Oil Terminal Chai Wan

LPG Cylinder Storage	Release Quantity	Outcome	Hazard Distance
Cold catastrophic rupture of LPG cylinder	45 kg	Fireball	10.4 m (Fireball radius)
		Flash Fire	36.2 m (100% LFL)
		VCE	17.4 m (0.3 bar)
Partial failure (1mm leak) of LPG cylinder	45 kg	Jet Fire	28.1 m (4 kW/m^2)
		Flash Fire	15.9 m (100% LFL)
		BLEVE	10.4 m (Fireball radius)
Multiple BLEVE of LPG cylinders	1,200 kg	Fireball	32.5 m (Fireball radius)

<u>Fuel Oil Filling Failure</u>

10.4.25. According to the New World Depot EIA, two stations are used for distribution of fuel oil within the Sinopec HK Oil Terminal Chai Wan. One station is for the bulk filling of road tanker which is mainly used for Automotive Diesel Oil (ADO) and Industrial Diesel Oil (IDO); and the other one is for the filling of package products (drums) which is mainly used for IDO and kerosene. And as per the observation in the site survey, the two stations still exist though not in operation.

10.4.26. Fuel oils are pumped from the storage tanks to the filling stations. A 100 mm articulated arm and a 25 mm loading hose are used in the bulk filling station and drum filling station respectively. Following the approach of the New World Depot EIA, the road tanker is assumed to have a capacity of 16,000 litres and the pool fires are enclosed by the drainage channels (15.2 m × 6.2 m) and the site area (54 m × 41 m) of the oil terminal.

10.4.27. Dye marker is stored in a storage tank outside the bund. By making reference to the New World Depot EIA, a pool fire could be resulted due to failure of the dye marker tank. The volume of dye marker tank is 3.4 m^3 as per a site survey conducted by the Consultant. By approximation of tank diameter from the site layout plan and the site survey conducted by the Consultant, the size of the dye marker tank is estimated to be 1.2 m in diameter and 3m high (approximate 3.4m^3). An unconfined pool fire is considered as a conservative approach due to insufficient information of the bund size obtained from the operator, site layout plan and site visits.

10.4.28. The failure cases and the corresponding consequences simulated using PHAST are summarized in ***Table 10.18***. As a conservative approach, kerosene is used for all scenarios instead of ADO and IDO. The failure cases listed are further considered in the frequency analysis in ***Section 10.5***.

Table 10.18 Failure cases for Fuel Oil Filling in Sinopec HK Oil Terminal Chai Wan

Fuel Oil Filling Operation	Release Quantity	Outcome	Hazard Distance
Cold catastrophic rupture of fuel oil road tanker	16,000 L	Pool Fire (confined by site area)	84.3 m (4 kW/m^2)
Partial failure (25mm leak) of fuel oil road tanker	16,000 L	Pool Fire (confined by site area)	71.3 m (4 kW/m^2)
Rupture of loading arm during loading to fuel oil road tanker	1,000 m^3	Pool Fire (confined by site area)	84.3 m (4 kW/m^2)
Rupture of flexible hose during loading to drum truck	1,000 m^3	Pool Fire (confined by drainage channels)	126.9 m (4 kW/m^2)
Full bore rupture of pump connecting pipeline in pump farm	1,000 m^3	Pool Fire (confined by site area)	85.4 m (4 kW/m^2)
Catastrophic rupture of dye marker tank	3.4 m^3	Pool Fire within site	56.3 m (4 kW/m^2)

Jetty Unloading Failure

10.4.29. The pool fire at the jetty of the Sinopec HK Oil Terminal Chai Wan was not considered in the risk summation of in the previous New World Depot EIA since it concluded a fire in bund and pool fire with overtopping the bund were more onerous. A pool fire at the jetty is further assessed in this study.

10.4.30. Rupture of the loading hose at the jetty could be caused by a misconnection and by the marine vessel steered away from the jetty during unloading, which could result in a pool fire on the sea if ignited.

10.4.31. In a case of loading hose rupture, operators in the field will spot the failure and initiate a rapid isolation. Should a rapid isolation fails, it is assumed that the release will be isolated by an emergency shut off intervention (such as pump cut-off) within 10 minutes[27] [28].

10.4.32. Since there is no information from Sinopec (Hong Kong) Ltd or from the New World Depot EIA about the operation data of the jetty, it is assumed it takes 2 hours on average to unload a 1,000 m^3 storage tank, resulted in a pumping rate of 500 m^3/hr (this is conservative as the pumping rate in PAFF is 3,500 m^3/hr for serving a 35,000 m^3 storage tank but the size of storage tank in Sinopec HK Oil Terminal Chai Wan is 1/35 of that of

[27] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007
[28] Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities, AEIAR-106/2007

PAFF). For a release of 10 minutes in the event of rapid isolation fails, the volume of release is 83 m^3 (500 $m^3 \times 10 / 60$). For a 10 mm thickness of pool, this is equivalent to a pool diameter of 103m. The effect distance of pool fire is 141.6 m at a radiation level of 4 kW/m^2.

10.4.33. There is also a potential rupture of the jetty fixed pipeline as a result of spontaneous rupture of the pipeline and striking by a marine vessel. Considering the same pumping rate and isolation mechanism as that of loading hose, the consequence is a pool fire with an effect distance of 141.6 m at a 4 kW/m^3 radiation ellipse.

Smoke Generation from Kerosene Fire

10.4.34. Combustion gases from burning hydrocarbons consist of mainly nitrogen, carbon monoxide and carbon dioxide[29]. Engulfed by smoke from combustion of hydrocarbon can cause incapability to a person due to combined effect of CO_2 and CO.

10.4.35. In this study, smoke ingression to the proposed Project will be the major concern.

10.4.36. Hot nitrogen tends to dominate in the combustion products due to its high proportion in air, the smoke is therefore modelled as nitrogen gas dispersion. The concentration necessary to cause fatality is estimated to 17% and the smoke temperature is suggested to be 600 ^{o}C for under-ventilated fires. Kerosene burning rate on land by Shell Research is 0.06 kg/m^2s with a smoke production rate that is 16 times of the burning rate.

10.4.37. PHAST 6.7 is used to model smoke dispersion and the results are summarised in ***Table 10.19*** below. The hazard distances at ground level as a result of bund fire in different wind speeds are shown, the worst hazard distances of single tank and multiple tank failure are 24.7 m and 38.7 m at a concentration of 17% respectively under a high wind speed (7.5 m/s) condition. It is obvious that at such distance the smoke will not cause any fatality to the Project site. Smoke ingression is deemed to be insignificant and will not be considered further.

Table 10.19 Summary of Smoke Dispersion Results of Oil Terminal Bund Fire

Parameter	**Single Tank Failure**		**Multiple Tank Failure**	
Fuel pool diameter	25 m		54 m	
Burning rate	0.06 kg/m^2s		0.06 kg/m^2s	
Smoke production rate	471.2 kg/s		2198.6 kg/s	
Dispersion distance @ ground level & Conc. 17%	20.5 m	3.0B	35.9 m	3.0B
	16.5 m	2.0D	34.9 m	2.0D
	18.1 m	4.5D	35.6 m	4.5D
	24.7 m	7.0D	38.7 m	7.0D
	20.4 m	3.0E	33.2 m	3.0E
	18.5 m	1.5F	29.7 m	1.5F

[29] A Guide To Quantitative Risk Assessment for Offshore Installations, DNV 7.0DTechnica, 1999

10.4.38. Carbon monoxide component in smoke is known to cause the majority of deaths in fire and an exposure to carbon monoxide in a concentration of 30,000 ppm can cause immediate death[30]. For a liquid fire, the typical carbon monoxide concentration in smoke is 3.1%[30]. ***Table 10.20*** below presents the hazard distance of carbon monoxide modelled using PHAST 6.7.

Table 10.20 Summary of Carbon Monoxide Effects of Oil Terminal Bund Fire

Parameter	**Single Tank Failure**		**Multiple Tank Failure**	
Fuel pool diameter	25 m		54 m	
Smoke production rate	471.2 kg/s		2,198.6 kg/s	
Carbon monoxide production rate	14.6 kg/s		68.2 kg/s	
Dispersion distance @ ground level & Conc. 30000ppm	5.2 m	3.0B	8.2 m	3.0B
	4.3 m	2.0D	7.0 m	2.0D
	5.7 m	4.5D	8.8 m	4.5D
	7.8 m	7.0D	12.0 m	7.0D
	4.7 m	3.0E	6.7 m	3.0E
	0.3 m	1.5F	14.7 m	1.5F

10.4.39. Taking into account the consequences induced by the hazardous scenarios of the Sinopec HK Oil Terminal Chai Wan, a 200m radius study area is adopted.

Sinopec and ExxonMobil Petrol-cum-LPG Filling Station

10.4.40. The properties of LPG is discussed in *Section 10.4.1*, the gas cloud formed due to release of LPG is flammable upon ignition and therefore is possible to induce off-site risk. The hazardous scenarios of petrol-cum-LPG filling station will follow that of Citybus Depot EIA[31] and Kai Tak Development EIA[32]. A study area of 225 m radius from the petrol-cum-LPG filling station will be adopted in this assessment according to the ***Table 10.21*** below.

10.4.41. ***Table 10.21*** below summarizes the hazardous events related to the storage and use of petrol / LPG in the filling station.

[30] HSE, SPC/Tech/OSD/30, Methods of approximation and determination of human vulnerability for offshore major accident hazard assessment. 2011

[31] Citybus Limited, Proposed Headquarters and Bus Maintenance Depot in Chai Wan, AEIAR-045/2001

[32] Kai Tak Development, Civil Engineering and Development Department, AEIAR-130/2009

Table 10.21 Summary of Hazardous Scenarios for Petrol-cum-LPG Filling Station

Hazardous Scenarios
LPG Filling Station
Cold catastrophic failure of LPG storage vessel
Cold partial failure of LPG storage vessel
Cold catastrophic failure of LPG road tanker
Cold partial failure of LPG road tanker
Guillotine failure of liquid-inlet pipework (rupture)
Partial failure of liquid-inlet pipework (leak)
Guillotine failure of liquid supply line to dispenser (rupture)
Partial failure of liquid supply line to dispenser (leak)
Failure of dispenser
Guillotine failure of flexible hose to vessel (rupture)
Partial failure of flexible hose to vessel (leak)
Guillotine failure of flexible hose to vehicle (rupture)
Submersible Pump Flange Leak
BLEVE of LPG road tanker (fire escalation)
Petrol Filling Station
Rupture / leak of petrol road tanker
Rupture / leak of petrol storage tank
Rupture / leak of delivery pipe
Leak of dispenser

10.4.42. Petrol vapour is heavier than air that it tends to sink through normal atmosphere. Since all petrol delivery pipeline and storage tanks in a Petrol-cum-LPG filling station are underground, their content is unlikely to contact with an ignition source. And a vent pipe is equipped with a flame arrestor that the released vapour is discharged at a high point.

10.4.43. Only a limited quantity of petrol in the hose of the petrol dispenser will be spilled in the event of loss of containment as petrol vapour is heavier than air. For a petrol dispenser with a typical size of 1.28 m × 0.63 m × 2.175 m = 1.75 m^3 [33] and an oil interceptor with a typical size of 0.75 m × 0.75 m × 1.2 m × 3 = 2.0 m^3 [34], the spill will be collected by the drainage system and the oil interceptor.

10.4.44. According to previous experience, the most hazardous scenarios are the failure of LPG storage vessel and road tanker, the hazard distances of these two scenarios are shown in ***Table 10.22*** below.

[33] Kai Tak Development, Civil Engineering and Development Department, AEIAR-130/2009
[34] Typical Details of A Petrol Interceptor, ProPECC PN 5/93, Environmental Protection Department

Table 10.22 Consequences for Release Scenarios at Petrol-cum-LPG Filing Station

Hazardous Scenarios	Release Quantity	Outcome	Hazard Distance
Cold catastrophic failure of LPG storage vessel	10200kg	Flash Fire	224.9m (100% LFL)
		VCE	105.8m (0.3 bar)
Cold catastrophic failure of LPG road tanker	9000kg	Flash Fire	216.8 (100% LFL)
		VCE	100.0 (0.3 bar)
		Jet Fire	44.5m (4kW/m^2)
		BLEVE	62.5m (Fireball radius)

10.4.45. Since the Project site is within the hazardous distances resulted from the releases of petrol-cum-LPG filling stations (170 m from Sinopec and 20 m from ExxonMobil), a quantitative risk assessment will be conducted in this Hazard to Life study to evaluate the risks from both Sinopec and ExxonMobil Petrol-cum-LPG Filling Station.

LPG Wagon Parking Site

10.4.46. Domestic LPG cylinders are stored inside the LPG wagons at the parking site, the general size of a domestic use LPG cylinder is 10.5 kg. The properties of LPG are discussed in *Section 10.4.1*. Instantaneous release due to cylinder rupture and continuous release due to cylinder leakage are considered in previous EIA reports that assess the effects of 50 kg LPG cylinders inside a LPG depot[35,36]. Single cylinder rupture and leak with a hole size of 1mm were modelled to identify the hazard distance of each scenario.

10.4.47. BLEVE of multiple LPG cylinders in the wagon is possible if they are engulfed by the pool fire of a petrol tanker. Assume a pool fire of a road tanker could affect two LPG wagons involving 500 number of cylinders that 10% of the cylinders would undergo BLEVE.

10.4.48. In view of possible parking of kerosene and diesel road tanker in the LPG wagon parking site, pool fires due to the ignition of kerosene (which is more volatile than diesel) from the rupture and leakage of a 9 tonnes road tanker is also modelled to evaluate the effects.

10.4.49. The hazard distances of the release scenarios are shown in ***Table 10.23***. The worst hazardous distance, which is a pool fire due to rupture of a petrol road tanker, can only reach 88.6 m from the release point. The study area is set to 150m radius from the LPG wagon parking site.

10.4.50. Since the LPG wagon parking site is around 300 m away from the Project site, it will therefore not pose risks to the proposed Project.

[35] Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment, Drainage Services Department, Hong Kong, AEIAR-121/2008
[36] South Island Line, MTR Corporation Limited, AEIAR-155/2010

Table 10.23 Consequences for Release Scenarios at LPG Wagon Parking Site

Hazardous Scenarios	Release Quantity	Outcome	Hazard Distance
Cylinder rupture	10.5kg	Fireball Flash fire VCE	6.5 m (Fireball radius) 22.0 m (100% LFL) 10.7 m (0.3 bar)
Cylinder leak (Hole size: 1 mm)	10.5kg	Jet fire Flash fire BLEVE	27.4 m (4kW/m^2) 15.9 m (100% LFL) 6.5 m (Fireball radius)
Multiple BLEVE of cylinders	525kg	BLEVE	24.8 m (Fireball radius)
Kerosene road tanker rupture	9,000kg	Pool Fire	88.6 m (4kW/m^2)
Kerosene road tanker leak (25 mm)	9,000kg	Pool Fire Jet Fire	71.3 m (4kW/m^2) 2.8 m (4kW/m^2)

Diesel Storage in NWFB and Citybus Depots

10.4.51. Underground diesel storage tanks are installed in both NWFB and Citybus Depots where the tanks are replenished by 16,000L road tankers. Spillages from road tanker, storage tank, delivery pipe and dispenser are considered possible.

10.4.52. The spilled diesel from underground tank is however unlikely to come in contact with ignition source since it is buried. And diesel vapour does not easily disperse in still air. Release from storage tank will not cause off-site risk.

10.4.53. In the event that diesel is released from a dispenser during refuelling, the spilled quantity will limited to the volume in the hose. Oil interceptors are installed according to the layout plan received from the bus depot operators, which will be able to confine the spillage within the site.

10.4.54. Diesel is not easily ignited as mentioned in *Section 10.4.1* but ignition of spilled diesel during unloading is deemed possible. It is assumed a spill from a diesel tanker will lead to a pool fire[37]. The hazard distance of each scenario is summarised in ***Table 10.24*** below:

Table 10.24 Summary of Hazardous Scenarios for Diesel Storage in Bus Depot

Hazardous Scenarios	Release Quantity	Outcome	Hazard Distance
Tanker rupture	16,000 L	Pool Fire (Radius 31.9 m)	98.0 m (4 kW/m^2)
Tanker medium liquid leak (Hole size: 25 mm)	16,000 L	Pool Fire (Radius 20.2 m)	71.7 m (4 kW/m^2)

[37] South Island Line, MTR Corporation Limited, AEIAR-155/2010

10.4.55. Since the Project site is within the hazard distance of the release scenarios of diesel road tanker, the scenarios will be taken into account in the risk assessment.

10.4.56. As mentioned in *Section 10.4.34* that burning of hydrocarbons could cause smoke ingression to the proposed Project. Using the same approach mentioned in *Section 10.4.36*, the largest distance the smoke can disperse is 41.7 m at ground level.

Table 10.25 Summary of Smoke Dispersion Results of Diesel Tanker Release

Parameter	Tanker Rupture		Tanker Medium Leak	
Fuel pool diameter	31.9 m		20.2 m	
Burning rate	0.06 kg/m^{2}s		0.06 kg/m^{2}s	
Smoke production rate	3069.0 kg/s		1225.8 kg/s	
Dispersion distance @ ground level & Conc. 17%	38.8 m	3.0 B	28.6 m	3.0 B
	39.1 m	2.0 D	24.7 m	2.0 D
	40.7 m	4.5 D	25.0 m	4.5 D
	41.7 m	7.0 D	32.4 m	7.0 D
	37.8 m	3.0 E	27.6 m	3.0 E
	36.2 m	1.5 F	24.8 m	1.5 F

10.4.57. The Citybus Depot is approximately 51m from the Project site. At such distance, the plume height is 29 m as calculated from [L x tan(90^o – tilt angle)] where L is the horizontal distance from the fire site boundary and tilt angle taken as 60^o to represent the worst case1. Which the 6-storey high (40 m) proposed Project can be affected by the smoke plume. And since the NWFB Depot is adjacent to the Project site, the smoke plume can affect the proposed Project. Smoke plume from the bus depots will be further considered in the study.

10.4.58. The future building design of the proposed Project is however not known at this stage and the facing direction of the building façade is therefore not available. However, it is worth to mention that both bus depots have the entrance opening at the east and the west with a solid wall of the building facing the Project site. With a prevailing wind direction from the east, if any smoke was generated it would be very unlikely to disperse towards the Project Site.

10.4.59. The hazard distances of smoke in terms of carbon monoxide dispersion are summarized in ***Table 10.26*** below.

Table 10.26 Summary of Carbon Monoxide Effects of Diesel Tanker Release

Parameter	Tanker Rupture		Tanker Medium Leak	
Fuel pool diameter	31.9 m		20.2 m	
Smoke production rate	3069.0 kg/s		1225.8 kg/s	
Carbon monoxide production rate	95.1 kg/s		38.0 kg/s	
Dispersion distance @ ground	8.8 m	3.0 B	6.1 m	3.0 B

Parameter	**Tanker Rupture**		**Tanker Medium Leak**	
level & 30000ppm	9.0 m	2.0 D	7.7 m	2.0 D
	7.8 m	4.5 D	6.3 m	4.5 D
	11.0 m	7.0 D	9.0 m	7.0 D
	8.4 m	3.0 E	6.0 m	3.0 E
	21.3 m	1.5 F	No hazard	1.5 F

Dangerous Goods Storage in NWFB Depot

10.4.60. As mentioned in *Section 10.2.28*, small amount of Category 2, 3, 5 and 10 DGs were licensed in the NWFB Depot.

10.4.61. Category 2 compressed gases, including oxygen and acetylene, were stored in form of cylinder in the DG store. Excessive heat, mechanical damage or corrosion of the cylinder can cause rapid release of containment and results in overpressure. The overpressure is however believed to be contained inside the building that will not pose off-site risk. Thus, compressed gases are not considered further in this study.

10.4.62. Sulphuric acid is classified as Category 3 DG that is a corrosive substance. Sulphuric acid can cause chemical burn if contacted with skin and eye. Toxic gas is not produced unless the solution is heated or misted and hence inhalation hazard is not expected. It is assumed any leakage or spillage of the solution within the DG store can be cleaned up by spillage kits and control within the building. Off-site risk is therefore not significant and is not further considered.

10.4.63. Lacquer thinner, Acetone and Paint are classified as Category 5 DG for their ability to give off inflammable vapour. Lacquer thinner, acetone and paint fall into Class 1, Division 1 of Category 5 DG, which have a flash point below 23 ^{o}C. If released, pool fire could occur from ignition of the vapour above the pool and the heat in turn vaporizes the liquid beneath to support the fire. Assume all Category 5 substances in the DG store with a quantity of 1171 L were released to form an uncontained pool, the hazardous distance of the pool fire is 49.6 m (4kW/m^2) and flash fire is 44.8 m (LFL).

10.4.64. Methyl ethyl ketone peroxide is classified as Category 10 DG. It is combustible and can cause skin, throat and lung irritation if inhaled. Methyl ethyl ketone peroxide has a flash point in between 52^{o}C and 93^{o}C[38]. The hazardous distances from an uncontained pool fire and flash fire from the rupture of 171L of methyl ethyl ketone peroxide vessel are 26.2m (4kW/m^2) and 2.57m (LFL) respectively.

10.4.65. Given that there is a lack of ignition source within a DG store and with a firefighting system, the fire arose from the DGs would be confined inside the building even if ignited. The Category 5 and Category 10 substances are therefore believed not to pose off-site risks and are not further considered in the analysis.

[38] Hazardous Substance Fact Sheet - State of New Jersey, http://nj.gov/health/eoh/rtkweb/documents/fs/1259.pdf

Dangerous Goods Storage in the Proposed Project

10.4.66. The facilities in the existing vehicle depots of the HKPF, EMSD and FEHD and the laboratory of GL will be relocated to the future Project once commissioned. HAZID workshops have been carried out with participants from HKPF, EMSD and GL to identify potential hazards in the existing facilities. Given that the future Project is of similar nature as the existing facilities, the hazards in the future complex and depot can be deduced.

10.4.67. The HAZID workshop involved interviewing with the operators of the existing facilities to learn the DG handling procedures, reviewing the existing safeguards and emergency response process and carrying out a brainstorming exercise to identify all hazards due to the operation of the proposed Project. The hazards were further evaluated and rated with risk ranking judging from their consequences and possibilities.

10.4.68. Details of the hazards identified in the workshops are provided in ***Appendix 10.3***. The following table gives a short summary of the conclusions based on the outcome of the HAZID workshops:

Table 10.27 Summary of HAZID Workshops

Facility	Main Functions	Conclusion of Hazards
HKPF Hong Kong Island PVP&EC	To examine defective vehicles identified by the HKPF and damaged vehicles from car accidents.	No hazard has been identified that could cause off-site risk. Hazards will be on-site only.
EMSD Depot	To provide mechanical repairing and general maintenance of government vehicles.	No hazard has been identified that could cause off-site risk. Hazards will be on-site only.
GL Specialist Laboratory	To provide chemical testing services for other government departments.	No hazard has been identified that could cause off-site risk. Hazards will be on-site only.

10.4.69. Considering the proposed Project of FEHD only serves as a car washing facility, the proposed Project Team did not anticipate any activities that could cause off-site risk to the public.

10.4.70. The hazardous scenario identified in HAZID workshop is further evaluated in ***Appendix 10.3A***. Hazardous scenarios such as fire of flammable chemical in government laboratory and fire of petrol in the proposed Project were modelled to ensure the hazardous effect does not affect offsite population.

10.4.71. Waste oil and lubricant having a high flash point of around 177^{o}C[39] are unlikely to be ignited. Typical automotive battery contains 20–44 wt.% of sulphuric acid as

[39] Material Safety Data Sheet, Gulfpride® Motor Oil 10W-40, Gulf Lubricants

electrolyte[40], the hazard of sulphuric acid is however concluded to be localized if released as discussed in ***Section 10.4.62***. Moreover, automotive battery is stored in a bunded DG store that is separated from the storage of waste oil / lubricant, sulphuric acid will therefore be contained within the bund when released and will not be heated to cause any off-site risk. For other DGs including Cat 2, Cat 3 and Cat 5 of Table 10.6 that are planned to be stored in the proposed Project, the quantities are less than that stored in the NWFB Depot. The hazards induced will be bounded within the site similar to those described in *Section 10.4.61* to *Section 10.4.64*, offsite risk is therefore not anticipated.

10.4.72. An incident review is also performed on WiseNews[41] in between 2000 and 2015 to identify worldwide news reporting incidents similar to vehicle depots and laboratories.

10.4.73. The keywords "vehicle maintenance"(汽車維修), "fire"(火警) and "death"(死亡) are searched, there were fire reported in small scale vehicle workshops but fatalities were on-site only.

10.4.74. The keywords "laboratory" (實驗室), "leakage"(洩漏) and "death"(死亡) are searched in the database. Three representable incidents were chlorine gas leakage from a university of Nanjing in 2001, Boron Tribromide gas leakage from a university of South Korea in 2013 and release of Chloroacetyl chloride from a university of Hong Kong in 2014, both involved evacuation of on-site staff and students but no off-site fatality was resulted. Those laboratories identified are chemical testing in nature and the Government Laboratory in this Study is for food and environmental testing purpose. Given that no acute fatality toxic chemicals are used in the Government Laboratory, similar incident is not anticipated in the proposed Project.

10.4.75. The keywords "laboratory" (實驗室), "fire"(火警) and "death"(死亡) are searched in the database. There were laboratory fires reported including ignition of chemicals in a university of Hong Kong in 2002, radioactive substance release from a medical laboratory in 2008 and machine overheat in a university of Taiwan in 2009 but none of the cases resulted in fatality.

10.4.76. Since all facilities are concluded not to pose off-site risk, no hazard scenarios from the proposed Project are considered in the risk modelling.

<u>Natural Hazards and External Events</u>

10.4.77. Loss of containment may occur due to external events and the consequences could be catastrophic failure or leak. The related natural hazards and external events are listed as follows, they will be further analysed in *Section 10.5*:

- Earthquake;
- Landslide;
- Lightning strike;

[40] MATERIAL SAFETY DATA SHEET, Battery Fluid Acid, Century Yuasa and Lead Acid Battery Wet, East Penn Manufacturing Co., Inc
[41] WiseNews, http://libwisesearch.wisers.net.lib.ezproxy.ust.hk/

- Severe environmental events;
- Aircraft crash;
- Car crash;
- Dropped object;
- Subsidence; and
- External fire

10.4.78. It is noted that some of the consequences induced by the hazardous scenarios do not cause offsite risk to the Project site, they are included in the risk summation to take into account as the background risk as required by the Authority.

10.5. FREQUENCY ASSESSMENT

10.5.1. Based on the hazard identification in *Section 10.4* above, the release scenarios that will be considered in this assessment are summarised in ***Table 10.28***.

Table 10.28 Release Scenarios to Be Considered

Potential Hazardous Source	Equipment	Failure Type	Release Type	Event Outcome
Sinopec/ ExxonMobil Petrol-cum-LPG Filling Station	LPG storage vessel	Catastrophic failure	Instantaneous	Flash fire, VCE
		Partial failure (leak)	Continuous	Flash fire, VCE, jet fire
	LPG road tanker	Catastrophic failure	Instantaneous	Flash fire, VCE, fireball, BLEVE
		Partial failure (leak)	Continuous	Flash fire, VCE, jet fire
	Liquid-inlet pipework	Guillotine failure	Continuous	Flash fire, VCE, jet fire
		Leak	Continuous	Flash fire, jet fire
	Liquid supply line to dispenser	Guillotine failure	Continuous	Flash fire, VCE, jet fire
		Leak	Continuous	Flash fire, jet fire
	Dispenser	Guillotine failure	Continuous	Flash fire, jet fire
	Flexible hose to vessel	Guillotine failure	Continuous	Flash fire, VCE, jet fire
		Leak	Continuous	Flash fire, jet fire
	Flexible hose to vehicle	Guillotine failure	Continuous	Flash fire, jet fire
	Submersible pump flange	Leak	Continuous	Flash fire, VCE, jet fire
	Petrol road tanker (with knock-on effect)	Catastrophic failure	Instantaneous	Fireball, VCE, flash fire
		Partial failure (leak)	Continuous	Pool fire followed by BLEVE, VCE, flash fire
Sinopec HK Oil Terminal Chai Wan	Fuel oil tank (Single tank)	Catastrophic failure	Instantaneous	Bund pool fire, overtop pool fire, sea pool fire, site pool fire
	LPG cylinder	Catastrophic failure	Instantaneous	Flash fire, fireball
		Partial failure (leak)	Continuous	Flash fire, jet fire, BLEVE
	Marine vessel fuel tank	Catastrophic failure	Instantaneous	Sea pool fire
	Fuel oil road tanker	Catastrophic failure	Instantaneous	Site pool fire
		Partial failure (leak)	Continuous	Site pool fire

Potential Hazardous Source	**Equipment**	**Failure Type**	**Release Type**	**Event Outcome**
	Loading arm to fuel oil road tanker	Guillotine failure	Continuous	Site pool fire
	Flexible hose to drum truck	Guillotine failure	Continuous	Site pool fire
	Pump connecting pipeline	Guillotine failure	Continuous	Site pool fire
	Loading hose at jetty for unloading	Guillotine failure	Continuous	Sea pool fire
	Fixed pipeline at jetty	Guillotine failure	Continuous	Sea pool fire
	Dye marker tank	Catastrophic failure	Instantaneous	Site pool fire
LPG Wagon Parking Site	LPG cylinder	Catastrophic failure	Instantaneous	Flash fire, fireball
		Partial failure (leak)	Continuous	Flash fire, jet fire, BLEVE
	Kerosene tanker	Catastrophic failure	Instantaneous	Pool fire
		Partial failure (leak)	Continuous	Pool fire followed by BLEVE
Bus Depot	Diesel tanker	Catastrophic failure	Instantaneous	Pool Fire
		Partial failure	Continuous	Pool Fire

10.5.2. The frequency for each of the identified hazardous scenario is estimated using the best available failure data or historical accident data. The frequencies documented in the relevant sources are reviewed and justified, to reflect the specific operation and risk reduction practices evident at hazardous facilities.

10.5.3. When the historic data on failure frequency is not fully available, failure frequencies of similar installations or events are adopted with suitable modifications. If there is no failure rate data for similar installations or events, the historical accident databases are further reviewed to find out the number of incidents happened in similar installations.

10.5.4. Fault Tree Analysis is adopted to estimate event frequency by considering initial events (e.g. failure probability of a valve) and site specific operation data (e.g. number of LPG tanker visiting the site) through a combination of simple "AND" and "OR" logic gates.

Ignition Probability

10.5.5. For LPG releases, the immediate ignition probabilities are determined in accordance with Cox, Lees and Ang[42], as listed in ***Table 10.29*** below. Immediate ignition probability of 0.3 will be adopted for rupture cases and 0.07 will be adopted for leakage cases. A delay ignition probability of 0.5 is assigned and given a fairly open nature of surrounding, an explosion probability of 0.2 is assumed[43,44]. The estimates by Cox are for general areas where density of ignition source is lower than industrial area, which is appropriate to this assessment.

Table 10.29 Ignition Probabilities from Cox, Less and Ang

Release Rate	**Ignition Probability**	**Release Rate**
	Gas Release	**Liquid Release**
Minor (<1 kg/s)	0.01	0.01
Major (1-50 kg/s)	0.07	0.03
Massive (>50 kg/s)	0.3	0.08

10.5.6. For diesel oil / kerosene release on land, an ignition probability of 0.004 will be adopted in this assessment following the "cautious best estimation" of the PAFF EIA[45]. The ignition probability was assigned to the bund area within PAFF where there was limited vehicle access, limited hot work and no significant source of heating, which are applicable to the Sinopec HK Oil Terminal Chai Wan and bus depots with similar environment.

10.5.7. For diesel oil / kerosene release on sea, same approach as the PAFF EIA will be followed by applying a factor of 10 to the liquid ignition probabilities of Cox, Lee and Ang due to a lower flammability and more difficult to ignite on sea.

[42] Loss Prevention in the Process Industries, F. Lees, Butterworth-Heinemann, United Kingdom, 2005.
[43] Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment, Drainage Services Department, Hong Kong, AEIAR-121/2008
[44] South Island Line, MTR Corporation Limited, AEIAR-155/2010
[45] Permanent Aviation Fuel Facility for Hong Kong International Airport, Airport Authority Hong Kong, AEIAR-107/2007

10.5.8. An immediate ignition of 0.005 and a delay ignition of 0.005 are adopted for the failure events of LPG cylinder by assuming even split[18] between the small leaks[42] in ***Table 10.29***.

<u>Sinopec HK Oil Terminal Chai Wan</u>

10.5.9. The rupture of fuel tanks in a loaded marine vessel considers striking the jetty while it is berthing. Although the marine vessels visiting the jetty of Sinopec HK Oil Terminal Chai Wan are smaller in size and less frequent when compared to the PAFF jetty, the frequency of striking is 8×10^{-6} per movement of marine vessel[13] is directly adopted from PAFF EIA considering a similar nature of operation. Similarly, the spill probability of 0.015 is also adopted as not all strikes will lead to spill from the marine vessel's fuel tank. The storage tanks are assumed to be full 40% of the time that the number of visits by the marine vessels is taken as 365 × 40% = 146 per year. The frequency of spill from the fuel tank of marine vessel is therefore 1.75×10^{-5} per year.

10.5.10. It is mentioned in *Section 10.4* that spills from the rupture of storage tanks and the overtopping of bund from instantaneous failure of storage tank are to be further considered.

10.5.11. The instantaneous release of the complete inventory from an atmospheric tank directly to the atmosphere is 5×10^{-6} per year is adopted according to the TNO purple book[46]. PAFF EIA estimated a cautious best instantaneous release frequency of 5×10^{-9} per tank year. The estimation has however considered that the tanks were new and designed and test to modern standard. For the storage tanks in the Sinopec HK Oil Terminal Chai Wan and an assumption of the tanks are full 40% of the time, the frequency of overtopping the bund is $5 \times 5 \times 10^{-6} \times 0.4 = 1 \times 10^{-5}$ per year.

10.5.12. For off-site spreading of fuel due to overtopping of the bund from multiple tank rupture, the frequency of simultaneous release of the tank's full content is assessed. An instantaneous release of the complete inventory from one single containment atmospheric tank directly to the atmosphere is 5×10^{-6}/year[46]. For a release from 2 tanks would give a failure frequency of $(5 \times 10^{-6})^2 = 2.5 \times 10^{-11}$/year. For a large release from 3 tanks, the failure frequency would reduce to 1.25×10^{-16}/year. The probability of an instantaneous release of more than one tank of the full inventory is much below 1×10^{-9}/year.

10.5.13. Making reference to the failure scenario of the PAFF EIA. Considering a rupture of the interconnection pipe between two automotive diesel oil tanks or two industrial diesel oil tanks while the valves are fail to close, which would cause a release of the full inventory from two tanks simultaneously. Since official information is not available, take an assumption that the diameter of the interconnection pipe is less than 75mm and estimate the length of the interconnection pipe to be 20m from the layout plan (Figure 10.5). The frequency of a full bore rupture of an aboveground <75mm pipeline is 1×10^{-6}/m/year[46] and a valve failure is 3×10^{-4}/year[42]. The failure frequency of the release is $1 \times 10^{-6} \times 40 \times 3 \times 10^{-4} \times 3 \times 10^{-4} = 3.6 \times 10^{-12}$/year. Release from multiple tanks through the pipeline is below 1×10^{-9}/year.

[46] Guidelines for Quantitative Risk Assessment "Purple Book", CPR18E, Committee for the Prevention of Disasters, 2005

10.5.14. The failure frequencies of rupture and leak of a LPG cylinder are 1×10^{-6} per cylinder year[46] and 2.6×10^{-6} per cylinder year respectively[18]. Assume the size of LPG cylinders is evenly distributed between 10.5kg, 16kg and 45kg, that there are around 503 cylinders with a maximum storage capacity of 12 tonnes LPG cylinder. The frequencies of LPG cylinder rupture and LPG cylinder leak are estimated at 5.03×10^{-4} per year and 1.31×10^{-3} per year respectively.

10.5.15. For escalation of LPG cylinder BLEVE, a flame impingement probability of 0.5 is adopted following the South Island Land EIA.

10.5.16. Firefighting facilities are available in the oil terminal according to the New World Depot EIA. A foam spraying network is operated manually for oil tanks, a failure frequency of 0.015 per demand is assumed.

10.5.17. The estimated base event frequencies of hazardous events are summaries in ***Table 10.30*** and the event trees are shown in ***Figure 10.7*** to ***Figure 10.9***.

Table 10.30 Base Failure Frequencies of Hazardous Events for LPG Cylinder Releases (Sinopec HK Oil Terminal Chai Wan)

Hazardous Event	Failure Frequency (per year)
Cold catastrophic failure of marine vessel fuel tank due to striking	5.03E-04
Instantaneous single fuel tank failure	1.00E-05
Cold catastrophic failure of LPG cylinder	1.50E-06
Cold partial failure of LPG cylinder	1.31E-03
BLEVE of LPG Cylinder	4.90E-08

10.5.18. The frequencies of rupture and leak (25mm) of a road tanker are 2.0×10^{-6} per tanker year and 5.0×10^{-6} per tanker year respectively[47]. While the guillotine failure frequency of a loading hose is 9.0×10^{-8} per hour[47] and frequency of full bore rupture of a pump connecting pipeline is 1.0×10^{-4} per year[48].

10.5.19. It is assumed that a transfer operation at the jetty takes 2 hours on average. There are 146 visits as described in ***Section 10.5.9***. The frequencies of hose misconnection, disconnection and vessel steered away are 3×10^{-5}, 2×10^{-6} and 4×10^{-6} per operation respectively[47].

10.5.20. For the rupture of the fixed pipeline at the jetty, the frequency of full bore rupture of a pipeline greater than 150mm is 1×10^{-7} per meter-year[49] (assume the jetty pipeline is 250mm). The length of the fixed pipeline from the storage tank to the jetty is approximately 100m estimated from the site layout plan. The frequency of striking and

[47] Quantitative Risk Assessment Methodology for LPG Installations, Conference on Risk & Safety Management in the Gas Industry, A. Reeves, V. Chow and F. Minah, Hong Kong, 1997
[48] Guidelines for Quantitative Risk Assessment "Purple Book", CPR18E, Committee for the Prevention of Disasters, 2005
[49] Guidelines for Quantitative Risk Assessment "Purple Book", CPR18E, Committee for the Prevention of Disasters, 2005

probability of impact enough to cause a pipeline rupture are 8×10^{-6} per movement of marine vessel and 0.015 respectively as described in ***Section 10.5.9***.

10.5.21. The instantaneous release of the complete inventory from an atmospheric tank of 5×10^{-6} per year is adopted for the dye marker tank. The number of filling is also assumed to be 146 per year (0.4×365).

10.5.22. For the rocketing of dye marker tank, considering a pool fire due to overtopping of the bund that engulfs the dye marker tank; frequency of overtopping the bund is 1×10^{-5} per year (Section 10.5.11) with an ignition probability of 0.004. Following that, the fire service fails to put off the fire, a failure probability of 0.5 for an engulfment fire is assumed[51]. The pressure relief valve of the tank then fails to depressurize the tank with a failure probability of 0.02 according to Lee's Loss Prevention in the Process Industries[50] (an open vent is installed on the dye marker tank as confirmed in a site survey that will have a much lower failure probability than a relief valve, 0.02 is adopted as a conservative approach). Finally, the bottom seam of the tank must then be fail instead of the top seam, a probability of 0.5 is taken. Therefore, an unbunded pool fire escalating to dye marker tank rocketing is estimated to be: $1 \times 10^{-5} \times 0.004 \times 0.5 \times 0.02 \times 0.5 = 2.0 \times 10^{-10}$ per year. The frequency calculated is therefore below 1×10^{-9} per year and is not considered in the study.

10.5.23. It should also note that dye marker has a typical boiling point of 450^{o}C and a flash point of 220-250^{o}C, taking into account (1) a storage temperature is much below the flash point, (2) time is required to boil off the liquid to form vapour causing a tank failure (fire services is reasonably reliable in Hong Kong), (3) liquid will be released at the bottom of the tank instead of pressurized vapour during failure and (4) the stands of the tank are mechanically mounted on a concrete base, the actual risk would be even lower. It can conclude that rocketing of the dye marker tank is very remote.

10.5.24. Typical loading line at a jetty is incorporated with an emergency release coupler, the failure frequencies of the coupler is taken as 0.013[51]. For unloading hose failure, there is personnel who would initiate an emergency shutdown, the probability of isolation failure is taken as 0.1 for human error that failure to start an emergency shutdown system.

10.5.25. There is no updated information from the operator of the Sinopec HK Oil Terminal Chai Wan in relation to the number of road tanker and drum truck for fuel oil filling. The number of visit of road tanker and drum truck are therefore directly quoted from the NWFB Depot EIA as 6000 road tanker filling operations per year and 60 drum trucks per day; bulk filling operation is assumed to have a duration of 2 hours. Where the pump in the pump farm is in service for 5 hours a day and 300 days per year.

10.5.26. The fault tree analysis is given in ***Appendix 10.4*** and the event tree analysis is illustrated in ***Figure 10.10 and Figure 10.12***. The base event frequencies are summarized in ***Table 10.31*** below.

[50] Loss Prevention in the Process Industries, F. Lees, Butterworth-Heinemann, United Kingdom, 2005.
[51] Quantitative Risk Assessment Methodology for LPG Installations, Conference on Risk & Safety Management in the Gas Industry, A. Reeves, V. Chow and F. Minah, Hong Kong, 1997

Table 10.31 Base Failure Frequencies of Hazardous Events for Bulk Filling Operations (Sinopec HK Oil Terminal Chai Wan)

Hazardous Event	Failure Frequency (per year)
Cold catastrophic failure of fuel oil road tanker	3.08E-06
Cold partial failure (25mm leak) of fuel oil road tanker	1.28E-05
Rupture of loading arm during loading to fuel oil road tanker	2.44E-02
Rupture of flexible hose during loading to drum truck	2.08E-01
Full bore rupture of pump connecting pipeline in pump farm	1.71E-06
Rupture of jetty loading hose during marine vessel unloading	3.54E-04
Full bore rupture of fixed pipeline from fuel oil tank to jetty	1.76E-05
Cold catastrophic failure of dye marker tank	3.41E-05

Sinopec and ExxonMobil Petrol-cum-LPG Filling Station

10.5.27. Release frequencies of LPG events are derived from "Quantitative Risk Assessment Methodology for LPG Installations"[52]. The methodology for frequency estimation will also be consistent with the approach of previous approved QRA[53] and EIA reports[54,55].

10.5.28. The inventories of underground vessel and road tanker are assumed to vary within a day as a result of consumption and refilling, the assumptions on inventory variation will follow that in Kai Tak Development EIA with justification. For underground LPG vessel, it is assumed that the vessel is nominally full (85% maximum capacity of vessel) in 20% of time and nominally 60% full in 80% of time. For road tanker, it is assumed that the inventory is full in 20% of time and 50% full in 80% of time.

10.5.29. For escalation event, the scenarios involving a jet fire impinging on the road tanker and a pool fire engulf the road tanker are considered.

10.5.30. Jet fire impingement from dispenser and flexible hose and engulfment by pool fires from a petrol tanker spillage, which could result in BLEVE of LPG road tanker. The probability of jet flame impingement is taken as 1/6 for aboveground pipework as in SIL EIA[56] and 1/12 for dispenser and vehicle filling hose considering a larger separation of LPG road tanker from dispensers. While a conservative factor of 0.5 is assumed for pool

[52] Quantitative Risk Assessment Methodology for LPG Installations, Conference on Risk & Safety Management in the Gas Industry, A. Reeves, V. Chow and F. Minah, Hong Kong, 1997
[53] Quantitative Risk Assessment of Proposed LPG Filling Station at Kwai Chung, DNV, 2002
[54] Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment, Drainage Services Department, Hong Kong, AEIAR-121/2008
[55] Kai Tak Development, Civil Engineering and Development Department, AEIAR-130/2009
[56] South Island Line, MTR Corporation Limited, AEIAR-155/2010

fire engulfment due to petrol road tanker release, which is a relative high factor by assuming an even distribution of opportunity for an LPG road tanker to be engulfed by the pool fire. Catastrophic rupture of a road tanker will be resulted that is already a worst case that no other knock on events have been identified.

10.5.31. To result in a petrol fire, an ignition source must be presence. Ignition probabilities of 0.08 and 0.03 are assigned for rupture and larger / medium leak of petrol road tanker respectively in accordance with the ignition probability of liquid release by Cox, Lees and Ang in ***Table 10.29***.

10.5.32. Hazards from an accidental LPG release can be prevented or mitigated by the safety provisions at the LPG filling station. The following failure probabilities in ***Table 10.32*** are assumed based on the previous “QRA methodology for LPG Installations” and Lees.

Table 10.32 Failure of Safety Provisions

Item	Failure probability	Remark
Excess Flow Valve (LPG vessel)	0.13 per demand	
Excess Flow Valve (LPG road tanker)	0.013 per demand	
Excess Flow Valve (LPG dispenser)	0.013 per demand	Same one-year test interval as the LPG road tanker
Non-Return Valve	0.013 per demand	
ESD Trip System Fails	1×10^{-4} per demand	
Breakaway Coupling	0.013 per demand	
Double-Check Filler Valve	2.6×10^{-3} per demand	
Water Spray System	0.015 per demand	
Chartek Coating under Jet Fire Attack	0.1 per demand	
Fire Service to Prevent BLEVE (Jet Fire Impingement on the Road Tanker)	0.5 per demand	
Pressure Relief Valve	0.01 per demand	PFD ranges from $1\text{x}10^{-2}$ to $1\text{x}10^{-4}$ per demand from Lees
Truck Pump Over-pressure Protection System (LPG Road Tanker)	1×10^{-4} per demand	Emergency protection

10.5.33. The fault trees are shown in ***Appendix 10.4*** and the event trees are shown in ***Figure 10.13*** to ***Figure 10.17***. The estimated base event frequencies of hazardous events are summaries in ***Table 10.33***.

Table 10.33 Base Failure Frequencies of Hazardous Events (Petrol-cum-LPG Filling Stations)

Hazardous Event	Inventory	Failure Frequency (per year)	
		Sinopec Station	ExxonMobil Station
Cold catastrophic failure of LPG storage vessel	100%	4.82E-08	9.53E-08
Cold catastrophic failure of LPG storage vessel	60%	1.93E-07	3.81E-07
Cold partial failure of LPG storage vessel	100%	1.50E-06	2.93E-06
Cold partial failure of LPG storage vessel	60%	5.99E-06	1.17E-05
Cold catastrophic failure of LPG road tanker	100%	6.20E-08	1.20E-07
Cold catastrophic failure of LPG road tanker	50%	2.48E-07	4.81E-07
Cold partial failure of LPG road tanker	100%	2.62E-07	4.99E-07
Cold partial failure of LPG road tanker	50%	1.05E-06	2.00E-06
Guillotine failure of liquid-inlet pipework (rupture)	100%	3.26E-09	6.23E-09
Guillotine failure of liquid-inlet pipework (rupture)	60%	1.31E-08	2.49E-08
Partial failure of liquid-inlet pipework (leak)	100%	4.18E-07	7.98E-07
Partial failure of liquid-inlet pipework (leak)	60%	1.67E-06	3.19E-06
Guillotine failure of liquid supply line to dispenser (rupture)	100%	8.51E-08	1.37E-07
Guillotine failure of liquid supply line to dispenser (rupture)	60%	3.40E-07	5.48E-07
Partial failure of liquid supply line to dispenser (leak)	100%	1.65E-06	2.97E-06
Partial failure of liquid supply line to dispenser (leak)	60%	6.61E-06	1.19E-05
Failure of dispenser	100%	7.27E-06	1.71E-05
Failure of dispenser	60%	2.91E-05	6.84E-05
Guillotine failure of flexible hose to vessel (rupture)	100%	2.59E-06	4.94E-06
Guillotine failure of flexible hose to vessel (rupture)	50%	1.04E-05	1.98E-05
Partial failure of flexible hose to vessel (leak)	100%	7.27E-06	1.39E-05
Partial failure of flexible hose to vessel (leak)	50%	2.91E-05	5.55E-05
Guillotine failure of flexible hose to vehicle (rupture)	100%	1.69E-04	5.92E-04
Guillotine failure of flexible hose to vehicle (rupture)	60%	6.77E-04	2.37E-03

Hazardous Event	Inventory	Failure Frequency (per year)	
		Sinopec Station	ExxonMobil Station
Submersible Pump Flange Leak	100%	1.00E-06	1.00E-06
Submersible Pump Flange Leak	60%	4.00E-06	4.00E-06
BLEVE of LPG road tanker (fire escalation)	100%	4.69E-11	1.78E-10
BLEVE of LPG road tanker (fire escalation)	50%	1.88E-10	7.11E-10

10.5.34. For petrol road tanker failure in petrol-cum-LPG filling station, the failure frequencies are shown in the fault tree in ***Appendix 10.4*** and event tree in ***Figure 10.18***. The failure frequencies of catastrophic rupture and partial failure of road tanker are further modified to consider the escalation effect due to vapour cloud explosion from LPG failure releases. The calculation of failure frequency is shown in ***Table 10.34*** below.

Table 10.34 Escalation Failure Frequencies of Petrol Road Tanker Due to LPG Explosion

Hazardous Event	Inventory	Failure Frequency without knock-on Effect (per year)	Fraction of Time Onsite [1]	Escalation Frequency [2]	Failure Frequency with knock-on Effect (per year)	Failure Frequency without knock-on Effect (per year)	Fraction of Time Onsite [1]	Escalation Frequency [2]	Failure Frequency with knock-on Effect (per year)
		Sinopec	Sinopec	Sinopec	Sinopec	ExxonMobil	ExxonMobil	ExxonMobil	ExxonMobil
Cold catastrophic failure of petrol road tanker	100%	1.85E-8	0.04	1.13E-8	1.90E-08	6.40E-08	0.14	1.96E-8	6.68E-08
Cold catastrophic failure of petrol road tanker	50%	7.41E-8	0.04	4.53E-8	7.60E-08	2.56E-07	0.14	7.83E-08	2.67E-07
Cold partial failure of LPG petrol road tanker	100%	7.82E-08	0.04	1.13E-8	7.86E-08	2.66E-07	0.14	1.96E-8	2.69E-07
Cold partial failure of LPG petrol road tanker	50%	3.13E-07	0.04	4.53E-8	3.15E-07	1.06E-06	0.14	7.83E-08	1.07E-06

Note [1]: Fraction of time onsite = No. of road tanker per year × Time of presence / 24 / 365. Time of presence is assumed to be 2 hours per delivery.

Sinopec: Fraction of time onsite = 183 × 2 / 24 / 365 = 0.04

ExxonMobil: Fraction of time onsite = 621 × 2 / 24 / 365 = 0.14

Note [2]: Escalation frequency = LPG BLEVE frequency + VCE frequency from cold catastrophic failure of LPG storage vessel + VCE frequency from LPG guillotine failure of liquid supply line to dispenser. (i) LPG BLEVE frequency due to petrol road tanker jet fire is excluded from the escalation frequency. (ii) VCE frequencies due to cold catastrophic failure of LPG road tanker, guillotine failure of LPG liquid-inlet pipework and guillotine failure of flexible hose to LPG vessel are excluded as LPG road tanker unloading is not carried out simultaneously with petrol road tanker unloading.

Sinopec: Escalation frequency = 1.90E-10 + 1.69E-8 + 3.96E-8 = 5.66E-8 per year

ExxonMobil: Escalation frequency = 7.23E-10 + 3.34E-8 + 6.38E-8 = 9.79E-8 per year

Note [3]: Following the same practice as that of LPG road tanker, petrol road tanker is assumed that the inventory is full in 20% of time and 50% full in 80% of time.

LPG Wagon Parking Site

10.5.35. The frequency of rupture of LPG cylinder on wagon is 6.8×10^{-6} per vehicle year while that of leak is 2.6×10^{-6} per cylinder year[18]. Assume 3 number of LPG wagons onsite that each contains 250 number of 10.5kg LPG cylinders, the frequencies of LPG cylinder rupture and leak are 2.4×10^{-5} per year and 1.95×10^{-3} per year.

10.5.36. Failure frequencies for rupture and leak of kerosene tanker are 2.0×10^{-6} per tanker year and 5.0×10^{-6} per tanker year respectively[57]. The LPG wagons and kerosene road tanker are assumed to be parked onsite for 24 hours, which is already conservative as the wagons and road tankers will be offsite for commercial activities.

10.5.37. The estimated base event frequencies of hazardous events are summaries in ***Table 10.35.*** The fault trees are shown in Appendix 10.4 and the event trees are shown in ***Figure 10.19*** to ***Figure 10.20***.

Table 10.35 Base Failure Frequencies of Hazardous Events (LPG Wagon Site)

Hazardous Event	Failure Frequency (per year)
Cold catastrophic failure of LPG cylinder	2.04E-05
Cold partial failure of LPG cylinder	1.95E-03
Cold catastrophic failure of kerosene tanker	2.02E-06
Cold partial failure of kerosene tanker	5.00E-06
BLEVE of LPG cylinder	4.98E-07

Diesel Storage in NWFB and Citybus Depots

10.5.38. The base failure frequency for tanker rupture and for tanker leak are 2.0×10^{-6} and 5.0×10^{-6} per tanker year respectively by taking reference from petrol/diesel tanker failure in the SIL EIA[18, 57].

10.5.39. The number of road tanker and the corresponding unloading time in the NWFB Depot and Citybus Depot are provided by the proposed Project operators as shown in ***Table 10.4***. The frequencies for release of diesel from road tanker are summarised in ***Table 10.36*** below and the fault trees and event trees are shown in ***Appendix 10.5*** and ***Figure 10.21*** respectively.

10.5.40. Taking into account the ignition probability, firefighting and water spray system of the depot, the frequencies of pool fire as a result of diesel tanker release are above 1×10^{-9} /year. Pool fire due to release from diesel tanker is therefore further considered in the study.

10.5.41. Since smoke plume is generated from the pool fire from ignition of diesel tanker releases, the frequencies of smoke plume is the same as that of the pool fire frequencies.

[57] Risk Assessment for the Siting And Developments Near Liquefied Petroleum Installations, Crossthwaite, P. J., Fitzpatrick, R. D., and Hurst, N. W., 1988

Table 10.36 Frequencies of Release from Diesel Road Tanker

Hazardous Event	Frequency (per tanker year)	Frequency of release (per year)		Frequency of Pool Fire / Smoke Plume (per year)	
		NWFB	Citybus	NWFB	Citybus
Tanker rupture	2.0E-6	5.34E-07	2.50E-07	2.14E-09	1.00E-09
Tanker medium liquid leak (Hole size: 25mm)	5.0E-6	2.87E-06	1.88E-06	1.15E-08	7.51E-09

External Events: Aircraft Crash

10.5.42. The Project site is located around 32 km from the Hong Kong International Airport. The frequency of aircraft crash is estimated using the HSE methodology[58].

10.5.43. The model takes into account specific factors such as the target area of the proposed hazard site and its longitudinal (x) and perpendicular (y) distances from the runway threshold. The crash frequency per unit ground area (per km^2) is calculated as:

$$g(x,y) = NRF\,(x,y)$$

10.5.44. Where N is the number of runway movements per year and R is the probability of an accident per movement (landing or take-off). $F_L(x,y)$ gives the spatial distribution of crashes for landing and is given by:

$$F_L(x,y) = \frac{(x+3.275)}{3.24} e^{\frac{-(x+3.275)}{1.8}} \left[\frac{56.25}{\sqrt{2\pi}} e^{-0.5(125y)^2} + 0.625 e^{-\frac{|y|}{0.4}} + 0.005 e^{-\frac{|y|}{5}} \right]$$

for x >-3.275 km

10.5.45. For aircraft take-off,

$$F_T(x,y) = \frac{(x+0.6)}{1.44} e^{\frac{-(x+0.65)}{1.2}} \left[\frac{46.25}{\sqrt{2\pi}} e^{-0.5(125y)^2} + 0.9635 e^{-4.1|y|} + 0.08 e^{-|y|} \right]$$

for x >-0.6 km

10.5.46. The 10-year moving average of the NTSB fatal accidents[59] suggests a downward trend in recent years of a failure rate of about 1×10^{-7} per flight. However, only 18.7% of accidents are associated with the approach to landing, 14% are associated with take-off

[58] The Calculation of Aircraft Crash Risk in the UK, Health and Safety Executive, United Kingdom, 1997.
[59] Aviation Statistical Reports, US National Transportation Safety Board, https://www.ntsb.gov/data/aviation_stats.html

and 4.7% are related to the climb phase of the flight according to the Annual Review of Aircraft Accident Data. The accident frequency for the approach to landings hence becomes 1.87×10^{-8} per flight and for take-off/ climb 1.87×10^{-8} per flight.

10.5.47. The number of flights from 2001 to 2013 is extracted from the Civil Aviation Department[60], and extrapolated to year 2016 and 2018 by adopting an annual growth rate of 5% for passenger and cargo traffic based on data from Hong Kong International Airport[61]. The number of flights at Chek Lap Kok for year 2016 and 2018 are estimated at 430,729 and 474,879 respectively.

10.5.48. The distance x and y are estimated to be 29 km and 15 km respectively. By applying the equations, the calculated crash frequencies and impact frequencies in 2016 and 2018 are given in ***Table 10.37*** and ***Table 10.38*** below.

Table 10.37 Aircraft Crash Frequency

Year	Estimated no. of flight	Distance from runway (km)				Crash Frequency (/km^2/yr)				
		07L/25R		07R/25L		07L	25R	07R	25R	Total
		x	y	x	y	Take off	Land-ing	Take off	Land-ing	
2016	430,729	29	15	29	15	9.05E-21	4.35E-14	9.05E-21	4.35E-14	8.70E-14
2018	478,879	29	15	29	15	9.97E-21	4.79E-14	9.97E-21	4.79E-14	9.59E-14

Table 10.38 Aircraft Impact Frequency

Year	Estimated no. of flight	Area of ExxonMobil Petrol-cum-LPG Filling Station[1] (km^2)	Impact Frequency (/yr)
2016	430,729	0.0126	1.10E-15
2018	478,879	0.0126	1.21E-15

Note:

Area is conservatively taken as the area of NWFB Depot since its area is the largest when compared to other identified potential hazardous sources such as the Sinopec and ExxonMobil Petrol-cum-LPG Filling Stations.

The calculated impact frequency is around 1×10^{-15} per year, which is much less than 1×10^{-9} per year. The impact of aircraft crash will therefore not be further considered in this assessment.

[60] Hong Kong International Airport Hong Kong International Airport (2001-2004), Civil Aviation Department, http://www.cad.gov.hk/english/p-through.htm

[61] Demand Forecast, Hong Kong International airport, https://www.hongkongairport.com/eng/future/an-engine-for-growth/demand-forecast.html

External Events: Earthquake

10.5.49. Hong Kong is situated on the southern coast of China. Hong Kong is not located within the seismic belt and according to Hong Kong Observatory, earthquakes occurring in the circum-Pacific seismic belt which passes through Taiwan and Philippines are too far away to affect Hong Kong significantly. Buildings and infrastructures in Hong Kong are designed to withstand earthquakes up to Modified Mercali Intensity (MMI) VII.

10.5.50. It is estimated that MMI VIII is of sufficient intensity to cause damage to specially designed structures. In this analysis it is assumed that such earthquake may result in storage vessel leakage and pipework rupture at a probability of 0.01[62]. The probability of earthquake occurrence at MMI VIII and higher in Hong Kong is very low comparing with other regions and is estimated to be 1.0 x 10^{-5} per year[63].

External Events: Helicopter Crash

10.5.51. Helicopter accidents during take-off and landings are confined to a small area around the helipad, extending up to 200 m only from the centre of the helipad. 93% of accidents occur within 100m of the helipad. The remaining 7% occur between 100 and 200 m of the helipad[64].

10.5.52. The nearest helicopter landing pad is located at the Pamela Youde Nethersole Eastern Hospital. The distance of the helicopter landing pad to the potential hazardous sources are listed in ***Table 10.39*** below. Since the distance to nearest helicopter landing pad is about 585 m away, only the background crash rate for helicopters is considered in this report.

10.5.53. From a study in the previous approved EIA report, the background crash rate for helicopter is $1.0\times10^{-5}/km^2/year$[65] and hence, by accounting for the target area of each potential hazardous source, the background crash frequencies for helicopter are calculated and summarised as in ***Table 10.39***.

Table 10.39 Background Helicopter Crash Frequencies

Potential Hazardous Sources	Approximate Distance to The Nearest Helicopter Landing Pad (m)	Site Area (m^2)	Estimated Helicopter Crash Frequency (per year)
Sinopec HK Oil Terminal Chai Wan	850	2,970	2.97E-08
Sinopec Petrol-cum-LPG Filling Station	825	486	4.86E-09

62 Risk of Hazardous Materials Release Following an Earthquake, K. J. Tierney, Disaster Research Centre, University of Delaware, 1990
63 Quantitative Risk Assessment Methodology for LPG Installations, Conference on Risk & Safety Management in the Gas Industry, A. Reeves, V. Chow and F. Minah, Hong Kong, 1997
64 The Calculation of Aircraft Crash Risk in the UK, Health and Safety Executive, United Kingdom, 1997
65 Tsuen Wan Bypass, widening of Tsuen Wan Road between Tsuen Tsing Interchange and Kwai Tsing Interchange, and associated junction improvement works, Civil Engineering and Development Department, AEIAR-124/2008

Potential Hazardous Sources	Approximate Distance to The Nearest Helicopter Landing Pad (m)	Site Area (m^2)	Estimated Helicopter Crash Frequency (per year)
ExxonMobil Petrol-cum-LPG Filling Station	600	3,930	3.93E-08
LPG Wagon Parking Site	585	1,870	1.87E-08
Diesel Storage in NWFB Depot	700	1,264	1.26E-08
Diesel Storage in Citybus Depot	485	11,116	1.11E-07
DGs Storage in the Proposed Project	630	6,987	6.99E-08

External Events: Vehicle Crash

10.5.54. Road traffic accident statistics in ***Table 10.40*** below as from the Transport Department shows 85% of all road accidents in Hong Kong are slight collision, 14% (take 20% in the aftermentioned calculation) are serious collision and 1% are fatal collision. Most of the road accidents are related to speeding, crossing the road, drunk / drug drive, poor road condition, bad weather, etc. In this assessment, it is assumed fatal accidents have the potential to cause catastrophic rupture of the tanker or guillotine failure of pipework, and serious accidents have the potential to cause leakage of the tanker / pipework.

10.5.55. Speed limit, sufficient lighting, well maintained concrete floor and warning signs are assumed to be provided in bus depot, oil terminal and LPG filling stations. To account for the aforementioned provisions, a modification factor of 0.5 is conservatively applied, i.e. the probability of fatal and serious damage in an impact accident is taken as 1% × 0.5 = 0.5% and 20% × 0.5 = 10%, respectively. For the liquid-inlet pipework at the LPG filling point, a modification factor of 0.1 is applied considering the extra protection from the crash barrier (Metal protection poles, ***Figure 10.6***), i.e., the probability of 0.1% and 2% is adopted for fatal and serious damage in an impact accident.

Table 10.40 Road Traffic Accidents by Severity (2008 - 2012)

Severity	Year						
	2008	2009	2010	2011	2012	Sum	%
Fatal	143	126	114	128	116	627	0.8
Serious	2,096	1,943	2,052	2,190	2,385	10,666	14.2
Slight	12,337	12,247	12,777	13,223	13,393	63,977	85.0
Total	14,576	14,316	14,943	15,541	15,894	75,270	100.0

External Events: Landslide

10.5.56. The nearest slope in the vicinity is adjacent the Island Eastern Corridor that across the Shing Tai Road and MTR rail track, risk due to landslide on the potential hazardous sources and the Project site is considered negligible.

External Events: Lightning Strike

10.5.57. Lightning sparks could ignite the combustible gas in air in case of leakage. Most tank fire accidents caused by lightning are due the ignition of hydrocarbon leak around the seal of the floating roof oil storage tanks. Petrol-cum-LPG filling stations and oil terminals are protected with lighting conductors to safety earth direct lightning strikes. The grounding will be inspected regularly. Plus the frequency of lightning strike on a properly protected building structure is extremely low in Hong Kong. The chance of lightning strike is therefore very remote and ignition due to lightning strike is taken to be covered by the ignition probability.

External Events: Subsidence

10.5.58. Excessive subsidence may lead to failure of the structure and ultimately loss of containment scenario. However, subsidence is usually slow in movement and such movement can be observed and remedial action can be taken in time. Risk from subsidence is therefore deemed remote and not further considered.

External Events: Typhoon / Tsunami

10.5.59. LPG filling stations, oil storage tank and building structures are designed safe to withstand the wind load for typhoon. The site is not threatened by tsunami with Hong Kong Island located between Victoria Harbour and South China Sea. Therefore the risk is deemed unlikely and not further considered in the analysis.

External Events: External fire

10.5.60. External fire refers to the occurrence of a fire event outside the potential hazardous sources which may lead to the failure of the facilities. This might be expected from road accidents on the public road, probably involving car crash or engine failures (e.g. overheating during hot summer). The resulting fire is usually small, only affecting a few meters around the car, and could be quickly extinguished using fire extinguishers or by the fire brigade. The key facilities inside are further protected by concrete building structures (e.g. the LPG vessel compartment, bus depot and fence wall of oil terminal) and activation of emergency shutdown system for potential external fire threat. The risk of escalation of external fire to the potential hazardous sources is deemed remote and not further considered in the analysis.

External Events: Dropped Object

10.5.61. A Petrol-cum-LPG filling station is sheltered by a roof and the bus depots are located within a building. Where there is no building in the close vicinity of the Sinopec HK Oil Terminal Chai Wan that is high enough to drop an object. And the nearest building to the LPG Wagon Parking Site is around 30m away. Thus, the threat from dropped objects to the potential hazardous installation is insignificant and not further assessed in the analysis.

10.6. CONSEQUENCE ANALYSIS

10.6.1. The consequence assessment is conducted in two steps: (1) Source term modelling to determine the release rate, duration and quantity; (2) Physical effects modelling to determine the gas dispersion, fire and explosion effects zone based on the output of source term modelling. The impact of the hazardous outcomes on the surrounding population is analyzed.

10.6.2. In this study, the simulation software SAFETI 6.7 by Det Norske Veritas (DNV) is employed to calculate the hazardous release and the effects zones.

Source Term Modelling

10.6.3. The DGs involved in this study are modelled as mixtures of hydrocarbons. To enable the assessment, simple mixtures or representative component will be used for the risk model building. Assumptions are made as follows:

- LPG is modelled as mixture of propane and n-butane in 30:70 ratio by mass.
- Petrol, diesel, kerosene and dye marker– petrol with a flash point lower than 23 ^{o}C is modelled as n-pentane and diesel/kerosene/dye marker with a flash point higher than 23 ^{o}C is modelled as nonane[66].
- The toxic effect of smoke is modelled using carbon monoxide as its toxicity causes the majority of deaths in fire[67].

10.6.4. For continuous release, release duration is based on time to empty the whole content of tank/cylinder.

10.6.5. For instantaneous failure of container, whole content of a tank is used. In case of continuous release, release parameters such as release rate and exit velocity are calculated by discharge model according to storage conditions. Release parameters together with release duration are then fed into dispersion model to calculate the effect.

Physical Effects Modelling

10.6.6. The following section briefly describes major mathematical models applied to various fire and dense gas dispersion in the consequence model.

Gas Dispersion

10.6.7. The Unified Dispersion Model (UMD), which is the dispersion model used in PHAST of SAFETI software to assess the dispersion, without rainout effect will be used for the dispersion in non-immediate ignition scenarios. The model takes into account various transition phases, from dense cloud dispersion to buoyant passive gas dispersion, in both instantaneous and continuous releases. Besides, toxic effect will be evaluated using the

[66] Guidelines for Quantitative Risk Assessment “Purple Book”, CPR18E, Committee for the Prevention of Disasters, 2005
[67] HSE, SPC/Tech/OSD/30, Methods of approximation and determination of human vulnerability for offshore major accident hazard assessment. 2011

UDM dispersion model when the cloud reaches population sites for release of gas without ignition.

10.6.8. Upon release of flammable gas, a number of possible outcomes may be occurred depended on whether the gas is ignited immediately or ignited after a period of time. The dispersion characteristics will be influenced by the meteorological conditions and the material properties, such as density, of the released gas.

10.6.9. Fire scenarios of different kinds may be developed in the presence of ignition source in the proximity of gas release. If no ignition source exist, the gas cloud may disperse downwind and be diluted to the concentration below its Lower Flammable Limit (LFL). In this case, no harm effect is anticipated since the gas would become too lean to ignite.

Fireball and BLEVE

10.6.10. Immediate ignition of an instantaneous release of the whole inventory inside a pressurized vessel will result in a fireball. A fireball is characterized by its high thermal radiation intensity and short duration time. The principal hazard of fireball arises from thermal radiation, which is not significantly influenced by weather, wind direction or source of ignition. A BLEVE is similar to a fireball except that it is caused by integrity failure from fire impingement and therefore occurs as fire escalation events. The physical effects are calculated in the same way as fireballs. A 100% fatality is assumed for anyone within the fireball radius. For persons indoor within the fireball radius, a 50% fatality is assumed.

Jet Fire

10.6.11. When a pressurised flammable gas is released and ignited immediately, a jet fire will occur. The momentum of the release carries the flammable substance forward in a long plume, giving a flammable mixture by entraining air. Combustion in a jet fire occurs in the form of a strong turbulent diffusion flame, which is heavily influenced by the momentum of the release. The major concern regarding jet fire is the heat radiation effect generated from the fire. The thermal effect to adjacent population will be quantified in the consequence model.

Flash Fire

10.6.12. Following a hazardous gas release, it may form a flammable gas cloud initially located around the release point. If this cloud does not get ignited immediately, it will move in the downwind direction and be diluted as a result of air entrainment. Flash fire is the consequence of combustion of gas cloud resulting from delayed ignition. The flammable gas cloud can be ignited at its edge and causes a flash fire of the cloud within the Lower Flammable Limit (LFL) and Upper Flammable Limit (UFL) boundaries.

10.6.13. Major hazards from flash fire are thermal radiation and direct flame contact. Since the flash combustion of a gas cloud normally lasts for a short duration, the thermal radiation effect on people near a flash fire is limited. Humans who are encompassed outdoors by the flash fire will be fatally injured. A fatality rate of unity is assumed for outdoor population, and 90% protection factor is assumed for indoor.

Vapour Cloud Explosion

10.6.14. When there is a large amount of pressurised gas rapidly releasing to the atmosphere from a pressurised tank, a vapour cloud will be formed, dispersed and mixed with the surrounding air. If the vapour cloud is passing through a confined/ semi-confined environment and gets ignited, the confinement will limit the degree of expansion of the burning cloud and create an overpressure and explosion. This type of explosion is called a VCE.

Thermal Radiation

10.6.15. Hazardous consequences, such as jet fire, flash fire etc. will be assessed using PHAST's consequence models. Fatality probability of various hazardous event outcomes will be evaluated at a number of end-point criteria in each type of hazard outcome. The estimation of the fatality / injury caused by a physical effect such as thermal radiation requires the use of Probit equations, which describe the probability of fatality as a function of some physical effect. The probability of fatality, Pr, due to exposure to heat radiation, i.e. jet fire and fireball is given by the following probit relationship by Eisenberg et al. which provides one of the more conservative estimates[68]:

$$\mathrm{Pr} = -14.90 + 2.56\, In\, Q^{\frac{4}{3}}t$$

Where,

Pr is the probit associated with the probability of fatality;

Q is the heat radiation intensity (kW/m^2); and

t is the exposure time (s).

Smoke (Carbon Monoxide)

10.6.16. The toxicity of carbon monoxide is due to the formation of blood carboxyhaemoglobin. This results in a reduction of the supply of oxygen to critical body organs and is referred to as anemic anoxia. The probit function for death due to toxic exposure to carbon monoxide is given by TNO Purple Book[69]:

$$\mathrm{Pr} = -7.4 + In\, \mathrm{C}t$$

Where,

Pr is the probit associated with the probability of fatality;

C is the concentration (mg/m^3); and

t is the exposure time (s).

[68] Vulnerability model. A simulation system for assessing damage resulting from marine spill , Eisenberg N A, et al., 1975

[69] Guidelines for Quantitative Risk Assessment "Purple Book", CPR18E, Committee for the Prevention of Disasters, 2005

Height Protection Factor

10.6.17. Following the methodology for LPG installations[70], a protection factor is used to factor down those population below the dispersed LPG cloud in the risk summation for flash fire events.

10.6.18. A cloud height of 36m is resulted from the catastrophic rupture of a LPG road tanker, which is highest cloud height amongst the LPG failure scenarios. Buildings are assumed to be 3 m for each storey.

10.6.19. The protection factor is determined by considering the height of a building relative to the dispersed cloud height, i.e., 36m divided by the height of a building.

Shielding factor

10.6.20. Shielding factors are used to allow for the shielding of buildings by other buildings from fireball effects. A shielding factor of 0.5 is assigned to those buildings within the fireball diameter, outside the fireball and partly inside and partly outside the fireball. The shielding factor is applied to the following populations:

ID	**Buildings Assigned with Fireball Shielding Factor**
1	Heng Fa Chuen Block 48, 49, & 50
3	Seawater Pump House
8	Government Logistics Centre
10	HKE Heng Fa Chuen Substation
12	NWFB Depot
13	Proposed Project
15	Citybus Depot
16	Planned THEi New Campus in Chai Wan
18	Hong Kong Institute of Vocational Education (Chai Wan)
19	Knight Court
20	MTR Chai Wan Depot
21	EMSD Workshop
24	Chai Wan Industrial City, Phase II
25	Chai Wan Industrial City, Phase I
26	Cornell Centre
27	Tsui Hong House, Tsui Wan Estate
28	Tsui Shou House, Tsui Wan Estate
29	Tsui Fuk House, Tsui Wan Estate
31	Hang Tsui Court Indoor Carpark
32	Hang Tsui Court
33	TWGHs & LKWFSL Mrs Fung Yiu Hing Memorial Primary School

[70] Quantitative Risk Assessment Methodology for LPG Installations, Conference on Risk & Safety Management in the Gas Industry, A. Reeves, V. Chow and F. Minah, Hong Kong, 1997

10.7. RISK ASSESSMENT

Risk Summation

10.7.1. By summation of the results of meteorological data, frequency estimation and consequence analysis, risk levels of the assessed scenarios will be characterised in terms of individual risk (presented by individual risk contours).

10.7.2. By combining the results of population data, meteorological data, frequency estimation and consequence analysis, societal risk of the assessed scenarios will be characterised in terms of F-N curves and Potential Loss of Life (PLL).

10.7.3. The above steps will be done by using MPACT in the SAFETI software suite version 6.7.

Individual Risk Results

10.7.4. The individual risk contours of the Sinopec HK Oil Terminal Chai Wan, Sinopec Petrol-cum-LPG Filling Station, ExxonMobil Petrol-cum-LPG Filling Station, LPG Wagon Parking Site, NWFB Depot and Citybus Depot are illustrated in ***Figure 10.22*** to ***Figure 10.27*** respectively. The overall individual risk contours are presented in ***Figure 10.28***.

10.7.5. For Sinopec HK Oil Terminal Chai Wan, Sinopec Petrol-cum-LPG Filling Station, ExxonMobil Petrol-cum-LPG Filling Station, LPG Wagon Parking Site, NWFB Depot and Citybus Depot, the corresponding individual risks to offsite population are lower than 1×10^{-5}/year and decrease at distances further away from the installations. Therefore in terms of individual risk, the criteria set in Section 2 of Annex 4 of the EIAO-TM are satisfied and no residual impact is anticipated.

10.7.6. It should be noted that the individual risk contours are independent of the population sets and are therefore consistent in both construction and operation phases.

Societal Risk Results

<u>Construction Phase</u>

10.7.7. The F-N curves of Case 1 and Case 2 compare the societal risks in the construction phase without and with construction workers of the proposed Project. The results are presented in ***Figure 10.29*** *to* ***Figure 10.34*** for Sinopec HK Oil Terminal Chai Wan, ExxonMobil Petrol-cum-LPG Filling Station, Sinopec Petrol-cum-LPG Filling Station, NWFB Depot, Citybus Depot as well as LPG Wagon Parking Site.

10.7.8. With an increased population by the construction workers of the proposed Project, the risk in terms of societal risk posed by the ExxonMobil Petrol-cum-LPG Filling Station is increased most obviously in the N = 40 to 100 region. For the NWFB Depot, the risk level is increased in the region of N = 5 to 30. The change in risk level is considered as temporary due to the temporary increase in population for construction works.

10.7.9. On the other hand, the effect of additional construction workers to the risks posed by the Sinopec HK Oil Terminal Chai Wan, Sinopec Petrol-cum-LPG Filling Station, Citybus Depot and LPG Wagon Parking Site are negligible as shown in ***Figure 10.29, Figure 10.31, Figure 10.33*** and ***Figure 10.34***.

10.7.10. The societal risks for Sinopec HK Oil Terminal Chai Wan, Sinopec Petrol-cum-LPG Filling Station, ExxonMobil Petrol-cum-LPG Filling Station, NWFB Depot, Citybus Depot as well as LPG Wagon Parking Site in the construction phase are within the ACCEPTABLE region and therefore satisfy Section 2 of Annex 4 of the EIAO-TM.

10.7.11. The F-N data for construction phase is presented in ***Table 10.41*** and top 5 most significant PLL contributors are shown in ***Table 10.43***. It can be observed that the cold catastrophic and partial failure of LPG road tanker with 50% of inventory and guillotine failure of liquid-inlet pipework contribute the most in the PLL. It can be seen that the increase in construction workers in the proposed Project does not contribute change to the F-N and PLL data of the Sinopec HK Oil Terminal Chai Wan and LPG Wagon Parking Site.

<u>Operation Phase</u>

10.7.12. The F-N curves of Case 3 and Case 5 compare the societal risks in the operation phase without and with the proposed Project while the F-N curves of Case 4 represent the risk to the proposed Project workers only. The results are presented in ***Figure 10.35 to Figure 10.40***.

10.7.13. The risk in terms of societal risk induced by the ExxonMobil Petrol-cum-LPG Filling Station is slightly increased by the increase of population of the proposed Project. As shown in ***Figure 10.36***, the F-N curve remains inside the ACCEPTABLE region. And with an increase in the population of the proposed Project, the risk level is increased slightly but again remains in the ACCEPTABLE region. The change in risk level is considered as permanent and irreversible due to the increase in population.

10.7.14. The societal risks of the New World First Bus Permanent Depot without and with the Project workers are shown in ***Figure 10.38***. The risk level is increased by an increase in population of the Project workers, the F-N curve however still remains in the ACCEPTABLE region.

10.7.15. The effect of Project workers to the risks posed by the Sinopec HK Oil Terminal Chai Wan, Sinopec Petrol-cum-LPG Filling Station, Citybus Depot and LPG Wagon Parking Site are negligible as shown in ***Figure 10.35***, ***Figure 10.37, Figure 10.39*** and ***Figure 10.40***. No residual impact is anticipated.

10.7.16. When evaluating the risk induced by the ExxonMobil Petrol-cum-LPG Filling Station to the proposed Project workers alone (Case 4), the F-N curve is in the ACCEPTABLE region as shown in ***Figure 10.36***. No residual impact is anticipated. Sinopec HK Oil Terminal Chai Wan, Sinopec Petrol-cum-LPG Filling Station and LPG Wagon Parking Site do not show an F-N data when considering Project workers alone.

10.7.17. The cumulative risk taking into account the proposed Project workers and all the offsite populations posed by all hazardous installations, including the Sinopec HK Oil Terminal

Chai Wan, Sinopec Petrol-cum-LPG Filling Station, ExxonMobil Petrol-cum-LPG Filling Station, NWFB Depot, Citybus Depot and LPG Wagon Parking Site, is illustrated in ***Figure 10.41***. With the additional population of the proposed Project, the cumulative risk in terms of the F-N curve is slightly increased and within the ACCEPTABLE region. The change in risk level is considered as permanent and irreversible due to the increase in population. No residual impact is anticipated.

10.7.18. The F-N data of the operation phase for individual potential hazardous installation is presented in ***Table 10.42*** and top 5 most significant PLL contributors among all hazardous installations are shown in ***Table 10.44***. The most significant events are the cold catastrophic and partial failure of LPG road tanker with 50% of inventory and guillotine failure of liquid-inlet pipework.

10.7.19. Further analyse the result from ***Table 10.44*** can observe the ExxonMobil Petrol-cum-LPG Filling Station is the main PLL contributor (overall around 50%) in the cumulative risk case, in which the most significant event is the failure of LPG road tanker.

Table 10.41 F-N Data for Construction Phase

ExxonMobil Petrol-cum-LPG Filling Station				Sinopec Petrol-cum-LPG Filling Station			
Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers		Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers	
No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)
1	2.10E-06	2.13E-06	2.15E-06	1	2.52E-06	1	2.52E-06
2	1.56E-06	1.59E-06	1.61E-06	2	1.19E-06	2	1.19E-06
3	1.34E-06	1.40E-06	1.42E-06	3	8.44E-07	3	8.44E-07
4	1.15E-06	1.19E-06	1.20E-06	4	5.52E-07	4	5.52E-07
5	9.77E-07	1.02E-06	1.04E-06	5	4.36E-07	5	4.36E-07
6	8.05E-07	8.21E-07	8.30E-07	6	3.78E-07	6	3.78E-07
8	5.82E-07	5.93E-07	6.00E-07	8	1.62E-07	8	1.62E-07
10	4.85E-07	5.09E-07	5.15E-07	10	1.00E-07	10	1.00E-07
12	3.75E-07	4.00E-07	4.05E-07	12	9.60E-08	12	9.60E-08
15	3.37E-07	3.44E-07	3.48E-07	15	8.37E-08	15	8.37E-08
20	2.57E-07	2.78E-07	2.81E-07	20	7.89E-08	20	7.89E-08
25	2.49E-07	2.55E-07	2.57E-07	25	3.82E-08	25	3.82E-08
30	2.20E-07	2.27E-07	2.29E-07	30	3.46E-08	30	3.46E-08
40	2.03E-07	2.09E-07	2.12E-07	40	1.95E-08	40	1.95E-08
50	1.15E-07	1.73E-07	1.75E-07	50	1.29E-08	50	1.29E-08
60	9.28E-08	9.89E-08	9.97E-08	60	7.50E-09	60	7.50E-09
80	4.72E-08	6.46E-08	6.51E-08	80	1.98E-09	80	1.98E-09
100	2.46E-08	2.74E-08	2.76E-08	100	6.43E-10	100	6.43E-10
120	1.50E-08	1.64E-08	1.65E-08	120	1.76E-10	120	1.76E-10

ExxonMobil Petrol-cum-LPG Filling Station				Sinopec Petrol-cum-LPG Filling Station			
Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers		Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers	
No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)
150	8.67E-09	9.17E-09	9.23E-09				
200	4.85E-09	5.03E-09	5.07E-09				
250	3.01E-09	3.09E-09	3.11E-09				
300	1.91E-09	1.96E-09	1.97E-09				
400	1.14E-09	1.16E-09	1.17E-09				
500	8.47E-10	8.48E-10	8.53E-10				
600	5.53E-10	5.55E-10	5.58E-10				
800	3.70E-10	3.68E-10	3.70E-10				
1000	1.83E-10	1.82E-10	1.83E-10				
1200	1.52E-10	1.51E-10	1.52E-10				

Note: The F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

Sinopec HK Oil Terminal Chai Wan				LPG Wagon Parking Site			
Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers		Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	9.88E-07	1	9.88E-07	1	2.50E-07	1	2.50E-07
2	2.20E-07	2	2.20E-07	2	2.58E-08	2	2.58E-08
3	2.15E-07	3	2.15E-07	3	4.04E-09	3	4.04E-09
4	1.50E-07	4	1.50E-07	4	1.40E-09	4	1.40E-09
5	1.45E-07	5	1.45E-07	5	1.15E-09	5	1.15E-09
6	1.20E-07	6	1.20E-07	6	6.00E-10	6	6.00E-10
8	1.10E-07	8	1.10E-07				
10	1.05E-07	10	1.05E-07				
12	8.57E-08	12	8.57E-08				
15	7.00E-08	15	7.00E-08				
20	7.00E-08	20	7.00E-08				
25	2.00E-08	25	2.00E-08				
30	2.00E-08	30	2.00E-08				

Note: The F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

NWFB Depot				Citybus Depot			
Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers		Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers	
No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)
1	1.18E-08	1	1.21E-08	1	7.20E-09	1	7.20E-09
2	1.05E-08	2	1.09E-08	2	6.22E-09	2	6.22E-09
3	9.10E-09	3	9.59E-09	3	5.20E-09	3	5.20E-09
4	7.42E-09	4	7.98E-09	4	4.73E-09	4	4.73E-09
5	6.38E-09	5	6.99E-09	5	4.56E-09	5	4.56E-09
6	5.78E-09	6	6.52E-09	6	4.46E-09	6	4.46E-09
8	4.44E-09	8	5.44E-09	8	4.28E-09	8	4.28E-09
10	3.34E-09	10	4.25E-09	10	4.09E-09	10	4.09E-09
12	2.92E-09	12	3.44E-09	12	3.89E-09	12	3.89E-09
15	2.70E-09	15	3.05E-09	15	3.64E-09	15	3.65E-09
20	2.33E-09	20	2.62E-09	20	3.12E-09	20	3.12E-09
25	2.06E-09	25	2.32E-09	25	2.09E-09	25	2.09E-09
30	1.96E-09	30	2.10E-09	30	1.78E-09	30	1.78E-09
40	8.66E-10	40	9.28E-10	40	1.44E-09	40	1.44E-09
50	6.02E-10	50	6.33E-10	50	1.01E-09	50	1.01E-09
60	1.80E-10	60	2.07E-10	60	6.93E-10	60	6.93E-10
80	1.59E-10	80	1.63E-10	80	4.92E-10	80	4.92E-10
100	1.58E-10	100	1.59E-10	100	4.75E-10	100	4.75E-10
120	1.53E-10	120	1.54E-10	120	4.30E-10	120	4.30E-10

NWFB Depot				Citybus Depot			
Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers		Case 1 – 2016 without construction workers		Case 2 – 2016 with construction workers	
No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)
150	1.27E-10	150	1.27E-10	150	3.96E-10	150	3.96E-10
				200	3.95E-10	200	3.95E-10
				250	3.85E-10	250	3.85E-10
				300	2.51E-10	300	2.51E-10
				400	1.73E-10	400	1.73E-10

Note: The F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

Table 10.42 F-N Data for Operation Phase

ExxonMobil Petrol-cum-LPG Filling Station					
Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)	No. of Fatalities	Frequency (/year)
No. Fatalities	Frequency (/year)	1	2.42E-07	1	2.13E-06
1	2.12E-06	2	1.00E-07	2	1.59E-06
2	1.57E-06	3	7.59E-08	3	1.38E-06
3	1.35E-06	4	2.20E-08	4	1.18E-06
4	1.16E-06	5	1.68E-08	5	1.02E-06
5	9.83E-07	6	1.60E-08	6	8.42E-07
6	8.11E-07	8	1.55E-08	8	5.95E-07
8	5.90E-07	10	2.25E-09	10	5.07E-07
10	4.97E-07	12	2.00E-09	12	3.98E-07
12	3.80E-07	15	1.67E-09	15	3.43E-07
15	3.40E-07	20	1.15E-09	20	2.96E-07
20	2.61E-07	25	8.74E-10	25	2.56E-07
25	2.54E-07	30	7.00E-10	30	2.31E-07
30	2.27E-07	40	4.72E-10	40	2.16E-07
40	2.13E-07	50	4.28E-10	50	1.38E-07
50	1.26E-07	60	4.03E-10	60	1.13E-07
60	1.10E-07	80	3.27E-10	80	6.33E-08
80	6.06E-08	100	2.69E-10	100	3.53E-08
100	3.41E-08	120	1.81E-10	120	2.24E-08
120	2.14E-08	150	1.14E-10	150	1.21E-08

ExxonMobil Petrol-cum-LPG Filling Station					
Case 3 – 2018 without Project workers		**Case 4 – 2018 with Project workers only**		**Case 5 – 2018 with Project workers and all offsite population**	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
150	1.12E-08			200	6.39E-09
200	5.73E-09			250	3.76E-09
250	3.37E-09			300	2.64E-09
300	2.40E-09			400	1.39E-09
400	1.30E-09			500	9.69E-10
500	9.35E-10			600	7.29E-10
600	7.03E-10			800	3.82E-10
800	3.82E-10			1000	1.89E-10
1000	1.89E-10			1200	1.57E-10

Sinopec Petrol-cum-LPG Filling Station					
Case 3 – 2018 without Project workers		**Case 4 – 2018 with Project workers only**		**Case 5 – 2018 with Project workers and all offsite population**	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	2.52E-06			1	2.52E-06
2	1.20E-06			2	1.20E-06
3	8.47E-07			3	8.47E-07
4	5.56E-07			4	5.56E-07
5	4.39E-07			5	4.39E-07
6	3.79E-07			6	3.79E-07

Sinopec Petrol-cum-LPG Filling Station					
Case 3 – 2018 without Project workers		**Case 4 – 2018 with Project workers only**		**Case 5 – 2018 with Project workers and all offsite population**	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
8	1.63E-07			8	1.63E-07
10	1.01E-07			10	1.01E-07
12	9.67E-08			12	9.67E-08
15	8.42E-08			15	8.42E-08
20	7.94E-08			20	7.94E-08
25	4.24E-08			25	4.24E-08
30	3.51E-08			30	3.51E-08
40	2.13E-08			40	2.13E-08
50	1.65E-08			50	1.65E-08
60	9.12E-09			60	9.12E-09
80	3.56E-09			80	3.56E-09
100	9.57E-10			100	9.57E-10
120	2.16E-10			120	2.16E-10

Note: Case 4 F-N data is not available for Sinopec Petrol-cum-LPG Filling Station and F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

Sinopec HK Oil Terminal Chai Wan					
Case 3 – 2018 without Project workers		**Case 4 – 2018 with Project workers only**		**Case 5 – 2018 with Project workers and all offsite population**	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	9.88E-07			1	9.88E-07

Sinopec HK Oil Terminal Chai Wan					
Case 3 – 2018 without Project workers		**Case 4 – 2018 with Project workers only**		**Case 5 – 2018 with Project workers and all offsite population**	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
2	2.20E-07			2	2.20E-07
3	2.15E-07			3	2.15E-07
4	1.50E-07			4	1.50E-07
5	1.45E-07			5	1.45E-07
6	1.20E-07			6	1.20E-07
8	1.10E-07			8	1.10E-07
10	1.05E-07			10	1.05E-07
12	8.60E-08			12	8.60E-08
15	7.00E-08			15	7.00E-08
20	7.00E-08			20	7.00E-08
25	2.00E-08			25	2.00E-08
30	2.00E-08			30	2.00E-08

Note: Case 4 F-N data is not available for Sinopec HK Oil Terminal Chai Wan

LPG Wagon Parking Site					
Case 3 – 2018 without Project workers		**Case 4 – 2018 with Project workers only**		**Case 5 – 2018 with Project workers and all offsite population**	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	2.50E-07			1	2.50E-07
2	2.58E-08			2	2.58E-08

LPG Wagon Parking Site

Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
3	4.04E-09			3	4.04E-09
4	1.40E-09			4	1.40E-09
5	1.15E-09			5	1.15E-09
6	6.00E-10			6	6.00E-10

Note: Case 4 F-N data is not available for LPG Wagon Parking Site and F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

NWFB Depot

Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	1.18E-08	1	6.25E-09	1	1.23E-08
2	1.05E-08	2	4.22E-09	2	1.14E-08
3	9.16E-09	3	3.01E-09	3	1.02E-08
4	7.65E-09	4	2.22E-09	4	8.65E-09
5	6.41E-09	5	1.71E-09	5	7.40E-09
6	5.81E-09	6	1.43E-09	6	6.96E-09
8	4.49E-09	8	1.24E-09	8	6.20E-09
10	3.39E-09	10	1.05E-09	10	5.29E-09
12	2.95E-09	12	8.45E-10	12	4.38E-09

NWFB Depot

Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
15	2.73E-09	15	6.06E-10	15	3.50E-09
20	2.37E-09	20	3.62E-10	20	3.12E-09
25	2.10E-09	25	2.66E-10	25	2.78E-09
30	1.97E-09	30	2.59E-10	30	2.49E-09
40	8.69E-10	40	1.26E-10	40	1.06E-09
50	7.23E-10			50	8.26E-10
60	2.38E-10			60	3.25E-10
80	1.59E-10			80	2.07E-10
100	1.59E-10			100	1.95E-10
120	1.57E-10			120	1.87E-10
150	1.27E-10			150	1.30E-10

Note: F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

Citybus Depot

Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	7.23E-09	1	1.12E-10	1	7.23E-09
2	6.29E-09			2	6.30E-09

Citybus Depot

Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
3	5.33E-09			3	5.34E-09
4	4.78E-09			4	4.78E-09
5	4.59E-09			5	4.59E-09
6	4.49E-09			6	4.49E-09
8	4.31E-09			8	4.31E-09
10	4.13E-09			10	4.14E-09
12	3.94E-09			12	3.94E-09
15	3.69E-09			15	3.70E-09
20	3.22E-09			20	3.22E-09
25	2.19E-09			25	2.20E-09
30	1.84E-09			30	1.84E-09
40	1.48E-09			40	1.48E-09
50	1.06E-09			50	1.06E-09
60	7.21E-10			60	7.26E-10
80	4.94E-10			80	4.94E-10
100	4.76E-10			100	4.76E-10
120	4.32E-10			120	4.32E-10
150	3.96E-10			150	3.96E-10
200	3.95E-10			200	3.95E-10
250	3.86E-10			250	3.86E-10

Citybus Depot

Case 3 – 2018 without Project workers		Case 4 – 2018 with Project workers only		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
300	2.54E-10			300	2.54E-10
400	1.75E-10			400	1.75E-10

Note: F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

Cumulative Risk

Case 3 – 2018 without Project workers		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
1	5.90E-06	1	5.91E-06
2	3.03E-06	2	3.05E-06
3	2.43E-06	3	2.47E-06
4	1.88E-06	4	1.90E-06
5	1.58E-06	5	1.62E-06
6	1.32E-06	6	1.35E-06
8	8.71E-07	8	8.78E-07
10	7.10E-07	10	7.22E-07
12	5.69E-07	12	5.89E-07
15	5.01E-07	15	5.04E-07
20	4.16E-07	20	4.52E-07

Cumulative Risk

Case 3 – 2018 without Project workers		Case 5 – 2018 with Project workers and all offsite population	
No. of Fatalities	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**
25	3.20E-07	25	3.24E-07
30	2.86E-07	30	2.90E-07
40	2.36E-07	40	2.40E-07
50	1.44E-07	50	1.56E-07
60	1.20E-07	60	1.23E-07
80	6.48E-08	80	6.75E-08
100	3.57E-08	100	3.69E-08
120	2.22E-08	120	2.33E-08
150	1.18E-08	150	1.27E-08
200	6.18E-09	200	6.83E-09
250	3.76E-09	250	4.15E-09
300	2.66E-09	300	2.90E-09
400	1.47E-09	400	1.56E-09
500	9.95E-10	500	1.03E-09
600	7.43E-10	600	7.69E-10
800	4.21E-10	800	4.21E-10
1000	2.13E-10	1000	2.13E-10
1200	1.76E-10	1200	1.76E-10

Note: The F-N data below 1×10^{-9}/year is not shown in the figures of F-N curves

Table 10.43 PLL Values for Construction Phase

ExxonMobil Petrol-cum-LPG Filling Station					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Cold catastrophic and partial failure of LPG road tanker (50% inventory)	7.56E-06	30.5%	Cold catastrophic and partial failure of LPG road tanker (50% inventory)	8.11E-06	30.6%
Cold catastrophic and partial failure of LPG road tanker (full inventory)	4.47E-06	18.0%	Cold catastrophic and partial failure of LPG road tanker (full inventory)	4.84E-06	18.3%
Guillotine failure of liquid-inlet pipework (50% inventory)	4.46E-06	18.0%	Guillotine failure of liquid-inlet pipework (50% inventory)	4.77E-06	18.0%
Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	2.78E-06	11.2%	Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	2.94E-06	11.1%
Guillotine failure of liquid-inlet pipework (full inventory)	2.10E-06	8.5%	Guillotine failure of liquid-inlet pipework (full inventory)	2.27E-06	8.6%
Others	3.40E-06	13.7%	Others	3.57E-06	13.5%
Total	**2.48E-05**	**100%**	**Total**	**2.65E-05**	**100%**

Sinopec Petrol-cum-LPG Filling Station					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Guillotine failure of liquid-inlet pipework (50% inventory)	2.97E-06	34.6%	Guillotine failure of liquid-inlet pipework (50% inventory)	2.97E-06	34.6%
Cold catastrophic and partial failure of LPG road tanker (50% inventory)	1.84E-06	21.4%	Cold catastrophic and partial failure of LPG road tanker (50% inventory)	1.84E-06	21.4%
Cold catastrophic and partial failure of	1.01E-06	11.7%	Cold catastrophic and partial failure of	1.01E-06	11.7%

Sinopec Petrol-cum-LPG Filling Station					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
LPG road tanker (full inventory)			LPG road tanker (full inventory)		
Guillotine failure of liquid-inlet pipework (full inventory)	9.57E-07	11.1%	Guillotine failure of liquid-inlet pipework (full inventory)	9.57E-07	11.1%
Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	5.46E-07	6.4%	Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	5.46E-07	6.4%
Others	1.26E-06	14.7%	Others	1.26E-06	14.3%
Total	**8.59E-06**	**100%**	**Total**	**8.59E-06**	**100%**

Sinopec HK Oil Terminal Chai Wan					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Cold catastrophic failure of marine vessel fuel tank due to striking	2.06E-06	59.5%	Cold catastrophic failure of marine vessel fuel tank due to striking	2.06E-06	59.5%
Instantaneous single fuel tank failure	6.36E-07	18.4%	Instantaneous single fuel tank failure	6.36E-07	18.4%
Rupture of jetty loading hose during marine vessel unloading	5.39E-07	15.6%	Rupture of jetty loading hose during marine vessel unloading	5.39E-07	15.6%
Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.00E-07	5.8%	Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.00E-07	5.8%
Full bore rupture of fixed pipeline from fuel oil tank to jetty	2.68E-08	0.8%	Full bore rupture of fixed pipeline from fuel oil tank to jetty	2.68E-08	0.8%
Others	2.47E-09	0.1%	Others	2.47E-09	0.1%
Total	**3.47E-06**	**100%**	**Total**	**3.47E-06**	**100%**

LPG Wagon Parking Site					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.65E-07	93.7%	Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.65E-07	93.7%
Cold catastrophic failure and cold partial failure of kerosene tanker	1.78E-08	6.3%	Cold catastrophic failure and cold partial failure of kerosene tanker	1.78E-08	6.3%
Total	**6.25E-07**	**100%**	**Total**	**6.25E-07**	**100%**

NWFB Depot					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Smoke from pool fire of diesel tanker rupture and leak	1.17E-07	75.2%	Smoke from pool fire of diesel tanker rupture and leak	1.32E-07	77.4%
Diesel tanker rupture and leak	3.85E-08	24.8%	Diesel tanker rupture and leak	3.85E-08	22.6%
Total	**1.55E-07**	**100%**	**Total**	**1.70E-07**	**100%**

Citybus Depot					
Case 1 – 2016 without construction workers			**Case 2 – 2016 with construction workers**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Smoke from pool fire of diesel tanker rupture and leak	2.90E-07	95.9%	Smoke from pool fire of diesel tanker rupture and leak	2.90E-07	95.9%
Diesel tanker rupture and leak	1.23E-08	4.1%	Diesel tanker rupture and leak	0.00E+00	0.0%
Total	**3.02E-07**	**100%**	**Total**	**3.02E-07**	**100%**

Table 10.44 PLL Values for Operation phase

ExxonMobil Petrol-cum-LPG Filling Station								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Cold catastrophic and partial failure of LPG road tanker (50% inventory)	7.87E-06	29.9%	Cold catastrophic and partial failure of LPG road tanker (50% inventory)	2.55E-07	43.4%	Cold catastrophic and partial failure of LPG road tanker (50% inventory)	8.20E-06	30.1%
Cold catastrophic and partial failure of LPG road tanker (full inventory)	4.80E-06	18.3%	Cold catastrophic and partial failure of LPG road tanker (full inventory)	1.88E-07	32.1%	Cold catastrophic and partial failure of LPG road tanker (full inventory)	5.03E-06	18.5%
Guillotine failure of liquid-inlet pipework (50% inventory)	4.58E-06	17.4%	Guillotine failure of liquid-inlet pipework (50% inventory)	6.22E-08	10.6%	Guillotine failure of liquid-inlet pipework (50% inventory)	4.75E-06	17.4%
Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	3.12E-06	11.9%	Guillotine failure of liquid-inlet pipework (full inventory)	3.33E-08	5.7%	Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	3.20E-06	11.7%
Guillotine failure of liquid-inlet pipework (full inventory)	2.12E-06	8.1%	Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	2.25E-08	3.8%	Guillotine failure of liquid-inlet pipework (full inventory)	2.21E-06	8.1%
Others	3.78E-06	14.4%	Others	2.57E-08	4.4%	Others	3.86E-06	14.2%
Total	**2.63E-05**	**100%**		**5.86E-07**	**100%**		**2.73E-05**	**100%**

Sinopec Petrol-cum-LPG Filling Station								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Guillotine failure of liquid-inlet pipework (50% inventory)	2.99E-06	34.2%	Cold catastrophic and partial failure of LPG storage vessel (full inventory)	3.18E-12	52.1%	Guillotine failure of liquid-inlet pipework (50% inventory)	2.99E-06	34.2%
Cold catastrophic and partial failure of LPG road tanker (50% inventory)	1.86E-06	21.3%	Cold catastrophic and partial failure of LPG road tanker (full inventory)	1.63E-12	26.7%	Cold catastrophic and partial failure of LPG road tanker (50% inventory)	1.86E-06	21.3%
Cold catastrophic and partial failure of LPG road tanker (full inventory)	1.05E-06	12.0%	Cold catastrophic and partial failure of LPG storage vessel during unloading (full inventory)	1.08E-12	17.7%	Cold catastrophic and partial failure of LPG road tanker (full inventory)	1.05E-06	12.0%
Guillotine failure of liquid-inlet pipework (full inventory)	9.61E-07	11.0%	Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	1.61E-13	2.6%	Guillotine failure of liquid-inlet pipework (full inventory)	9.61E-07	11.0%
Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	5.69E-07	6.5%	Cold catastrophic and partial failure of LPG storage vessel during unloading (60% inventory)	5.49E-14	0.9%	Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	5.69E-07	6.5%
Others	1.31E-06	14.6%	Others	4.26E-15	0.1%	Others	1.31E-06	14.6%
Total	**8.74E-06**	**100%**		**6.10E-12**	**100%**		**8.74E-06**	**100%**

Sinopec HK Oil Terminal Chai Wan								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Cold catastrophic failure of marine vessel fuel tank due to striking	2.11E-06	60.1%				Cold catastrophic failure of marine vessel fuel tank due to striking	2.11E-06	60.1%
Instantaneous single fuel tank failure	6.37E-07	18.1%				Instantaneous single fuel tank failure	6.37E-07	18.1%
Rupture of jetty loading hose during marine vessel unloading	5.39E-07	15.3%				Rupture of jetty loading hose during marine vessel unloading	5.39E-07	15.3%
Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.00E-07	5.7%				Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.00E-07	5.7%
Full bore rupture of fixed pipeline from fuel oil tank to jetty	2.68E-08	0.8%				Full bore rupture of fixed pipeline from fuel oil to jetty	2.68E-08	0.8%
Others	2.48E-09	0.1%				Others	2.48E-09	0.1%
Total	**3.52E-06**	**100%**				**Total**	**3.52E-06**	**100%**

Note: PLL data is not available for Case 4 of Sinopec HK Oil Terminal Chai Wan

LPG Wagon Parking Site								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.65E-07	93.7%				Cold catastrophic failure, cold partial failure and BLEVE of LPG cylinder	2.65E-07	93.7%
Cold catastrophic failure and cold partial failure of petrol tanker	1.78E-08	6.3%				Cold catastrophic failure and cold partial failure of petrol tanker	1.78E-08	6.3%
Total	**2.83E-07**	**100%**				**Total**	**2.83E-07**	**100%**

Note: PLL data is not available for Case 4 of LPG Wagon Parking Site

NWFB Depot								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Smoke from pool fire of diesel tanker rupture and leak	1.21E-07	75.0%	Smoke from pool fire of diesel tanker rupture and leak	3.77E-08	100.0%	Smoke from pool fire of diesel tanker rupture and leak	1.59E-07	79.7%
Diesel tanker rupture and leak	4.04E-08	25.0%	Diesel tanker rupture and leak	4.15E-13	0.0%	Diesel tanker rupture and leak	4.04E-08	20.3%
Total	**1.61E-07**	**100%**	**Total**	**3.77E-08**	**100%**	**Total**	**1.99E-07**	**100%**

Citybus Depot								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
Smoke from pool fire of diesel tanker rupture and leak	2.94E-07	95.8%	Smoke from pool fire of diesel tanker rupture and leak	1.87E-10	100.0%	Smoke from pool fire of diesel tanker rupture and leak	2.94E-07	95.8%
Diesel tanker rupture and leak	1.29E-08	4.2%	Diesel tanker rupture and leak	0.00E+00	0.0%	Diesel tanker rupture and leak	1.29E-08	4.2%
Total	**3.07E-07**	**100%**	**Total**	**1.87E-10**	**100%**	**Total**	**3.07E-07**	**100%**

Cumulative Risk								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
ExxonMobil – Cold catastrophic and partial failure of LPG road tanker (50% inventory)	7.87E-06	20.0%	ExxonMobil – Cold catastrophic and partial failure of LPG road tanker (50% inventory)	2.55E-07	40.8%	ExxonMobil – Cold catastrophic and partial failure of LPG road tanker (50% inventory)	8.20E-06	20.3%
ExxonMobil – Cold catastrophic and partial failure of LPG road tanker (full inventory)	4.80E-06	12.2%	ExxonMobil – Cold catastrophic and partial failure of LPG road tanker (full inventory)	1.88E-07	30.1%	ExxonMobil – Cold catastrophic and partial failure of LPG road tanker (full inventory)	5.03E-06	12.5%
ExxonMobil – Guillotine failure of liquid-inlet	4.58E-06	11.7%	ExxonMobil – Guillotine failure of liquid-inlet	6.22E-08	10.0%	ExxonMobil – Guillotine failure of liquid-inlet	4.75E-06	11.8%

Cumulative Risk								
Case 3 – 2018 without Project workers			**Case 4 – 2018 with Project workers only**			**Case 5 – 2018 with Project workers and all offsite population**		
Event	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**	**Event**	**PLL (/year)**	**% of total PLL**
pipework (50% inventory)			pipework (50% inventory)			pipework (50% inventory)		
ExxonMobil – Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	3.12E-06	7.9%	ExxonMobil – Guillotine failure of liquid-inlet pipework (full inventory)	3.77E-08	6.0%	ExxonMobil – Cold catastrophic and partial failure of LPG storage vessel (60% inventory)	3.20E-06	7.9%
Sinopec – Guillotine failure of liquid-inlet pipework (50% inventory)	2.99E-06	7.6%	ExxonMobil – Cold catastrophic and partial failure of LPG storage vessel during unloading (60% inventory)	3.33E-08	5.3%	Sinopec – Guillotine failure of liquid-inlet pipework (50% inventory)	2.99E-06	7.4%
Others	1.59E-05	40.5%	Others	4.84E-08	7.7%	Others	1.61E-05	40.0%
Total	**3.93E-05**	**100%**		**6.24E-07**	**100%**		**4.03E-05**	**100%**

10.8. UNCERTAINTY ANALYSIS

10.8.1. The Hazard to Life study is based on a number of assumptions that are mentioned in other sections of this report. The uncertainties of the results are discussed below.

10.8.2. There is currently no activity in the Sinopec HK Oil Terminal Chai Wan that the operation is stopped, a full operation of oil terminal was however assumed in the study. The hazardous scenarios associated with jetty unloading operation, fuel oil storage, dye marker storage, LPG cylinder storage and fuel oil bulk filling were taken into account in calculating the societal risks, which is a conservative assumption.

10.8.3. LPG wagons and kerosene road tanker that are parked inside the LPG Wagon Parking Site are normally driven in and out of the site for distributing LPG cylinder and kerosene. Presences of the LPG wagons and kerosene road tanker were assumed to be full time onsite, which gave conservative results.

10.8.4. Without information from Sinopec (Hong Kong) Ltd, the LPG cylinder inventory of the Sinopec HK Oil Terminal Chai Wan was set at its maximum capacity at all time. The inventory is expected to be less and varies from time to time.

10.8.5. A 5000DWT marine vessel was assumed when analysing the rupture of its loaded cargo tank. The size of marine vessel berthing the Sinopec HK Oil Terminal Chai Wan is however expected to be smaller as the size is restricted by the maximum draft and overall length (LOA) of the berth. The inventory that was involved in the loss of containment and therefore the pool diameter formed could be over-estimated.

10.8.6. In the event of the potential rupture of a fuel oil storage tank in the Sinopec HK Oil Terminal Chai Wan that results in an overflow of fuel oil outside the site, part of the spilled fuel oil could be contained and directed to the drainage system and oil interceptor when considering the surface gradient outside the oil terminal (which falls towards the oil terminal). In the study, the fuel oil was considered spilled out to the public road without taking in account the drainage system and oil interceptor. The estimated risk should be conservative and the actual risk is therefore lower.

10.8.7. In view of applying varies conservative assumptions in the study that has minimised the uncertainty, it is safe to assume the risk level assessed would comply with the risk guideline of Section 2 of Annex 4 of the EIAO-TM.

10.9. SENSITIVITY ANALYSIS

10.9.1. The effect of increasing 50 workers in both construction phase and operation phase are illustrated in ***Figure 10.42*** and ***Figure 10.43*** respectively. The comparison of F-N data is shown in ***Table 10.45*** below

10.9.2. With an additional 50 construction workers (hence 150 construction workers, increased by 50%) in the construction phase, the risk level is slightly increased in the N = 20 to 300 region. The total PLL is increased by 2.6%

10.9.3. With an additional 50 Project workers (hence 290 Project workers, increased by 21%) in the operation phase, the risk level is slightly increased in the N = 40 to 500 region. The total PLL is increased by 0.56%.

Table 10.45 FN Data and PLL for Sensitive Analysis

Cumulative Risk

	Case 2 – 2016 with construction workers	**Case 2 with 50 more construction workers**		**Case 5 – 2018 with Project workers and all offsite population**	**Case 5 with 50 more Project workers**
No. of Fatalities	**Frequency (/year)**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**Frequency (/year)**
1	5.92E-06	5.94E-06	1	5.91E-06	5.91E-06
2	3.07E-06	3.09E-06	2	3.05E-06	3.05E-06
3	2.50E-06	2.53E-06	3	2.47E-06	2.47E-06
4	1.92E-06	1.95E-06	4	1.90E-06	1.91E-06
5	1.63E-06	1.67E-06	5	1.62E-06	1.62E-06
6	1.34E-06	1.35E-06	6	1.35E-06	1.36E-06
8	8.81E-07	8.86E-07	8	8.78E-07	8.78E-07
10	7.28E-07	7.37E-07	10	7.22E-07	7.25E-07
12	5.94E-07	6.09E-07	12	5.89E-07	5.94E-07
15	5.08E-07	5.20E-07	15	5.04E-07	5.06E-07
20	4.35E-07	4.55E-07	20	4.52E-07	4.61E-07
25	3.20E-07	3.23E-07	25	3.24E-07	3.24E-07
30	2.88E-07	2.92E-07	30	2.90E-07	2.91E-07
40	2.33E-07	2.37E-07	40	2.40E-07	2.41E-07
50	1.89E-07	1.94E-07	50	1.56E-07	1.88E-07
60	1.08E-07	1.12E-07	60	1.23E-07	1.23E-07
80	6.77E-08	7.11E-08	80	6.75E-08	7.98E-08
100	2.88E-08	3.18E-08	100	3.69E-08	3.71E-08
120	1.72E-08	1.99E-08	120	2.33E-08	2.34E-08
150	9.81E-09	1.11E-08	150	1.27E-08	1.29E-08
200	5.49E-09	5.83E-09	200	6.83E-09	7.03E-09
250	3.50E-09	3.65E-09	250	4.15E-09	4.33E-09
300	2.22E-09	2.27E-09	300	2.90E-09	3.00E-09
400	1.34E-09	1.36E-09	400	1.56E-09	1.67E-09
500	9.09E-10	9.19E-10	500	1.03E-09	1.04E-09
600	5.98E-10	6.01E-10	600	7.69E-10	7.79E-10

Cumulative Risk					
	Case 2 – 2016 with construction workers	**Case 2 with 50 more construction workers**		**Case 5 – 2018 with Project workers and all offsite population**	**Case 5 with 50 more Project workers**
No. of Fatalities	**Frequency (/year)**	**Frequency (/year)**	**No. of Fatalities**	**Frequency (/year)**	**Frequency (/year)**
800	4.10E-10	4.10E-10	800	4.21E-10	4.21E-10
1000	2.06E-10	2.06E-10	1000	2.13E-10	2.13E-10
1200	1.71E-10	1.71E-10	1200	1.76E-10	1.76E-10
Total PLL (/year)	3.93E-05	4.03E-05	**Total PLL (/year)**	4.03E-05	4.05E-05

10.10. MITIGATION MEASURES

10.10.1. As mentioned in *Section 10.7*, the individual and societal risks of the proposed Project and posed by hazardous installations are acceptable, while the increase in population from the proposed Project has negligible effect on the cumulative societal risk. Therefore mitigation measure is not required.

10.11. RECOMMENDATIONS

10.11.1. Although mitigation measure is not required, the following good site practices are suggested to be implemented during the construction phase:

- ignition of fire on site should be controlled throughout the construction programme;
- any temporary storage of fuel and flammable chemical should be minimised to reduce chance of causing explosion or escalation of fire in the case of emergency event at nearby potentially hazardous sources;
- fire extinguisher or other firefighting equipment should be made easily accessible to on-site workers; and
- establish communication channel and evacuation plan in the case of emergency event at nearby potentially hazardous sources.

10.11.2. The following good site practices are suggested to be implemented during the operation phase:

- arrangements and facilities for the storage of any flammable goods should be in strict compliance with relevant legislation and guidelines;
- the building should be carefully designed to allow for rapid evacuation of people in protected routes; and

- proper training on safety procedures and evacuation arrangement should be conducted to enhance building users' capability to handle emergencies. An emergency response plan should be adopted during the operation phase of the depot. The plan should list out emergency procedures, identify members of emergency response teams and summarise contact information of nearby potentially hazardous sources.

10.12. ENVIRONMENTAL MONITORING AND AUDIT

10.12.1. As mentioned in *Section 10.4 and 10.7,* the proposed Project did not pose off-site risk and the individual and societal risks posed by the hazardous installations are acceptable, while the increase in population from the proposed Project has negligible effect on the cumulative societal risk. Therefore specific Environmental Monitoring for hazard to life is not required in general. However, good site practices recommended in *Section 10.11* should be implemented and checked in routine site inspections and regular audits.

10.13. CONCLUSION

10.13.1. The risk to construction workers of the proposed Project complies with Section 2 of Annex 4 of the EIAO-TM in terms of both individual risk and societal risk.

10.13.2. It was concluded in the HAZID workshops that the operation of the proposed Project had no failure event that could cause off-site risk and therefore was not considered in the risk summation.

10.13.3. The risks to the on-site Project workers posed by the Sinopec HK Oil Terminal Chai Wan, ExxonMobil Petrol-cum-LPG Filling Station, Sinopec Petrol-cum-LPG Filling Station, NWFB Depot, Citybus Depot and LPG Wagon Parking Site comply with Section 2 of Annex 4 of the EIAO-TM as shown in the F-N curves.

10.13.4. The cumulative risk by taking into account the on-site Project workers together with all off-site population sets due to the proposed Project and all hazardous installations comply with the Section 2 of Annex 4 of the EIAO-TM.

10.13.5. Uncertainty analysis is conducted to conclude the assumptions adopted in the study are conservative. Sensitivity analysis is also performed on the increase in Project population in construction and operation phase. Good site practices are recommended in both construction phase and operation phase of the Project.

11. CONCLUSIONS

11.1. INTRODUCTION

11.1.1. This section presents the summary of key environmental issues regarding the proposed Project on surrounding sensitive receivers during the construction and operation phases. The proposed Project was predicted to be environmentally acceptable with the implementation of proposed mitigation measures, and no adverse residual impacts would be imposed on population and surroundings.

11.2. ENVIRONMENTAL / SOCIAL BENEFITS OF THE PROPOSED PROJECT

11.2.1. The proposed Project aims to accommodate the existing HKPF PVP&EC, the HKPF Centralised Case Property Store, the FEHD Depot, the EMSD Depot and the GL Specialist Laboratory, which all occupy temporary sites that require periodic extensions of their tenancy duration.

11.2.2. Moreover, the relocation of existing HKPF PVP&EC and the FEHD Depot in Quarry Bay can pave the way for the future development of the Quarry Bay Park Phase II.

11.2.3. Since the Project site is located some distance away from nearby residential developments in Chai Wan and has a shorter travelling distance from the IEC, the site selected is expected to introduce less vehicular emissions and noise nuisance to nearby sensitive receivers.

11.3. ENVIRONMENTAL FRIENDLY DESIGN AND BENEFITS

11.3.1. Environmental friendly designs have been incorporated into the proposed Project, including the following:

- Providing green roof to minimise reflection from roofing materials and enhancing the landscape character of the Project site and the visual quality to the nearby viewers;
- Using non-reflective finishes in light colour on the exterior of the building to blend in with the surrounding environment;
- Providing landscape area along the Project site boundary to soften the hard edges of the building structure;
- Adopting similar building height as compared to the existing developments in the vicinity of the Project site to minimise visual intrusion;
- Incorporating gaseous treatment equipment for extracted gases from laboratory to minimise nuisance to neighbourhood;

- Optimising the use of natural ventilation so as to reduce the use of mechanical ventilation; and
- Engineering design for fixed plant complies with the day-time, evening time and night time noise criteria.

11.4. ESTIMATED POPULATION AND ENVIRONMENTALLY SENSITIVE AREAS PROTECTED

11.4.1. The proposed Project would influence populations including on-site workers and workers in the offices, depots and industrial area in the vicinity. Educational, institutional and residential users were identified within the study area, including Heng Fa Chuen, Tsui Wan Estate, Knight Court, the Hong Kong Institute of Vocational Education (Chai Wan), Endeavourers Chan Cheng Kit Wan Kindergarten, the planned THEi New Campus and the Pamela Youde Nethersole Eastern Hospital. With the implementation of relevant mitigation measures, these people would not be significantly affected by the proposed Project.

11.4.2. The major sensitive areas within the study area include the abovementioned educational, institutional and residential developments. Avoidance and / or minimisation of environmental impacts due to the construction and operation of the proposed Project were considered and therefore 100% of population and sensitive areas within the study area will be protected from various environmental aspects.

11.5. KEY ENVIRONMENTAL PROBLEMS AVOIDED/ MINIMISED

11.5.1. A number of environmental assessments were conducted with the aim of identifying environmental impacts and alternative strategies in advance. As such, the following key environmental problems have been avoided or minimised:

- Fixed plant noise will be minimised by arranging all the vehicle repair / testing activities to be carried out in covered area.
- Substantial visual impact and incompatibility with the surrounding environment will be minimised with the adoption of similar building height as compared with adjacent buildings; and.
- Impacts on the adjacent landscape including Landscape Resources (LRs) and Landscape Character Areas (LCAs) will be minimised by appropriate landscape designs and incorporation of the proposed landscape and visual mitigation measures.

11.6. COMPENSATION AREAS INCLUDED

11.6.1. Trees are expected to be felled due to direct conflict with the proposed Project. In accordance with the landscape impact assessment, compensatory tree planting will be undertaken within the Project site boundary.

11.7. ENVIRONMENTAL BENEFITS OF THE ENVIRONMENTAL PROTECTION MEASURES

11.7.1. Mitigation measures have been recommended to reduce the environmental impacts due to the construction and operation of the proposed Project. Key recommended mitigation measures and their associated benefits include the following:

Air Quality

- Adopting dust control measures to reduce dust generation;
- Providing metal tailgate cover and deodourising system in every RCV to mitigate the spread of odour; and
- Installing activated carbon or scrubber to treat the extracted gases from fumehood to minimise the harmful gaseous emissions

Noise

- Selecting QPME, using movable noise barriers and limiting concurrent use of plants during construction to reduce construction noise impacts to nearby NSRs;
- Avoiding the carrying out of the vehicle repair / testing activities to reduce noise emission during night-time as far as possible; and
- Applying acoustic treatments including silencers and acoustic louvers to the MVAC/ BS installation in order to achieve the specified maximum allowable SWL.

Water Quality

- Implementing site practices as outlined in ProPECC Note PN 1/94 to control and minimise site runoff and drainage; and
- Discharging all generated sewage effluent to the existing Chai Wan Preliminary Treatment Works (PTW) via public sewer connection at Sheung On Street.

Landscape and Visual

- Avoiding disturbance to existing vegetation as far as practicable for preservation of landscape values;
- Erection of construction site hoarding with aesthetic treatment around works area to minimise visual intrusion;
- Providing temporary landscape treatments during construction phase to improve the landscape and visual aesthetics;
- Implementing compensatory planting, landscape planting and green roof to enhance the environmental settings as well as screening and softening the hard edges of the building structure; and

- Adopting compatible building height and form with non-reflective materials to blend in with the surrounding environment to minimise potential visual impact to visual sensitive receivers

Waste Management

- Using standardized, durable and pre-fabricated formwork or plastic facing as far as practicable to minimise the C&D Materials arising;
- Sorting construction debris and excavated materials on-site to recover reusable/recyclable portions (i.e. soil, broken concrete, metal, etc.) for backfilling and reinstatement;
- Establishing a trip-ticket system in accordance with DevB TC(W) No. 6/2010 and Waste Disposal (Charges for Disposal of Construction Waste) Regulation in order to monitor the disposal of inert C&D materials at public fill and the remaining C&D waste to landfills, and control fly-tipping;
- Handling chemical waste in accordance with the "Code of Practice on the Packaging, Handling and Storage of Chemical Wastes";
- Providing waste separation facilities on site for papers, aluminium cans, plastic bottles, etc. to encourage recycling; and
- Providing sufficient enclosed bins for general refuse, food and beverage waste to reduce odour, pest and litter impact.

11.8. AIR QUALITY

11.8.1. Air quality impact assessment has been conducted for the construction and operation phases of the proposed Project.

11.8.2. During the construction period, there would be no major earthworks carried out for the site formation works for the Project site. With the implementation of sufficient dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation, thus adverse construction dust impact would not be anticipated.

11.8.3. For the operation of the proposed Project, no adverse air quality impacts would be anticipated as there would be limited vehicular emissions from the vehicle repair / testing and parking activities of the Project, considered with cumulative effect of emissions from the open roads within the study area. Modelling results show that the predicted maximum 1-hour and annual average NO_2 and maximum daily and annual average $PM_{2.5}$ and PM_{10} concentrations at the representative ASRs complied with the AQOs. No mitigation measure is required.

11.8.4. Particularly, potential odour nuisance and the volatile chemicals emissions associated with the operation of the proposed Project are also predicted to be negligible.

11.9. NOISE

11.9.1. Noise impact assessment has been conducted for the construction and operation phases of the proposed Project.

Construction Noise

11.9.2. With the implementation of the recommended mitigation measures such as the use of QPME, limiting the number of construction plants operating concurrently, using movable noise barriers and adopting good site practices, adverse construction noise impact is not anticipated except at NSR 2. As it is close to the site, NSR 2 is expected to expose to construction noise exceeding the relevant noise standard during examination period when the noise criterion will be 65 dB(A), when site formation, excavation and filling works take place in mid 2016. The duration of exceedance is expected to be around 7 days. It is recommended that more detailed construction planning, which includes the arrangement on work sequence and plant locations, etc. before actual construction work is undertaken by the Contractor, and practicable noise mitigation measures should be implemented according to the actual site condition and constraints, in order to reduce the construction noise impact. In this connection, the Contractor should keep close liaison with the nearby educational institutions to obtain the examination schedule and should control noise from their construction work such as avoiding concurrent operation of noisy PME, and /or reduction in percentage on-time of PME during school examination periods. A Construction Noise Management Plan shall be provided by the Contractor before commencement of the construction to avoid noise exceedance.

11.9.3. To ensure the implementation of construction noise mitigation measures as well as to establish a noise complaint handling mechanism, environmental monitoring and auditing are also recommended in EM&A Manual.

Fixed Plant Noise

11.9.4. With the implementation of the mitigation measures for vehicle repair / testing activities (including carrying out vehicle repair / testing activities at covered area during daytime and evening as far as possible), and the selection of MVAC and other BS equipment with mitigation measures where necessary to meet the maximum allowable sound power levels, adverse fixed noise impact on the NSRs will not be anticipated during operation phase.

Road Traffic Noise

11.9.5. A comparison of the noise levels for the “with project” and “without project” scenarios predicted for year 2033 (i.e. the worst case scenarios) indicated that traffic noise contribution from the road traffic generated by the proposed Project will be insignificant. Therefore, operation of the proposed Project will have no significant contribution to road traffic noise impact on the nearby NSRs.

11.10. WATER QUALITY

11.10.1. Construction site run-off, sewage from workforce and potential risk of chemical spillage have been considered and identified as potential water pollution sources. Mitigation measures including the implementation of construction site practices in accordance with the EPD’s ProPECC PN 1/94 Construction Site Drainage, provision and management of portable chemical toilets on-site, and preventive measures to avoid accidental chemical spillages are recommended to minimise potential adverse impacts on water quality. Residual adverse impact on water quality would not be anticipated.

11.10.2. Considering the operation phase of the proposed Project, insignificant sewerage and sewage treatment implications are predicted, along with the implementation of recommended mitigation measures, adverse water quality impact would not be anticipated.

11.11. LANDSCAPE AND VISUAL

11.11.1. Assessment on landscape and visual impact has been conducted for the proposed Project. The potential sources of landscape and visual impact of the proposed Project mainly arisen from the operation of site works, removal of existing vegetation, and the presence of the permanent structure and its operation.

11.11.2. With the implementation of the proposed mitigation measures, such as proper control of construction activities, incorporation of hard landscape design, and provision of compensatory planting and green roof, to enhance the screening of the proposed Project and soften the impact of the permanent structure, the proposed Project would have insubstantial impact on the existing landscape resources and landscape character area during both construction and operation phases.

11.11.3. Although the residual visual impact ranges from insubstantial to moderately adverse and insubstantial to slightly adverse during construction and operation phase respectively, the overall visual quality of the Project site would be enhanced with the provision of mitigation measures as compared to the original setting of the Project site. Therefore, the landscape and visual impact of the proposed Project is considered as acceptable with mitigation measures.

11.12. WASTE MANAGEMENT IMPLICATION

11.12.1. Assessment on waste management implication has been conducted for the proposed Project for both construction and operation phases.

11.12.2. With the implementation of mitigation measures to ensure prior handing, storage, collection, transportation and disposal of waste, adverse residual impact is predicted to be not anticipated during both the construction and operation phases.

11.13. LAND CONTAMINATION

11.13.1. Assessment on land contamination has been conducted for the proposed Project based on historical and current land uses and site reconnaissance.

11.13.2. With the implementation of proper site practice for handling, storage, transportation, collection and disposal of DGs, chemicals and chemical waste, the construction and operation of the proposed Project is not anticipated to result in quantifiable adverse land contamination.

11.14. HAZARD TO LIFE

11.14.1. Assessment on hazard to life has been conducted for the proposed Project for both construction and operation phases.

11.14.2. The risks to construction workers and to on-site Project workers of the proposed Project comply with the EIAO-TM in terms of both individual risk and societal risk. The cumulative risk due to DG of the proposed Project and all neighbouring DG installations predicted to comply with the EIAO-TM.

11.15. KEY ASSESSMENT ASSUMPTIONS, LIMITATIONS OF ASSESSMENT METHODOLOGIES AND PRIOR AGREEMENTS

11.15.1. A summary of key assessment assumptions, limitation of assessment methodologies and related prior agreements with relevant Government departments is presented in ***Appendix 11.1***.

12. ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

12.1. INTRODUCTION

12.1.1. In addition to the assessment for various environmental parameters previously, programme and methodologies for Environmental Monitoring and Audit (EM&A) are recommended to evaluate the environmental performance and implementation of this project. This chapter summarises the requirements for EM&A. Details of the EM&A programme are presented as part of this EIA Report in a stand-alone EM&A Manual which is formulated in accordance with Annex 21 of the EIAO-TM and EPD's EM&A Guidelines for Development Projects in Hong Kong.

12.1.2. This EM&A programme provides systematic procedures for monitoring, auditing and minimising of environmental impacts during construction and operation phases of this proposed Project. Major objectives of the EM&A are listed as following:

- To ensure the compliance with the relevant requirements, standards, Government policies and this EIA study recommendations;
- To enhance the implementation of proposed mitigation measures through monitoring and auditing;
- To allow early warning to any possible exceedance of environmental compliance;
- To establish an appropriate procedures for environmental complaints handling;
- To determine the scope and extent of remedial actions when they are required.

12.1.3. All EM&A data, assessment results and recommendations shall be reported in a series of regular EM&A reports during the next phase of this project.

12.2. EM&A REQUIREMENT

12.2.1. All proposed mitigation measures in this EIA study shall be incorporated in EM&A programme during implementation. Through that, early warning would be released to the Contractor for necessary actions to mitigate environmental impacts. ***Table 12.1*** summarised the general EM&A requirements for each environmental parameters.

Table 12.1 Summary of EM&A requirements

Environmental Parameters	Construction Phase		Operation Phase	
	Monitoring	Audit	Monitoring	Audit
Air Quality	-	√	-	-
Noise	√	√	-	-
Water Quality	-	√	-	-
Landscape and Visual	-	√	-	-
Waste Management	-	√	-	-
Land Contamination	-	-	-	-
Hazard to Life	-	-	-	-

12.2.2. Details of the proposed mitigation measures, monitoring locations and procedures are presented in a stand-alone Environmental Monitoring and Audit (EM&A) Manual.

12.3. AIR QUALITY

Construction Phase

12.3.1. No adverse dust impact is anticipated at each representative ASR, given that dust suppression measures during construction phase aforementioned in *Section 4.8.2* and recommendations under the Air Pollution Control (Construction Dust) Regulation are properly implemented. Regular site environmental audits during the construction of the proposed Project shall be conducted in accordance with the requirements in the EM&A Manual.

Operation Phase

12.3.2. The results of the operation air quality impact assessment showed that no adverse impact due to vehicular movement, odour from RCVs as well as laboratory emission would be anticipated during the operation of the proposed Project. Hence, EM&A auditing work is considered not necessary.

12.4. NOISE

Construction Phase

12.4.1. With the implementation of the recommended mitigation measures such as the use of QPME, limiting the number of construction plants operating concurrently, using movable noise barriers and adopting good site practices, adverse construction noise impact is not anticipated except at NSR 2. As it is close to the site, NSR 2 is predicted to expose to construction noise exceeding the relevant noise standard during examination period when site formation, excavation and filling works take place in mid-2016. The duration of the exceedance is expected to be around 7 days. It is recommended that more detailed construction planning, which includes the arrangement on work sequence and plant locations, etc. before actual construction work is undertaken by the Contractor, and practicable noise mitigation measures should be implemented according to the actual site condition and constraints, in order to reduce the construction noise impact. In this connection, the Contractor should keep close liaison with the nearby educational institutions to obtain the examination schedule and should control noise from their construction works such as avoiding concurrent operation of noisy PME, and /or reduction in the percentage on-time of PME during school examination periods. A Construction Noise Management Plan shall be provided by the Contractor before commencement of the construction to avoid noise exceedance.

12.4.2. Environmental Monitoring and Audit measures are also recommended in EM&A Manual to further ensure the implementation of construction noise mitigation measures and to establish appropriate procedures for handling noise complaints. Details of implementation schedules are recorded in the EM&A Manual.

Operation Phase

12.4.3. Noise monitoring during operation phase is not necessary as no adverse fixed noise impact from the proposed Project is anticipated with the implementation of the recommended mitigation measures, and the MVAC and other fixed plant properly selected with mitigation measure where necessary to meet the maximum allowable SWLs. The proposed Project will have no significant contribution to road traffic noise impact on the NSRs.

12.5. WATER QUALITY

Construction Phase

12.5.1. Adverse water quality impact was not predicted and thus water quality monitoring is not considered necessary. However, to ensure that good construction work practices and proposed mitigation measures would be implemented appropriately, construction activities are recommended to be subject to a routine audit programme throughout the construction period. Details on the scope of this audit are presented in the EM&A Manual.

Operation Phase

12.5.1.1. With full implementation of the proposed mitigation measures during the operation period, no adverse water quality is predicted. Therefore, EM&A for water quality is not required.

12.6. LANDSCAPE AND VISUAL

Construction Phase

12.6.1. With implementation of the proposed mitigation measures as mentioned in *Section 7.8.2* to *7.8.5*, no substantial landscape impact but slight to moderate visual impact is anticipated during construction phase. The implementation of mitigation measures shall be checked by regular environmental site audit as part of the EM&A procedures as detailed in the EM&A Manual.

Operation Phase

12.6.2. This proposed Project would result in felling of 9 trees within the Project site and 3 trees on the North-western boundary. Approval on tree felling would be obtained from relevant Government departments including Lands Department. EM&A work is considered not necessary in general. However, any necessary monitoring of the compensatory planting after establishment will be conducted, if required, subject to the tree felling approval conditions as required by the approval authorities.

12.7. WASTE MANAGEMENT

12.7.1. The regular auditing by Environmental Team is recommended during the construction phase of this proposed Project to ensure waste are being managed with appropriate procedures or practices in accordance to relevant legislation and waste management guidelines as well as those recommended in this EIA Report. The audits will examine all aspects of waste management including waste generation, storage, recycling, transport and disposal.

12.7.2. A WMP, as part of EMP, should be prepared in accordance with ETWB TC(W) No.19/2005 and submitted to the Project/ Site Engineer for approval. The recommended mitigation measures should form the basis of the WMP. The monitoring and auditing requirement stated in ETWB TC(W) No.19/2005 shall be followed with regard to the management of C&D Materials.

12.8. LAND CONTAMINATION

12.8.1. As assessed in previous chapter, the land contamination at the Project site was identified to be insignificant during the construction and operation phases with the implementation of good site practice and design, thus, no EM&A for contaminated land is recommended.

12.9. HAZARD TO LIFE

12.9.1. The risk to construction workers of this proposed Project is predicted to comply with the Hong Kong Planning Standards and Guidelines in terms of both individual and societal risk. Also, it is concluded that the operation of this project has no failure event that could cause off-site risk. Therefore, the EM&A for hazard to life is not recommended during both the construction and operation phases.

13. IMPLEMENTATION SCHEDULE

13.1. INTRODUCTION

13.1.1. Various mitigation measures have been presented to minimise possible pollution and implement adverse impact control in planning, design, construction and operation stages. ***Table 13.1*** below provides the Environmental Mitigation Implementation Schedule (EMIS) for the recommended mitigation measures of the proposed Project which should be implemented as far as practicable in the work areas as specified. For each of the measures, both the location and timing for the measures, and the responsible parties for implementing the measures and for maintenance, are well identified.

Table 13.1 Environmental Mitigation Implementation Schedule for the proposed Project

Note # DS = Design; C = Construction; O = Operation; DC = Decommissioning

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
Air Quality									
4.8.2	2.3.1	Dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation and good site practices: • Use of regular watering, to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather; • Use of frequent watering for particularly dusty construction 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 temporary stockpiles should be avoided or covered. Prevent placing dusty material storage plies 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; • Imposition of speed controls for vehicles on unpaved site roads. 8 km/hr is the recommended limit; • Routing of vehicles and positioning of construction plant should be at the	All work sites	Contractor and sub-contractor(s)	Air Pollution Control Ordinance		✓		

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage # DS	C	O	DC
		maximum possible distance from ASRs; • Every stock of more than 20 bags of cement or dry pulverised fuel ash (PFA) , if applicable, should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3-sides; and • Loading, unloading, transfer, handling or storage of large amount of cement or dry PFA should be carried out in a totally enclosed system or facility, and nay vent or exhaust should be fitted with the an effective fabric filter or equivalent air pollution control system.							
4.10.2	2.3.2	There will be metal tailgate cover and deodourisation system with odour removal efficiency of 85% or above equipped in every RCVs of the FEHD Depot to mitigate the spread of odour.	FEHD Depot	FEHD	Waste Disposal (Designated Waste Disposal Facility) Regulation			✓	
4.10.2	2.3.2	Activated carbon or scrubber will be equipped in the GL to treat the extracted gases from fumehood prior to discharge.	GL Specialist Laboratory	Contractor, sub-contractor(s) and GL	-	✓		✓	
Noise									
5.8.3	3.4.1 – 3.4.2	Selection and Optimisation of Construction Processes • Carefully arrange the timing and sequencing of the various construction activities according to the actual site work situation; • Limit the quantity of PME to be operated concurrently; • In the case during school examination, more stringent construction noise criteria should be imposed, the potentially most disruptive construction activities should be avoided, and arranged to be conducted during school holidays as far as practicable; and	All work sites	Contractor and sub-contractor(s)	EIAO, Noise Control Ordinance		✓		

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
		• Preparation of the Construction Noise Management Plan.							
5.8.4 – 5.8.6	3.4.1 – 3.4.2	Use of QPME and Quiet Working Methods In order to reduce the excessive noise impacts at the NSRs, quieter PME are recommended. Whilst quieter PME are listed, the Contractor may be able to obtain particular models of plant that are quieter than the PMEs given in GW-TM. The associated mitigation measures to the particular PME should be reviewed by the Contractor. The use of plants with SWLs less than those in the GW-TM are summarized in ***Table 5.14*** of the EIA report and the proposed mitigated plant inventory for the construction works of the proposed Project is detailed in ***Appendix 5.8***.	All work sites	Contractor and sub-contractor(s)	EIAO, Noise Control Ordinance		✓		
5.8.7 – 5.8.8	3.4.1 – 3.4.2	Use of movable noise barriers The use of movable noise barrier for certain PME could further minimize the construction noise impact. In general 5dB(A) reduction for mobile PME and 10dB(A) for stationary PME can be achieved provided that the direct line-of site of the PME is blocked. The Contractor shall be responsible for the design of the movable noise barrier with due consideration given to the size of the PME and the requirement of intercepting the line of sight between the NSRs and the PME, as well as ensuring that the barriers should have no openings and gaps.	All work sites	Contractor and sub-contractor(s)	EIAO, Noise Control Ordinance		✓		
5.8.9	3.4.1 – 3.4.2	Good site practices: • Use of well-maintained and regularly-serviced plant during the works; • Plant operating on intermittent basis should be turned off or throttled down to a minimum;	All work sites	Contractor and sub-contractor(s)	EIAO, Noise Control Ordinance		✓		

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
		• Plant known to emit noise strongly in one direction should be orientated to face away from the NSRs; • Silencers, mufflers and enclosures for plant should be used where possible and properly maintained throughout the works; • Where possible fixed plants should be sited away from NSRs; and • Stockpiles of excavated materials and other structures such as site buildings should be used effectively to screen noise from the works.							
5.8.10 – 5.8.11	3.4.3	Avoid the vehicle repair activities to be carried out during nighttime period.	EMSD Depot	EMSD	EIAO, Noise Control Ordinance			✓	
5.8.12 – 5.8.13	3.4.3	Provided that the fixed plants are properly selected with mitigation measures where necessary to meet the maximum allowable SWLs, no adverse residual impacts would be anticipated. However, it is still recommended that the following noise reduction measures be considered as far as practicable during the processes of detailed design: • Apply noise mitigation measures including silencers, acoustic louvers and acoustic enclosure where necessary; • As part of the design process, commissioning test should be conducted to ensure the compliance of relevant fixed plant noise criteria; and • Develop and implement a regularly scheduled plant maintenance programme to ensure that equipment is properly operated and services in order to maintain controlled level of noise. The programme should be implemented by properly trained personnel.	The Government Complex and Vehicle Depot	Contractor and sub-contractor(s); HKPF, FEHD, EMSD and GL	EIAO, Noise Control Ordinance	✓		✓	
Water Quality & Sewerage									

<table>
<tr><th rowspan="2">EIA Ref.</th><th rowspan="2">EM&A Manual Ref.</th><th rowspan="2">Environmental Protection Measures</th><th rowspan="2">Location/ Duration of Measures/ Timing of Completion of Measures</th><th rowspan="2">Implementation Agent</th><th rowspan="2">Relevant Legislation & Guidelines</th><th colspan="4">Implementation Stage #</th></tr>
<tr><th>DS</th><th>C</th><th>O</th><th>DC</th></tr>
<tr><td>6.9.1</td><td>4.4.2</td><td>In accordance with Professional Persons Environmental Consultative Committee Practice Notes (ProPECC PN) 1/94, potential water quality impact shall be minimised by the implementation of construction phase mitigation measures and general good site practice including the following:

• At the establishment of works site, perimeter cut-off drains to direct off-site water around the Site should be constructed with internal drainage works and erosion and sedimentation control facilities implemented. Channels (both temporary and permanent drainage pipes and culverts), earth bunds or sand bag barriers should be provided to divert the stormwater to silt removal facilities.

• Dikes or embankments for flood protection should be implemented around the boundaries of earthwork areas. Temporary ditches should be provided to facilitate the run-off discharge into an appropriate watercourse, through a silt/sediment trap. Silt/sediment traps should also be incorporated in the permanent drainage channels to enhance deposition rates;

• The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94, which states that the retention time for silt/sand traps should be 5 minutes under maximum flow conditions. The sizes may vary depending upon the flow rate, but for a flow rate of 0.1m^3/s, a sedimentation basin of 30m^3 would be required and for a flow rate of 0.5m^3/s the basin would be 150m^3. The detailed design of the sand/silt raps should be undertaken by the Contractor prior to the commencement of construction.

• The construction works should be programmed to minimise surface excavation works during rainy seasons (April to September), as possible. All exposed earth areas should be completed and vegetated as soon as possible after completion of the earthwork, or alternatively, within 14 days of the cessation of earthworks where practicable. If excavation of soil</td><td>All work sites</td><td>Contractor and sub-contractor(s)</td><td>Water Pollution Control Ordinance</td><td></td><td>✓</td><td></td><td></td></tr>
</table>

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
		cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means; • The overall slope of works sites should be kept to a minimum to reduce the erosive potential of surface water flows, and all trafficked areas and access roads should be protected by coarse stone ballast. An additional advantage accruing from the use of crushed stone is the positive traction gained during the prolonged periods of inclement weather and the reduction of surface sheet flows; • All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure their proper and efficient operation at all times particularly following rainstorms. Deposited silts and grits should be removed regularly and disposed of by spreading evenly over stable, vegetated areas; • Measures should be taken to minimise the ingress of site drainage into excavations. If the excavation of trenches in wet season is inevitable, they should be dug and backfilled in short sections wherever practicable. The water pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities; • All open stockpiles of construction materials (for example, aggregates, sand and fill materials) should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system; • Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system and storm run-off being directed into foul sewers;							

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
		• Precautions to be taken at any time of the year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecasted and during or after rainstorms, are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface run-off during storm events; • All vehicles and plants should be cleaned before leaving the Project site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing bay should be provided at the exit of Project site where practicable. Wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-washing bay to public roads should be paved with sufficient backfall toward the wheel-washing bay to prevent vehicle tracking of soil and silty water to public roads and drains; • Oil interceptors should be provided in the drainage system downstream of any oil/fuel pollution sources. Oil interceptors should be emptied and cleaned regularly to prevent the release of oil and grease into the storm water drainage system after accidental spillage. A bypass should be provided for oil interceptors to prevent flushing during heavy rain. Any drainage channels connecting storm drains via designed sand/silt removal facilities should be disconnected/removed after completion of construction stage to prevent any direct discharge to the stormwater system; • The construction solid waste, debris and rubbish on-site should be collected, handled and disposed of properly to avoid causing any water quality impacts. The requirements for solid waste management are detailed in Section 8 of EIA report; and • All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds of a capacity equal to 110% of the storage							

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage # DS	C	O	DC
		capacity of the largest tank to prevent spilled fuel oils from reaching the nearby WSRs.							
6.9.3	4.4.3	There is a need to apply to the EPD for a discharge licence for discharge of effluent from the construction site under the WPCO. The discharge quality must meet the requirements as specified in the discharge licence. All the run-off and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the Technical Memorandum. Minimum distances of 100 m should be maintained between the discharge points of construction site effluent and the existing seawater intakes. In addition, no new effluent discharges in nearby typhoon shelters should be allowed. The beneficial uses of the treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., would minimise water consumption and reduce the effluent discharge volume.	All work sites	Contractor and sub-contractor(s)	Water Pollution Control Ordinance		✓		
6.9.4	4.4.4	Portable chemical toilets and sewage holding tanks are recommended for the handling of the construction sewage generated by the workforce. A licenced contractor should be employed to provide appropriate and adequate portable toilets and be responsible for appropriate disposal and maintenance.	All work sites	Contractor and sub-contractor(s)	Water Pollution Control Ordinance Waste Disposal (Chemical Waste)(General) Regulation		✓		
6.9.6	4.4.5	Any maintenance facilities should be located on hard standings within a bunded area, and sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should be undertaken within the areas appropriately equipped to control these discharges.	All work sites	Contractor and sub-contractor(s)	Water Pollution Control Ordinance		✓		
6.9.7	4.4.6	All sewage arising from the proposed Project should be collected and diverted to the public foul water drainage system via proper connections to minimise water	The Government Complex and	Contractor and sub-contractor(s),	Water Pollution Control Ordinance	✓		✓	

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
		quality impact from the operation of the Project and ensure compliance with Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters under the Water Pollution Control Ordinance (WPCO-TM).	Vehicle Depot	HKPF, FEHD, EMSD and GL					
6.9.8	4.4.7	Run-offs from the covered areas including vehicle washing bays and vehicle examination / maintenance / repair / testing area would be properly treated prior to discharge into the foul water drainage system. The wastewater treatment facilities for the proposed Project, which comprised of petrol interceptor and sedimentation tank, would be designed using sedimentation process with adequate treatment capacity. Oily waste collected by petrol interceptors is considered and disposed of as chemical waste. The wastewater treatment facilities for the proposed Project will be designed during the detailed design stage and the treated effluent for discharging into the public foul water drainage system should comply with the effluent standards as stated in the WPCO-TM.	The Government Complex and Vehicle Depot	Contractor and sub-contractor(s), HKPF, FEHD, EMSD and GL	Water Pollution Control Ordinance	✓		✓	
6.9.9	4.4.8	Best practices with appropriate management should be implemented during transfer of operation chemicals. Each chemical container should be provided with drip trays at storage. In case of chemical spillage, licensed collector would be appointed for waste collection.	The Government Complex and Vehicle Depot	HKPF, FEHD, EMSD and GL	Water Pollution Control Ordinance			✓	
6.9.10	4.4.9	There is a need to apply to the EPD for a discharge licence for discharge of the operational effluent from the proposed Project under the Water Pollution Control Ordinance. The discharge quality must meet the requirements as specified in the discharge licence.	The Government Complex and Vehicle Depot	HKPF, FEHD, EMSD and GL	Water Pollution Control Ordinance			✓	
Landscape and Visual									

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
7.8.2	5.2.1	Hoardings should be provided with aesthetic treatment and designed to be subtle and camouflaged. It should be compatible with the surrounding landscape and visually “impermeable” to block the view of construction activities from VSRs.	All work sites	Contractor and sub-contractor(s)			✓		
7.8.3	5.2.1	Temporary landscape treatment, such as the provision of temporary landscape planting around the Site office in ornamental pots and application of green roof for Site office, should be considered during construction phase. Landscape planting in movable planters should also be considered as a temporary greening measure for the Project area (i.e. along Site hoarding). Design of the green roof and the type of species to be used shall be reviewed and confirmed during detailed design stage.	All work sites	Contractor and sub-contractor(s)		✓	✓		
7.8.4	5.2.1	Disturbance to existing vegetation should be avoided as far as practicable. Where possible, the construction programme should retain all trees in situ that are not in direct conflict with the development proposals. Subject to the detailed design of the proposed Project, a review shall be carried out before commencement of construction phase to assess the potential conflict of the construction activities with existing roadside trees and the need of corresponding measures. Proper protective fencing should be provided by the Contractor to protect the preserved trees before commencement of any works within the Project site. The protective fencing should be erected along or beyond the perimeter of the tree protection zone of each individual tree.	All work sites	Contractor and sub-contractor(s)			✓		

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage # DS	C	O	DC
7.8.5	5.2.1	Compensatory planting should be provided in the landscape area on Level 1 for the 12 trees that are proposed to be felled. The planting would follow the requirements as stipulated in Development Bureau Technical Circular (Works) (DEVB TC(W)) No. 10/2013, such as the provision of compensatory trees of heavy-standard size in a ratio of 1:1 in terms of number and aggregate diameter at breast height (DBH). The planting location and the type of compensatory plant species will be reviewed during detailed design stage. A compensatory tree planting proposal should be submitted together with tree removal application for approval by authorities in later stage. The planting should be commenced during construction stage and be completed before the completion of construction stage to ensure the measure will be implemented on Day 1 of operation stage. Vegetation maintenance should be provided by the Operator.	The Government Complex and Vehicle Depot	Contractor and sub-contractor(s), Operator	DEVB TC(W) No. 10/2013	✓	✓	✓	
7.8.6	5.2.1	Landscape areas should be provided along the Site boundary on Level 1 to soften the built structure of the proposed Project. An approximate of $700m^2$ of trees, shrubs or groundcovers shall provide year-round streetscape amenity as well as enhancing visual interest at street level. A mix of native and ornamental trees, shrubs or groundcovers shall be planted to articulate the spatial arrangements as well as to further add to the visual amenity. The type of species to be used will be confirmed during detailed design stage. The planting should be commenced during construction stage and be completed before the completion of construction stage to ensure the measure will be implemented on Day 1 of operation stage. Vegetation maintenance should be provided by the Operator.	The Government Complex and Vehicle Depot	Contractor and sub-contractor(s), Operator		✓	✓	✓	
7.8.7	5.2.1	A multi-patch of landscape area should be provided on the roof of the proposed building to soften the impact of the built structure. An area of approximately $2600m^2$ of shrub, which comprises of a mix of native and ornamental species, is	The Government Complex and Vehicle Depot	Contractor and sub-contractor(s), Operator		✓	✓	✓	

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage #			
						DS	C	O	DC
		proposed to be provided to enhance the aesthetics of views for those viewing the roof. The type of shrub species will be confirmed during detailed design stage. The planting should be commenced during construction stage and be completed before the completion of construction stage to ensure the measure will be implemented on Day 1 of operation stage. Vegetation maintenance should be provided by the Operator.							
7.8.8 7.8.9	5.2.1	The exterior of the permanent structure of the proposed Project should use non-reflective external finishes in light colour that is visually unobtrusive with surrounding context. Non-reflective paving materials should be considered to reduce potential glare from surface reflectance. The finishing material and colour will be reviewed and confirmed during detailed design stage. Lighting should be efficiently designed so that minimum amount of lighting is required for safety and security. The design may make reference to the Guidelines on Industry Best Practices for External Lighting Installations by Environmental Bureau, EPD and EMSD. The mounting height and direction of exterior lighting fixtures shall be designed and arranged to point away from sensitive receivers where possible. Specification of lighting operation schedule shall be formed by the operator to impose restriction on lighting operation after business hours, such as limiting the operation of lighting except for security lighting only, and in areas with necessary night-time operation where applicable.	The Government Complex and Vehicle Depot	Contractor and sub-contractor(s), Operator		✓		✓	
Waste Management									
8.5.1	6.2.1	Recommendations for good site practices: • The Contractor shall prepare a Waste Management Plan (WMP) in	All works sites	Contractor and Sub-contractors	Waste Disposal Ordinance, Land (Miscellaneous		✓		

EIA Ref.	EM&A Manual Ref.	Environmental Protection Measures	Location/ Duration of Measures/ Timing of Completion of Measures	Implementation Agent	Relevant Legislation & Guidelines	Implementation Stage # DS	C	O	DC
		accordance with the requirements set out in the ETWB TCW No. 19/2005, Waste Management on Construction Site, for the Engineer's Representative approval. The WMP shall include monthly and yearly Waste Flow Tables that indicate the amounts of waste generated, recycled and disposed of (including final disposal site); • The Contractor's waste management practices and effectiveness shall be audited by the Engineer's Representative on regular basis; • The Contractor shall provide training for site staff for the concept of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycling; • The Contractor shall ensure sufficient waste disposal points and regular collection of waste; • The Contractor shall use trucks with covering for the open-box bed and enclosed container shall be used to minimise windblown litter and dust during transportation of waste; • The Contractor shall implement regular cleaning and maintenance programme for drainage systems, pumps and oil interceptors; • Separation of chemical wastes for special handling and appropriate treatment at a Chemical Waste Treatment Facility (CWTF); • Encourage collection of aluminium cans, paper and plastic bottles by providing separate labelled bins to enable these wastes to be segregated from other general refuse generated by the workforce; • Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;			Provisions) Ordinance, DEVB TC(W) No. 6/2010, ETWB TC(W) No. 19/2005				

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		• Wheel washing facilities shall be used by all trucks leaving the site to prevent transfer of mud onto public roads; • Make provisions in contract documents to allow and promote the use of recycled aggregates where appropriate; • No waste shall be burnt on-site; • A recording system for the amount of wastes generated, recycled and disposed (including disposal sites) should be proposed; • Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste; and • Adequate numbers of portable toilets should be provided for on-site workers. Portable toilets should be maintained in reasonable states, which will not deter the workers form utilizing them. Night soil should be regularly collected by licensed collectors.							
8.5.1	6.2.1	<u>C&D Materials / Waste:</u> • Use standard formwork or pre-fabrication as far as practicable so as to minimise the C&D Materials arising; • Consider the use of more durable formwork or plastic facing for construction works; • Avoid the use of wooden hoardings and substitute with metal hoarding to facilitate recycling; • Purchase of construction materials should be carefully planned in order to avoid over-ordering and wastage; • Establish a trip-ticket system in accordance with DevB TC(W) No. 6/2010	All work sites	Contractor and Sub-contractors	Waste Disposal Ordinance, Land (Miscellaneous Provisions) Ordinance, DEVB TC(W) No. 6/2010, ETWB TC(W) No. 19/2005		✓		

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		and Waste Disposal (Charges for Disposal of Construction Waste) Regulation in order to monitor the disposal of inert C&D Materials at public fill and the remaining C&D Waste to landfills, and control fly-tipping; • Design foundation works to minimise the amount of excavated material to be generated; • Sort construction debris and excavated materials on-site to recover reusable/recyclable portions (i.e. soil, broken concrete, metal, etc.) for backfilling and reinstatement; • Segregate and store different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal; • Specify in design & build contract the use of recycled aggregates where appropriate; • Plan and stock construction materials carefully to minimise the amount of waste to be generated and to avoid unnecessary generation of waste; and • Recommend the use of metal fencing or building panels, which are more durable than wooden panels, for the erection of construction site hoarding.							
8.5.1	6.2.1	Chemical waste: • Chemical waste producers should be registered with the EPD; • Chemical waste should be handled in accordance with the"Code of Practice on the Packaging, Handling and Storage of Chemical Wastes" including but not limited to the followings: – Good quality containers compatible with the chemical wastes should	The Government Complex and Vehicle Depot	Contractor and Sub-contractor; HKPF, FEHD, EMSD and GL	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes, Waste Disposal (Chemical Waste)		✓	✓	

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		be used and maintained in good conditions and securely closed, with incompatible chemicals be stored separately. – Appropriate labels should be securely attached on each chemical waste container in English and Chinese according to the instructions prescribed in Schedule 2 of the Regulations. – A licensed collector to transport and dispose of the chemical wastes should be employed by the Contractor, to either the Chemical Waste Treatment Centre at Tsing Yi, or any other licensed facilities. • Waste oils, chemicals or solvents should not be discharged to drain; and • Routine cleaning and maintenance programme for drainage systems, sumps and oil interceptors during operation.			(General) Regulation				
8.5.1	6.2.1	General refuse: • Sufficient dustbins should be provided for storage of waste as required under the Public Cleansing and Prevention of Nuisances By-laws; • Sufficient enclosed bins should be provided for general refuse, food and beverage waste to reduce odour, pest and litter impacts; • General refuse arising on-site should be stored in enclosed bins or compaction units separately from C&D and chemical wastes; • A reliable waste collector should be employed to clear general refuse from the construction site on a daily basis and disposed of to the licensed landfill or refuse transfer station; • Office wastes can be reduced by recycling of paper if such volume is sufficiently large to warrant collection. Participation in a local collection	The Government Complex and Vehicle Depot	Contractor and Sub-contractor; HKPF, FEHD, EMSD and GL	-		✓	✓	

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		scheme by the Contractor should be advocated; and • Waste separation facilities for paper, aluminium cans, plastic bottles, etc. should be provided on-site and collected by individual collectors should be encouraged.							
Land Contamination									
N/A	N/A	N/A	N/A	N/A	N/A				
Hazard to Life									
10.11.1	8.2.1	Recommendations for good site practices in construction phase: • ignition of fire on site should be controlled throughout the construction programme; • any temporary storage of fuel and flammable chemical should be minimised to reduce chance of causing explosion or escalation of fire in the case of emergency event at nearby potentially hazardous sources; • fire extinguisher or other firefighting equipment should be made easily accessible to on-site workers; and • establish communication channel and evacuation plan in the case of emergency event at nearby potentially hazardous sources.	All works area	Contractor and sub-contractors	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes		✓		
10.11.2	8.2.1	Recommendations for good site practices in operation phase: • arrangements and facilities for the storage of any flammable goods should be in strict compliance with relevant legislation and guidelines; • the building should be carefully designed to allow for rapid evacuation of	The Government Complex and Vehicle Depot	HKPF, FEHD, EMSD and GL	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes	✓		✓	

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		people in protected routes; and • proper training on safety procedures and evacuation arrangement should be conducted to enhance building users' capability to handle emergencies. An emergency response plan should be adopted during the operation phase of the depot. The plan should list out emergency procedures, identify members of emergency response teams and summarise contact information of nearby potentially hazardous sources.							