Agreement No. CE 8/2012 (HY)

Flyover from Kwai Tsing Interchange Upramp to Kwai Chung Road

Environmental Impact Assessment Report

Volume 1 of 2

AECOM

AECOM Consulting Services Limited

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CEDD

土木工程拓展署
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LIST OF ABBREVIATIONS

AAB	Antiquities Advisory Board
AMO	Antiquities and Monuments Office
ANLs	Acceptable Noise Levels
AOI	Area of Influence
APCO	Air Pollution Control Ordinance
API	Aerial Photograph Interpretation
AQOs	Air Quality Objectives
ASR	Air Sensitive Receiver in air section; Area Sensitivity Rating in noise section
bgl	Below Ground Level
BHIA	Built Heritage Impact Assessment
CAC	Community Affairs Committee
CDG	Completely Decomposed Granite
CEDD	Civil Engineering and Development Department
CHIA	Cultural Heritage Impact Assessment
C&D	Construction and Demolition
CNLs	Corrected Noise Levels
CNP	Construction Noise Permit
CP	Construction Phase
CRTN	Calculation of Road Traffic Noise
CWTC	Chemical Waste Treatment Centre
DA-TM	Technical Memorandum on Noise from Construction Work in Designated Areas
DASO	Dumping at Sea Ordinance
DCS	Drake Chemical Superfund
DCVs	Diesel Commercial Vehicles
DevB	Development Bureau
DNMM	Direct Noise Mitigation Measure
DP	Designated Project
DO	Dissolved Oxygen
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EIAO-TM	Technical Memorandum on Environmental Impact Assessment Process
EM&A	Environmental Monitoring and Audit
EMP	Environmental Management Plan
EP	Environmental Permit
EPD	Environmental Protection Department
ETWB TC(W)	Environment Transport and Works Bureau Technical Circular (Works)
FSD	Fire Services Department
GCO	Geotechnical Control Office
GEO	Geotechnical Engineering Office
GI	Geotechnical Investigation
GIU	Geotechnical Information Unit
GW-TM	Noise from Construction Work Other Than Percussive Piling
GN-CH	Guidance Notes on Assessment of Impact on Site of Cultural Heritage in Environmental Impact Assessment Studies
HATS	Harbour Area Treatment Scheme
HD	Housing Department
HDG	Highly Decomposed Granite
HIA	Heritage Impact Assessment
HOS	Home Ownership Scheme

HyD	Highways Department
HKGS	Hong Kong Geological Survey
HKPSG	Hong Kong Planning Standards and Guidelines
HKUST	Hong Kong University of Science and Technology
IAQM	Institute of Air Quality Management
KCAQMS	Kwai Chung Air Quality Monitoring Station
KCCT	Kwai Chung Container Terminal
KCR	Kwai Chung Road
KTDC	Kwai Tsing District Council
KT I/C	Kwai Tsing Interchange
L	Leisure
LandsD	Lands Department
LCA	Landscape Character Area
LCSD	Leisure and Cultural Services Department
LFG	Landfill Gas
LNRS	Low Noise Road Surfacing
LPG	Liquefied Petroleum Gas
LPMIS	Landslip Preventive Measures Information System
LR	Landscape Resource
LVIA	Landscape and Visual Impact Assessment
MDG	Moderately Decomposed Granite
MTRCL	Mass Transit Railway Corporation Limited
NAAQS	National Ambient Air Quality Standards
NCA	Noise Control Authority
NCO	Noise Control Ordinance
NIW	Noise Insulation Works
NMM	Noise Mitigation Measures
NSR	Noise Sensitive Receivers
O	Occupational
OGV	Ocean Going Vessels
OLM	Ozone Limiting Method
OP	Operation Phase
OVTs	Old and Valuable Trees
OZP	Outline Zoning Plan
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PCW	Prescribed Construction Works
PCRs	Petroleum Carbon Ranges
PFA	Pulverised Fuel Ash
PFC	Public Fill Committee
PFRFs	Public Fill Reception Facilities
PlanD	Planning Department
PME	Powered Mechanical Equipment
PRD	Pearl River Delta
ProPECC PN 1/9	Practice Note for Professional Persons on Construction Site Drainage
RBRGs	Risk-Based Remediation Goals
PPE	Personal Protective Equipment
PP-TM	Technical Memoranda on Noise from Percussive Piling
PSPS	Private Sector Participation Scheme
QPME	Quiet Powered Mechanical Equipment
R	Residential
SB	Southbound

SCISTW	Stonecutters Island Sewage Treatment Works
SDG	Slightly Decomposed Granite
SI	Site Investigation
SIL	Significant Impact Level
SIS	Slope Information System
SMRIS	Slope Maintenance Responsibility Information System
SPME	Specified Powered Mechanical Equipment
SPT	Standard Penetration Test
SW	Scott Wilson Limited
SW-NE	Southwest & Northeast
SWL	Sound Power Level
SVOCs	Semi-volatile Organic Compounds
T	Transportation
TBT	Tributyltin
TC	Technical Circular
TD	Transport Department
TIA	Traffic Impact Assessment
TIN	Total Inorganic Nitrogen
TK H/W	Tsing Kwai Interchange
TM	Technical Memorandum
TM-DSS	Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters
TPDM	Transport Planning and Design Manual
TMR	Turn Mun Road
TWR	Tsuen Wan Road
T&TC	Transport & Traffic Committee
UCS	Unconfined Compressive Strength
ULSD	Ultra Low Sulphur Diesel
USEPA	US Environmental Protection Agency
UTS	Universal Treatment Standards
v/c	Volume/Capacity
VE	Visual Envelope
VIC	Visual Impacts during Construction Phase
VIO	Visual Impacts during Operation Phase
VKT	Vehicle Kilometres Travelled
VOCs	Volatile Organic Compounds
VSRs	Visual Sensitive Receivers
WBTC	Works Branch Technical Circular
WCZs	Water Control Zones
WDO	Waste Disposal Ordinance
WMP	Waste Management Plan
WPCO	Water Pollution Control Ordinance (Cap.358)
WQOs	Water Quality Objectives
WSD	Water Supplies Department
WSRs	Water Sensitive Receivers
UIA	Utility Impact Assessment
ZVI	Zone of Visual Influence

1. INTRODUCTION

1.1 Project Background

1.1.1 The Transport Department (TD) has reviewed the traffic conditions of Tsuen Wan Road (TWR) near Kwai Tsing Interchange (KT I/C) and considered that a section of the southbound carriageway of TWR between KT I/C and Kwai Chung Road (KCR) would deteriorate in the future years due to congestion that would occur during peak hours. TD considers that there is a need to implement the Project to improve the road section to cope with the future traffic growth, and the scope comprises the following principal works elements:

(a) Provision of an additional traffic lane for the southbound traffic between KT I/C upramp and KCR (Bridge H);

(b) Modification of existing slip roads (Bridge G); and

(c) Associated environmental mitigation measures, utility diversion, street lighting, traffic aids, traffic and control surveillance, drainage works, landscaping works and other related works.

1.1.2 AECOM Consulting Services Limited (formerly URS Hong Kong Ltd or Scott Wilson Ltd) was commissioned by the Civil Engineering and Development Department (CEDD) of the Government of the Hong Kong Special Administrative Region to undertake the investigation stage of Flyover from Kwai Tsing Interchange up-ramp to Kwai Chung Road ('the Project' refers hereinafter) under Agreement No. CE 8/2012 (HY).

1.1.3 The Project is a Designated Project under the Environmental Impact Assessment Ordinance (EIAO). An application (No. ESB-242/2012) for an Environmental Impact Assessment (EIA) Study Brief under section 5(1)(a) of the EIAO was submitted by the CEDD on 29 February 2012 with a Project Profile (No. PP-459/2012) for the Project. An EIA Study for the Project has been undertaken as part of the Assignment, in accordance with the EIA Study Brief (No. ESB-242/2012) which was issued in April 2012 and the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

1.2 Designated Projects under EIAO

1.2.1 The new additional traffic lane (Bridge H) is a designated project under Item A.8 of Part I, Schedule 2 of the EIAO: "A road or railway bridge more than 100m in length between abutments".

1.2.2 Regarding the modification of existing slip road (Bridge G), it would not cause any environmental impact likely to affect existing or planned community, or environmental sensitivity uses in the vicinity. It is because the modification of Bridge G would not increase any traffic lane and it would divert some traffic flow from Bridge G to Bridge H, and that traffic noise impact and vehicular emission during operation phase would be slightly improved in considering of Bridge G itself in view of the reduced traffic. Hence, it would not have any increase in pollution emissions or discharges or waste generation likely to violate guidelines or criteria stipulated in EIAO-TM without mitigation in place. Therefore, referring to section 6 of EIAO-TM, Bridge would not constitute any "material change" under the EIAO. As Bridge G would not induce adverse noise impact during operation phase in view of the reduced traffic, mitigation measures for Bridge G is anticipated not necessary.

1.3 Purpose of the EIA Study

1.3.1 The purpose of the EIA Study is to provide information on the nature and extend of the environmental impacts from the construction and operation of the Project and associated mitigation, and related activities that take place concurrently. This information will contribute to decisions on:

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

1.4 Objectives of this EIA Study

1.4.1 The EIA Study has been conducted and completed in accordance with the requirements of the EIA Study Brief under the EIAO and the guidelines on assessment methodologies provided in the EIAO-TM. The EIA Report has been prepared:

(a) to describe the Project and associated works together with the requirements and environmental benefits for carrying out the Project;

(b) to identify and describe the elements of the community and environment likely to be affected by the Project, and/or likely to cause adverse impacts to the Project, including both the natural and man-made environment and the associated environmental constraints;

(c) to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(d) to identify any systematically evaluate any potential landscape and visual impacts and to propose measures to mitigate these impacts;

(e) to identify any negative impacts on sites of cultural heritage and to propose measures to mitigate these impacts;

(f) to propose the provision of infrastructure or mitigation measures to minimize pollution, environmental disturbance and nuisance during construction and operation of the Project;

(g) to investigate the feasibility, effectiveness and implications of the proposed mitigation measures;

(h) to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction and operation phases of the Project in relation to the sensitive receivers and potential affected uses;

(i) to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these residual environmental impacts and cumulative effects and reduce them to acceptable levels;

(j) to design and specify the environmental monitoring and audit requirements; and

(k) to identify any additional studies necessary to implement the mitigation measures or monitoring and proposals recommended in the EIA report.

1.5 Approach to EIA Study

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

Description of the Environment

1.5.2 The characteristics of the existing environment were described for the identification and prediction of potential impacts which are likely to arise from implementing the 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

1.5.3 Individual aspect assessments were undertaken in accordance with the relevant guidelines on assessment methodologies given in the EIAO-TM.

Impact Evaluation

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

Impact Mitigation

1.5.5 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.

1.5.6 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.

1.6 EIA Study Scope

1.6.1 The environmental issues covered in this EIA study, as addressed in the EIA Study Brief (No. ESB-242/2012), are as follows:

- Potential noise and air quality impacts from the construction and operation of the Project to sensitive receivers along or near the Project, taking into account the cumulative impact from the operation of existing roads in the vicinity of the Project;
- potential water quality impact from the construction and operation of the Project on the relevant water system(s);
- potential waste management issues and impacts arising from the construction and operation of the Project;
- potential land contamination arising from land to be resumed for the Project;

- potential landfill gas hazard on site during the construction and operation of the Project due to the former Gin Drinker's Bay Landfill;
- potential landscape and visual impacts during the construction and operation of the Project;
- potential impacts on sites of cultural heritage from construction and operation of the Project; and
- potential cumulative environmental impacts of the Project and associated works, through interaction or in combination with other existing, committed and planned projects in their vicinity, and that those impacts may have a bearing on the environmental acceptability of the Project.

1.7 Public Engagement /Consultation

1.7.1 The Project was presented to the Transport & Traffic Committee (T&TC) and Community Affairs Committee (CAC) under Kwai Tsing District Council (KTDC) in December 2014 after consultation with Kwai Tsing District Office and on completion of TIA, DIA and draft EIA studies. The presentation was to introduce the proposed road alignment option, associated works, implementation programme, results of the TIA and EIA together with the mitigation measures, land resumption, and road crossing facilities to be affected during construction and operation stages. The Project was supported without opposition in the T&TC meeting, and no adverse comment was received from the CAC on the consultation paper circulated to CAC.

1.7.2 Early consultation with the neighbouring facilities that may be affected by the Project was conducted prior to the aforementioned presentation to T&TC in order to provide an opportunity for direct dialogue with the public having concerns on matters relating to the traffic, environment, and community services. Informal meetings were held with the representatives of Sin Ching Kindergarten, Lai King Catholic Secondary School, Lingnan Dr. Chung Wing Kwong Memorial Secondary School and Estate Management Advisory Committee of Lai King Estate, and the district councillors of Lai King/Hing Fong constituencies during November and December 2014.

1.8 Structure of the EIA Report

1.8.1 The background of the project, purpose and objectives of this Report are introduced in this section. A description of the Project and details of consideration alternative options are provided in **Section 2**. **Sections 3 to 9** detail the results of the environmental impact assessment of each key subject area, covering relevant legislation, environmental conditions, assessment criteria, methodology, and assessment findings.

1.8.2 Sections 3 to 9 include:

- Section 3: Air Quality Impact
- Section 4: Noise Impact
- Section 5: Water Quality Impact
- Section 6: Waste Management Implication and Land Contamination
- Section 7: Landscape and Visual Impacts

- Section 8: Landfill Gas Hazard Assessment
- Section 9: Impact on Cultural Heritage

1.8.3 An outline of the requirements for the environmental monitoring and audit (EM&A) programme is presented in **Section 10**. The EM&A programme is presented in detail in a separate EM&A Manual. A summary of environmental outcome and conclusion of the whole assessment is given in **Section 11**. A detailed implementation schedule of the recommended mitigation measures is provided in **Section 12**.

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2. PROJECT DESCRIPTION

2.1 Introduction

2.1.1 This section presents a summary of the adopted alignment and preferred construction methodology for the Project as well as provides details of the alternative options considered, the constraints and considerations assessed in adopting the preferred scheme and construction method.

2.2 Existing Road Networks

2.2.1 Major roads inside the study area of the Project include Kwai Tsing Interchange (KT I/C) Upramp, Tsuen Wan Road (TWR), Kwai Chung Road (KCR) and Kwai Chung Road Upramp as well as Tsing Kwai Highway (TK H/W) and Tsing Kwai Highway Upramp.

2.2.2 KCR upramp runs parallel with KCR where it intersects with TWR and connects with KCR at grade. The primary purpose of this upramp is to allow traffic from KCR to access Tsing Kwai Highway (Route 3). Therefore, regulatory marking which prohibits traffic weaving from the nearside lane of KCR southbound (SB) outside Lai King Estate is in place.

2.2.3 TWR is generally a dual-three expressway providing connections between KCR / TK H/W and TMR.

2.2.4 Tsing Kwai Highway ramp has two traffic lanes linking KCR and TK H/W.

2.3 The Need for the Project

2.3.1 As mentioned in Section 1, Transport Department (TD) has reviewed the traffic conditions of TWR near KT I/C and considered that a section of the southbound carriageway of TWR between KT I/C and KCR would deteriorate due to congestion occurs during peak hours in the future years. TD considers that there is a need to implement the Project to improve the road section to cope with future traffic growth.

2.3.2 According to the Traffic Impact Assessment (TIA) carried out under this Project, the section of the southbound carriageway of TWR between KT I/C and KCR is currently operating marginally above capacity in the morning peak hours and it is envisaged that the congestion would continue to worsen in the future years. The TIA has confirmed that with the introduction of an additional traffic lane (i.e. the Project), this section of the southbound carriageway of TWR would be operating within capacity in both the morning and evening peak hours in all design years.

2.3.3 The TIA has also confirmed that the Project would not cause adverse impact on the local road junctions.

2.4 Benefit of the Project

2.4.1 A section of the SB carriageway of TWR between KT I/C and KCR has been predicted to be deteriorated due to congestion occurs during peak hours in the future years. An additional one-lan flyover is therefore proposed to improve the road section to cope with the future traffic growth by directing traffic flow from fast lane of SB TWR to merge the fast lane of SB KCR. This would decrease the ratio of the traffic volume to the road link capacity (v/c ratio) on the concerned section, i.e. reduce chance of traffic congestion in future.

2.4.2 Since the proposed new flyover shall be connecting with the fast lane of SB TWR, it would

therefore direct some of the on-road traffic away from the nearby noise sensitive receivers at Lai King Estate. In addition, it is feasible to cope with direct noise mitigation measures as needed associated with the new flyover construction. In this connection, traffic noise impact due to TWR could be slightly relieved with this Project in place.

2.4.3 With the decrease of v/c ratio on SB TWR when this Project is in place, local traffic congestion problem could be resolved. In other words, the on road traffic speed would be resumed to the design speed limit instead of idling during rush hours. As a result, the overall vehicular emission would likely be reduced in the vicinity area in the future.

2.4.4 In summary, the Project would not only improve traffic congestion problem but also introduce environmental benefits to the vicinity's sensitive receivers in the future.

2.5 Proposed Road Works

2.5.1 To fulfil the future demand and to prevent traffic congestion in the future during peak traffic flow hours, an additional southbound lane (a separated viaduct) is introduced on TWR and connected to the existing lane on the west side of KCR with design speed of 70 km/hr.

2.5.2 The proposed road works and section drawings are shown in **Figures 2.1** and **2.2** respectively, details would be presented in Section 2.6. The basis of design for this proposed flyover is to utilise the remaining capacity currently available on the two segregated KCR carriageways.

2.5.3 In addition, a second structure (approximately 150m long) along the nearside lane of TWR near existing KT I/C upramp is required to achieve widening at the east side of TWR.

2.5.4 Associated works in the following areas have been identified:

- Existing footbridge NF303 is to be demolished and be re-provided;
- Existing Public Works Regional Laboratory will be affected;
- Existing drainage reserve zone positioned alongside TWR will be affected;
- Existing bus stop outside subway NS10A is to be relocated; and
- Minor modification to the existing KCR involves removal of the existing planter, breaking and reinstating KCR with the new road marking.

2.6 Consideration of Alternative Options

Considered Options

2.6.1 The proposed flyover connects the KT I/C Upramp to KCR. Two improvement options, namely Option 1 and Option 2, were identified in Clause 3.1 of the Brief. Two additional improvement options, Option 1A and Option 2A, have been developed by improving the road geometry of Option 1 and Option 2 respectively in order to achieve a design speed of 70km/hr, and to match the speed limit on the existing TWR. Another improvement option, Option 3, which is based on widening along both nearside and offside lanes of TWR, has also been identified in the *"Working Paper on Alignment Options and Assumptions"* under this Project.

2.6.2 Subsequent to the circulation of the aforementioned working paper, which covers Options 1, 1A, 2, 2A and 3, two additional options, namely Option 2B and Option 3A have been

developed in the report named *"Report on the Development and Evaluation of Options"*. Option 2B is similar to Option 2 and 2A; and Option 3A is similar to Option 3.

2.6.3 Figures for these seven options are depicted in **Figures 2.3** to **2.9** while a summary of these considered options are as follows:

- Option 1: Separate Viaduct on East Side of TWR (Design Speed 50km/hr)
- Option 1A: Separate Viaduct on East Side of TWR (Design Speed 70km/hr)
- Option 2: Separate Viaduct on West Side of TWR (Design Speed 50km/hr)
- Option 2A: Separate Viaduct on West Side of TWR (Design Speed 70km/hr)
- Option 2B: Separate Viaduct on West Side of TWR and Merging Nearside Lane of TWR with KCR Upramp (Design Speed 70km/hr)
- Option 3: Widening Along Both Nearside and Offside Lanes of TWR (Design Speed 70km/hr)
- Option 3A: Widening Along Both Nearside and Offside Lanes of TWR and Merging Nearside Lane of TWR with KCR Upramp (Design Speed 70km/hr)

2.6.4 **Option 1**: Separate Viaduct on East Side of TWR (Design Speed 50km/hr)

This option introduces an additional southbound lane from KT I/C upramp which connects to the existing downslope segment of KCR upramp. Currently, KCR upramp has a single traffic lane and is dedicated to Route 3 traffic, connecting KT I/C upamp to KCR upramp lane will require allowing non-Route 3 traffic leaving KCR upramp lane. This is currently not allowed. This option is illustrated in **Figure 2.3**. Results from the traffic survey undertaken have indicated that the KCR upramp lane has v/c ratios of 0.26 and 0.27 for am peak and pm peak respectively. The basis of the design for this option is to utilize the remaining capacity available on the KCR upramp lane.

The space available at the gap between piers D8 and D9 of Tsing Kwai Highway (TK H/W) elevated road is a constraint to the width of KT I/C upramp structure. A viaduct structure with design speed of 50km/hr can readily meet the horizontal clearance requirement. The design speed of 50km/hr is in compliance with Transport Planning and Design Manual (TPDM) requirement for slip roads, however, the speed limit on KCR upramp will need to be reduced to 50km/hr (from the current 70km/hr) to match KT I/C upramp, up to the straight section of KCR upramp where it runs parallel to the three lanes of TWR. In addition, weaving movement (over approximately a 300m length) will have to be allowed to enable destination selection.

2.6.5 **Option 1A**: Separate Viaduct on East Side of TWR (Design Speed 70km/hr)

This option is similar to Option 1 except the design speed of 70km/hr is adopted and consequently a wider road width on the curved section of the viaduct is required to achieve the required sight distance. Widening of TWR on the west side is also required. This option is illustrated in **Figure 2.4**.

As compared with Option 1, a longer taper is required at the merge with KCR upramp, consequently only about 215m length (compared to 300m in Option 1) is available for weaving movement before the junction with Route 3 upramp.

2.6.6 **Option 2**: Separate Viaduct on West Side of TWR (Design Speed 50km/hr)

This option introduces an additional southbound lane on the west side of TWR and this lane is connected to the existing lane on the west side of KCR. This option is illustrated in **Figure 2.5**. Results from the traffic survey undertaken have indicated that the two segregated lanes on the west side of KCR have v/c ratio of 0.32 and 0.40 for am peak and pm peak respectively. The basis of design for this option is to utilize the remaining capacity currently available on the two segregated.

A separate viaduct structure with design speed of 50 km/hr on the west side of TWR is proposed. The space available at the gap between piers D6 and D7 of TK H/W elevated road is a constraint to the width of the viaduct structure. The design speed of 50km/hr for the additional lane meets TPDM slip road standard. This design speed will have to be maintained at 50km/hr up to the position where the lane merges with the adjacent lanes of KCR. A second structure (150 m in length) along the nearside lane of TWR near existing KT I/C upramp is required to achieve widening at the east side of TWR.

2.6.7 **Option 2A**: Separate Viaduct on West Side of TWR (Design Speed 70km/hr)

This is the preferred option for this Project. This option is similar to Option 2 except the design speed is 70km/hr and a wider road width is provided due to the need for longer sight distance. An additional southbound lane is introduced on TWR and this lane is carried through to KCR. The two segregated lanes on the west side of KCR are to be merged into one to enable this arrangement. This option is illustrated in **Figure 2.6**.

Similar to Option 2, a second structure (150 m in length) along the nearside lane of TWR near existing KT I/C upramp is required to achieve widening at the east side of TWR.

2.6.8 **Option 2B**: Separate Viaduct Option on West Side of TWR and Merging Nearside Lane of TWR with KCR Upramp (Design Speed 70km/hr)

The main difference of this option from Option 2A is that the segregated lanes on the west side of KCR will not be affected, and that the TWR nearside lane from KT I/C upramp is connected to the existing downslope segment of KCR upramp. This option is illustrated in **Figure 2.7**. The basis of design for this option is to utilize the remaining capacity available on the KT I/C upramp lane. Results from the traffic survey undertaken have indicated that the KCR upramp lane have v/c ratio of 0.26 and 0.27 for am peak and pm peak respectively.

Similar to Option 2, a second structure (approximately 150 m in length) along the nearside lane of TWR near existing KT I/C upramp is required to achieve widening at the east side of TWR.

2.6.9 **Option 3**: Widening along Both Nearside and Offside Lanes of TWR (Design Speed 70km/hr)

This option introduces an additional southbound lane on TWR and this lane is carried through to KCR. The two segregated lanes on the west side of KCR are to be merged into one so that one traffic lane is available for connection to the additional southbound lane on TWR. This option is illustrated in **Figure 2.8**. The basis of design for this option is to utilize the remaining capacity available on the two segregated lanes on KCR. Results from the traffic survey undertaken have indicated that the two segregated lanes on KCR have v/c ratio of 0.32 and 0.40 for am peak and pm peak respectively, i.e. there is spare capacity of over one traffic lane.

Widening structures are proposed along both edges of the existing TWR. Designed for design speed of 70km/hr, which matches current TWR, the widening structures meet the horizontal clearance requirement between piers D7 and D8 of TK H/W elevated road.

2.6.10 **Option 3A**: Widening along Both Nearside and Offside Lanes of TWR and Merging Nearside Lane of TWR with KCR Upramp (Design Speed 70km/hr)

The main difference of this option from Option 3 is that the segregated lanes on the west side of KCR will not be affected, and that the TWR nearside lane from KT I/C upramp is connected to the existing downslope segment of KCR upramp. This option is illustrated in **Figure 2.9**. The basis of design for this option is to utilize the remaining capacity available on the KCR upramp lane. Results from the traffic survey have indicated that the KCR upramp lane have v/c ratio of 0.26 and 0.27 for am peak and pm peak respectively.

Widening structures are proposed along both edges of the existing TWR. Designed for design speed of 70km/hr, which matches current TWR, the widening structures meet the horizontal clearance requirement between piers D7 and D8 of TK H/W elevated road.

2.7 Screening of the Options

2.7.1 Referring to the "*Report on the Development and Evaluation of Options*" report, three criteria have been conducted to screen out infeasible options:

- For option that introduces weaving, weaving analysis based on preliminary traffic forecast;
- Compliance with TPDM standards; and
- Feasibility assessment on the proposed bridge scheme.

2.7.2 Out of the seven options presented above, Options namely Option 1 and Option 1A were screened out due to non-compliance with the weaving requirements in that the number of lanes required could not be achieved along the weaving section between KCR upramp and KCR southbound. Another option namely Option 2B was eliminated under the screening assessment as well due to the insufficient deck depth of Bridge P available. This structural depth is constrained by the vertical profile of the road alignment and the minimum 5.1m headroom of KCR below.

2.8 Evaluation of Options

2.8.1 There are 13 viewpoints in evaluation of the remaining options:

Traffic & Other Operational Consideration

(I) Permanent Traffic Arrangement

The road improvement scheme is to provide an additional traffic lane for the southbound traffic between KT I/C upramp and KCR. The critical factors that would affect permanent traffic arrangement are:

(i) With the number of traffic lanes on KCR fixed, the reserve capacity of the existing lane will be critical to the performance of the improvement scheme.

(ii) Change to current traffic arrangement.

The factors taken into consideration in comparison of the options are described in the table below with the ranking determined accordingly:

Table 2-1 Consideration on Permanent Traffic Arrangement

Option	Factors	*Ranking
2	(i) This option requires the segregated lanes on KCR be merged prior to the introduction of the additional lane from the Project. From the conducted traffic survey, the respective v/c ratio for the two segregated lanes on KCR was 0.32 and 0.40 for the am and pm peak respectively. Capacity of more than one traffic lane is anticipated to be available. (ii) Merging the original two segregated lanes on KCR to one lane. Based on v/c ratio, impact to traffic should be minimal.	1
2A	(i) Identical to Option 2. (ii) Identical to Option 2.	1
3	(i) Identical to Option 2. (ii) Identical to Option 2.	1
3A	(i) This option converts the existing downslope segment of KCR Upramp lane as continuation of the additional lane and uses up its remaining capacity. From the conducted traffic survey, the respective v/c ratio was 0.26 and 0.27 for the am and pm peak respectively. Capacity of less than one traffic lane is therefore anticipated to be available. (ii) (a) A merge is introduced from the KCR upramp to TWR sacrificing the original priority of traffic destined for Route 3. (b) In this option, early lane selection for TWR traffic is required for traffic destined for Route 3.	2

* Ranking: 1 = most preferable & 2 = least preferable under this viewpoint

(II) Alignment Design Standard

According to TPDM, TWR and KCR are urban trunk roads which should have design speed of 80km/hr. Due to the site constraints, design speed is to match with the existing speed limit (70km/hr) on TWR and KCR. Comparisons among the options are therefore made to the corresponding alignment design standard and summarised in below table.

Table 2-2 Consideration on Alignment Design Standard

	Alignment Design Standard		Option 2	Option 2A	Option 3	Option 3A
(i)	Design Speed	70km/h for existing TWR/KCR	50 km/h	70 km/h	70 km/h	70 km/h
(ii)	Lane Width	3.65m (minimum)	4.0m	4.0m	4.0m	4.0m
(iii)	Horizontal Curve	TPDM Vol. 2 Cl. 3.3.3.1 175m(R3) Desirable – 70km/hr 88m (R1) Absolute – 70km/hr	219.6m> R3	219.5m> R3	168.5m> R1	175m=R3

	Alignment Design Standard		**Option 2**	**Option 2A**	**Option 3**	**Option 3A**
(iv)	Superelevation	TPDM Vol. 2 Cl. 3.3.3.3 7% for curve of radius < R4 10% for R3 radii or less	7%	10%	10%	10%
(v)	Sight Distance	TPDM Vol. 2 Cl. 3.3.5 120m Desirable 90m Absolute	50m	90m	90m	90m
(vi)	Vertical Gradient	TPDM Vol. 2 Cl. 3.3.6 4% Desirable 8% Absolute	10%	8%	6%	6%
(vii)	Vertical Curve (Crest) minimum K value	TPDM Vol. 2 Cl. 3.3.7 K=30 Desirable (70m/hr) K=17 Absolute (70m/hr)	K=6.5	K=17.0	Match existing TWR	Match existing TWR
(viii)	Vertical Curve (Sag) minimum K value	TPDM Vol. 2 Cl. 3.3.7 K=20 Desirable (70m/hr) K=20 Absolute (70m/hr)	K=13.0	K=20.0	Match existing TWR	Match existing TWR
(ix)	Merging Length	TPDM Vol. 2 Cl. 4.8.6.12 60m nose + 150m taper	{Not applicable}	{Not applicable}	{Not applicable}	60m nose + 150m taper
		***Ranking**	**3**	**1**	**2**	**1**

Note: Items complying with the design standard are underlined. * Ranking: 1 = most preferable & 3 = least preferable under this viewpoint.

(III) Traffic Impact at Construction Stage

In the construction stage, there would be impact, arising from both the construction activities as well as the additional construction traffic, to road traffic in the Project area. Detailed evaluation and assessment with recommendation on the appropriate temporary traffic management scheme or other mitigation measures would be included under the construction traffic impact assessment in the TIA Report. Comparison of different impacts arising from construction of major items of Works in the options have been conducted

Traffic through the existing road system in TWR should basically be maintained during the construction stage. Impacts to the following major roads in the Project area are considered in turn:

(i) Tsuen Wan Road

(ii) Kwai Chung Road

(iii) Kwai Chung Road Upramp

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly.

Table 2-3 Consideration on Traffic Impact at Construction Stage

Option	Factors	*Ranking
2	(i) Considerable impact to traffic on TWR is anticipated due to the very long stitched joint between Grid E1 & E6. Minor impact for the very localized stitched joint between Grid F1 & F3. (ii) There would be some impact during construction of the Grid F8 abutment. Considerable impact to traffic on KCR for realignment of this road. Some impact is anticipated for demolition of footbridge NF303 and for reconstruction. (iii) No impact.	1
2A	(i) Considerable impact to traffic on TWR is anticipated due to the very long stitched joint between Grid G1 & G6. Minor impact for the very localized stitched joint between Grid H1 & H3. (ii) There would be some impact during construction of Grid H7 foundation and Grid H8 abutment. Considerable impact to traffic on KCR for realignment of this road. Some impact is anticipated for demolition of footbridge NF303 and for its reconstruction. (iii) No impact.	2
3	(i) Considerable impact to traffic on TWR is anticipated due to the very long stitched joint between Grid J1 & J8. Considerable impact is also anticipated for the very long stitched joint between Grid K1 & K6. High impact during construction of NMM. (ii) There would be some impact during construction of Grid K5 foundation and Grid K6 abutment. Considerable impact to traffic on KCR for realignment of this road. Some impact is anticipated for demolition of footbridge NF303 and for its reconstruction. (iii) High impact during construction of NMM.	3
3A	(i) Considerable impact to traffic on TWR is anticipated due to the very long stitched joint between Grid L1 & L8. Considerable impact is also anticipated for the very long stitched joint between Grid M1 & M6. High impact during construction of NMM. (ii) There would be some impact during construction of Grid M5 foundation and Grid M6 abutment. Considerable impact to traffic on KCR for realignment of this road. Some impact is anticipated for demolition of footbridge NF303 and for its reconstruction. (iii) High impact during construction of NMM.	3

* Ranking: 1 = most preferable & 3 = least preferable under this viewpoint

(IV) Other Operational Consideration

Within the Project area, there is a bus stop originally located in front of a pedestrian subway (NS10A) which is now mainly serving the residents of Lai King Estate. It would be affected during construction and after the proposed flyover will be built. Requirement of relocation is the critical issue on operational consideration.

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly.

Table 2-4 Consideration on Other Operational Factors

Option	Factor (I)	*Ranking
2	Require relocation.	2
2A	Require relocation.	2
3	Require relocation.	2
3A	No relocation required.	1

* Ranking: 1 = most preferable & 2= least preferable under this viewpoint

Engineering Consideration

(V) Bridge Scheme

The comparison is concentrated on the design of the bridge schemes. The critical factors to be considered are:

(i) The design should minimize the impact on existing and, in particular, lowering the risk and uncertainties associated with any required strengthening of the structure.

(ii) The design should minimize the impact on Tsing Kwai Highway (TK H/W) elevated road and, in particular, lowering the risk and uncertainties associated with any required reconstruction of its bridge pier(s).

(iii) The design should maintain adequate horizontal and vertical clearance to existing structures.

The factors taken into consideration in comparison of the options are described in the following table with the ranking determined accordingly.

Table 2-5 Consideration on Bridge Scheme

Option	Factors	*Ranking
2	(i) Bridge E is stitch joined (whole length) to existing TWR flyover by the nearside lane. There could be need to strengthen existing TWR flyover. Bridge F is a separate bridge structure. A short stub end between Grid F1 & F2 is stitched to existing TWR flyover, but impact on it is very low. (ii) No reconstruction required on TK H/W piers. (iii) Bridge E: 5.11m vertical clearance to MTRC viaduct. Bridge F: 6.06m & 0.66m horizontal clearance to TK H/W pier D6 and D7 respectively. 6.60m vertical clearance to TK H/W viaduct.	1
2A	(i) Bridge G is stitch joined (whole length) to the existing upramp by the nearside lane. There could be need to strengthen the existing TWR flyover. Bridge H is a separate bridge structure. A short stub end between Grid H1 & H2 is stitched to the existing TWR flyover, but impact on it is very low. (ii) No reconstruction required on TK H/W piers. (iii) Bridge G: 5.11m vertical clearance to MTRC viaduct. Bridge H: 2.3m horizontal clearance to TK H/W pier D7. 7.18m vertical clearance to TK H/W viaduct.	2

Option	Factors	*Ranking
3	(i) Bridge J is stitch joined (whole length) to the existing TWR flyover by the nearside lane while Bridge K is stitch joined (whole length) to the existing TWR flyover by the offside lane. There could be a need to strengthen the existing TWR flyover. (ii) No reconstruction required on TK H/W piers. (iii) Bridge J: 5.11m vertical clearance to MTRC viaduct. Bridge K: 0.69m horizontal clearance to TK H/W pier D7. 7.53m vertical clearance to TK H/W viaduct.	3
3A	(i) Bridge L is stitch joined (whole length) to the existing TWR flyover by the nearside lane while Bridge M is stitch joined (whole length) to the existing TWR flyover by the offside lane. There could be a need to strengthen the existing TWR flyover. (ii) No reconstruction required on TK H/W piers. (iii) Bridge L: 5.11m vertical clearance to MTRC viaduct. Bridge M: 0.69m horizontal clearance to TK H/W pier D7. 7.53m vertical clearance to TK H/W viaduct.	3

* Ranking: 1 = most preferable & 3 = least preferable under this viewpoint

(VI) Noise Mitigation Measure (NMM)

The comparison is focused on the design of the noise mitigation measures. The critical factors to be considered are:

(i) The design should minimize the impact on existing TWR flyover and, in particular, avoid additional loading put on this structure which was completed under earlier design standards.

(ii) The design should minimize impact to traffic on adjacent roads and to other elements such as roadside slopes.

(iii) Construction complexity.

The factors taken into consideration in comparison of the options are described in the following table with the ranking determined accordingly:

Table 2-6 Consideration on Noise Mitigation Measure

Option	Factors	*Ranking
2	(i) The NMM extends beyond the new bridge onto the new abutment. There would be no impact on existing TWR flyover. (ii) The NMM can be constructed from the new bridge and from the new abutment. Minimal impact on adjacent roads and other elements. (iii) The NMM is spanning approximately 7m over the new lane. Construction complexity is low.	1
2A	(i) The NMM extends beyond the new bridge onto the new abutment. There would be no impact on the existing TWR flyover. (ii) The NMM can be constructed from the new bridge and from the new abutment. Minimal impact on adjacent roads and other elements.	2

Option	Factors	*Ranking
	(iii) Due to the wider bridge, the required span of the NMM is approximately 10m. The required extent is also longer than Option 1A.	
3	(i) The NMM over both the new lane and the existing lanes of TWR. Support from existing TWR flyover would be required. Strengthening of TWR flyover is very likely required. High impact on existing TWR flyover. (ii) Support (columns & foundations) would be required to be constructed on the roadside slopes in front of Fung King House. Also, construction over existing roads will be required. Disturbance to existing traffic is unavoidable. High impact is anticipated on adjacent roads and other elements. (iii) The NMM is spanning over 5 lanes requiring a span of over 20m. Construction complexity is much higher than other options.	3
3A	(i) The NMM over both the new lane and the existing lanes of TWR. Support from existing TWR flyover would be required. Strengthening of TWR flyover is very likely required. High impact on existing TWR flyover. (ii) Support (columns & foundations) would be required to be constructed on the roadside slopes in front of Fung King House. Also, construction over existing roads will be required. Disturbance to existing traffic is unavoidable. High impact is anticipated on adjacent roads and other elements. (iii) The NMM is spanning over 5 lanes requiring a span of over 20m. Construction complexity is much higher than other options.	3

* Ranking: 1 = most preferable & 3 = least preferable under this viewpoint

(VII) Utilities and Drainage Impact

In construction stage especially foundation construction, there would be impact to the utilities in the Project area. Permanent diversion and local realignment of the existing utilities would be required. The existing utilities potentially to be affected include drainage and sewage system, electrical power supplies, watermains, lighting systems and telecom utilities. For other underground obstructions such as the box culvert and the foundation of existing bridges, no significant difference is anticipated among the options. Comparisons among the options are made based on the major impacts identified in the UIA Report under this Project as below:

(i) There are high voltage power cables i.e. 132kV laid under the footprint of the proposed alignment options and would be affected during foundation construction.

(ii) Piers and foundation will be located within the drainage reserve which requires seeking agreement from DSD.

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly:

Table 2-7 Consideration on Bridge Scheme

Option	Factor	*Ranking
2	(i) 132kV cable near Grids E1 to E5, F3 piers & F8 abutment (6 piers + abutment wall) (ii) 2 piers (Grid E4-E5) located within drainage reserve. Impact is considered as minor.	1
2A	(i) 132kV cable near Grids G1 – G5, H3 piers & H8 abutment (6 piers + abutment wall) (ii) 2 piers (Grid G4-G5) located within drainage reserve. Impact is considered as minor.	1
3	(i) 132kV cable near Grids J1 – J5, J7, K1, K2 piers & K6 abutment (8 piers + abutment) (ii) 2 piers (Grid J4-J5) located within drainage reserve. Impact is considered as minor.	2
3A	(i) 132kV cable near Grids L1 – L5, L7, M1, M2 piers & M6 abutment (8 piers + abutment) (ii) 2 piers (Grid L4-L5) located within drainage reserve. Impact is considered as minor.	2

* Ranking: 1 = most preferable & 2 = least preferable under this viewpoint

(VIII) Impact on Other Elements

The existing footbridge NF303 currently serves as a main access for pedestrians crossing KCR. Under some of the road improvement options, this footbridge NF303 would be modified or reconstructed. Moreover, there is a pedestrian subway (NS10A), providing access under KCR to Lai King Estate. The subway would be required to be extended to cater for widening the KCR downramp.

The ranking factors to be considered on other main elements affected by the Project would be as shown below:

(i) Footbridge NF303: For comparison purpose, the surface area of proposed reconstructed footbridge [Afootbridge] was estimated for each option.

(ii) Subway NS10A: For comparison purpose, the surface area of proposed extension to subway [Asubway] was estimated for each option.

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly:

Table 2-8 Consideration on Other Elements

Option	Factor (i) [Afootbridge]	Factor (ii) [Asubway]	*Ranking
2	440 sq m	Nil	1
2A	440 sq m	Nil	1
3	440 sq m	15 sq m	3
3A	440 sq m	9 sq m	2

* Ranking: 1 = most preferable & 3 = least preferable under this viewpoint

Other Considerations

(IX) Land Requirements

Based on the latest land status plan, all proposed works in the seven options are either within Government land lots or public roads. The major lands to be affected in the Project area and its status are listed as follows:

(i) The amount of land (otherwise available for other use) sterilized by works under this Project. For comparison purpose, the area within land lots [Alot] was estimated for each option.

- Lot No. STT3706K&T STT: Short term tenancy for car parking use
- Lot No. GLA-TKT 1726 TGLA: Temporary Government land allocation to Public Works Laboratory until 23 June 2016

(ii) The impact on the existing feature, i.e. Public Works Laboratory within Lot No. GLA-TKT 1726 TGLA (in terms of the two buildings' footprint) in the construction stage of the Project.

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly:

Table 2-9 Consideration on Land Requirement

Option	Factor (i)[Alot]	Factor (ii)	*Ranking
2	1810 sq m (535 sq m of Lot No. STT3706K&T STT and 1275 sq m of Lot No. GLA-TKT 1726 TGLA)	Affected	3
2A	1810 sq m (535 sq m of Lot No. STT3706K&T STT and 1275 sq m of Lot No. GLA-TKT 1726 TGLA)	Affected	3
3	1715 sq m (615 sq m of Lot No. STT3706K&T STT and 1100 sq m of Lot No. GLA-TKT 1726 TGLA)	Affected	2
3A	1707 sq m (612 sq m of Lot No. STT3706K&T STT and 1095 sq m of Lot No. GLA-TKT 1726 TGLA)	Affected	1

* Ranking: 1 = most preferable & 3 = least preferable under this viewpoint

(X) Environmental Impacts

In evaluating the recommended road improvement option, the comparison of major environmental impacts (noise and air quality) generated from the road against all options is mainly focused. The anticipated differences among the options are listed as factor for comparison:

(i) Noise Impact

Noise impacts during construction and operation phases are taken into consideration.

(a) Construction phase – the necessity of lengthy night time construction, the distance from works area boundary to NSRs, and site area

(b) Operation phase – the noise level from the roads to NSRs. Assumption of providing noise enclosure in all options is made for comparison.

(ii) Air Quality Impact

The different physical alignments would impose different separation distance among sources and receivers and hence lead to variation on pollutant dispersion. Therefore, comparison of air quality impact during construction and operation phases is to be made through the consideration of separation distance.

(a) Construction phase – potential dust impacts generated from different options are generally similar. No significant difference is anticipated.

(b) Operation phase – separate distance

(iii) Landscape and Visual Impacts

In view of the similar nature of works and work areas between different options, no significant difference is anticipated in comparison.

The factors taken into consideration in comparison of the options are described in the below tables with the ranking determined accordingly.

Table 2-10a Consideration on Environmental Impacts

Option	Factor (i) – Noise Impact	Factor (ii) – Air Quality Impact
2	(a) Works area boundary is around 30m from the closest NSR	(a) Air quality impact to be mitigated on site
	(b) Noise from the proposed flyover is mitigated.	(a) Around 30m separation distances from additional traffic lane to Fung King House and around 60m to Lai King Catholic Secondary School.
2A	(a) Works area boundary is around 30m from the closest NSR. Works area is larger than Option 2.	(a) Air quality impact to be mitigated on site
	(b) Noise from the proposed flyover is mitigated.	(a) Around 30m separation distances from additional traffic lane to Fung King House and around 60m to Lai King Catholic Secondary School.
3	(a) Partial noise enclosure construction anticipated over existing roads. Considerable amount of night time construction works anticipated and in close proximity to Fung king House. Significant construction noise impact is anticipated.	(a) Air quality impact to be mitigated on site
	(b) Noise from the proposed flyover and section of KCR is mitigated.	(a) Shortest separation distance among all options.

Option	Factor (i) – Noise Impact	Factor (ii) – Air Quality Impact
3A	(a) Partial noise enclosure construction anticipated over existing roads. Considerable amount of night time construction works anticipated and in close proximity to Fung king House. Significant construction noise impact is anticipated.	(a) Air quality impact to be mitigated on site
	(b) Noise from the proposed flyover and section of KCR is mitigated.	(a) Shortest separation distance among all options.

Table 2-10b Rankings of Factors of Environmental Impacts

Option	*Sub-ranking of Factor (i)(a)	*Sub-ranking of Factor (i)(b)	**Sub-ranking of Factor (ii)(a)	*Sub-ranking of Factor (ii)(b)	**Sub-ranking of Factor (iii)	*Overall Ranking
2	1	2	-	1	-	**1**
2A	2	2	-	1	-	**2**
3	3	1	-	2	-	**3**
3A	3	1	-	2	-	**3**

* Ranking: 1 = most desirable and 3 = least desirable
** No significant difference

(XI) Capital and Recurrent Cost

The annual recurrent expenditure arising from the proposed structures is taken into account in evaluation of options. The proposed items induced the most capital and recurrent costs are mainly the highway structures, which are:

(i) The extent of the bridge works. For comparison purpose, the surface area of bridge deck [Adeck] was estimated for each option.

(ii) The extent of the noise mitigation measures. For comparison purpose, the surface area of noise mitigation measures [Anmm] was estimated for each option.

(iii) The extent of other major items of works. With the proposed options, the major items of works include:

- Footbridge NF303. For comparison purpose, the surface area of proposed reconstructed footbridge [Afootbridge] was estimated for each option.
- Subway NS10A. For comparison purpose, the surface area of proposed extension to subway [Asubway] was estimated for each option.

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly:

Table 2-11 Consideration on Capital and Recurrent Cost

Option	Factor (i) [Adeck]	Factor (ii) [Anmm]	Factor (iii)	*Ranking
2	2630 sq m	3455 sq m	(a) Afootbridge = 440 sq m (b) Asubway = Nil	1
2A	3919 sq m	5402 sq m	(a) Afootbridge = 440 sq m (b) Asubway = Nil	2

Option	Factor (i) [Adeck]	Factor (ii) [Anmm]	Factor (iii)	*Ranking
3	2340 sq m	8615 sq m	(a) Afootbridge = 440 sq m (b) Asubway = 15 sq m	4
3A	2066 sq m	7940 sq m	(a) Afootbridge = 440 sq m (b) Asubway = 9 sq m	3

* Ranking: 1 = most preferable & 4 = least preferable under this viewpoint

(XII) Maintenance Consideration

Maintenance is one of the considerations of evaluation and assessment on an alignment scheme. It can be evaluated by analyzing the maintainability of the proposed items (serviceability and reparability), future maintenance cost and time. The comparison is focused on the maintenance consideration of special features of the bridges which controls the maintenance cost and require particular inspections, and the provision of clearance for maintenance (i.e. min. 2m between existing and proposed structures).

(i) Stitched joint requires special attention on maintenance. For comparison purpose, the length of stitched joint [Lstitch] was estimated for each option.

(ii) Provision of min. clearance between existing and proposed structures.

The factors taken into consideration in comparison of the options are described in the table below with the ranking determined accordingly:

Table 2-12 Consideration on Maintenance Consideration

Option	Factor (i)[Lstitch]	Factor (ii)	*Ranking
2	190 m	>2 m	1
2A	190 m	>2 m	1
3	500 m	<2 m	3
3A	486 m	<2 m	2

* Ranking: 1 = most preferable & 2 = least preferable under this viewpoint

(XIII) Time for Completion

The estimation of the construction time depends on many factors such as the nature of proposed structures, construction methods, site constraints, etc. For evaluation and assessment of the optimal scheme, the following critical factors are considered. Other constructions such as the utility diversion, re-provision of footbridge and extension of subway will likely be carried out in parallel with the major works. Hence, the influence to the construction programme is considered as minor.

(i) The extent of the bridge works. For comparison purpose, the surface area of bridge deck [Adeck] was estimated for each option.

(ii) The extent of the noise mitigation measures. For comparison purpose, the surface area of noise mitigation measures [Anmm] was estimated for each option.

(iii) The complexity of the construction. With the proposed options, construction will be more complex for option(s) involving:

- Reconstruction of TK H/W pier(s). For comparison purpose, the number of pier to be reconstructed was counted.

- Bridge deck(s) that requires stitch-jointing to existing upramp. For comparison purpose, the length of stitch joint [Lstitch] was estimated.
- Construction of noise mitigation measures adjacent to / over operational roadways. For noise mitigation measures to be installed on newly proposed bridge(s), the complexity of construction is considered to be lower.

The factors taken into consideration in comparison of the options are described in the below table with the ranking determined accordingly:

Table 2-13 Consideration on Time for Completion

Option	Factor (i) [Adeck]	Factor (ii) [Anmm]	Factor (iii)	*Ranking
2	2630 sq m	3455 sq m	(a) Nil (b) 190m (c) Some length beyond Gird F8	1
2A	3919 sq m	5402 sq m	(a) Nil (b) 190m (c) Considerable length beyond Gird H8	2
3	2340 sq m	8615 sq m	(a) Nil (b) 500m (c) Very long length between J1 & K4	4
3A	2066 sq m	7940 sq m	(a) Nil (b) 486m (c) Very long length between L1 & M4	3

* Ranking: 1 = most preferable & 4 = least preferable under this viewpoint

Overall Ranking & Recommendation

2.8.2 For each of the viewpoints, the major factors that affect ranking of the road improvement options have been identified, compared and documented in the "*Report on the Development and Evaluation of Options*" report. These viewpoints have been selected to give an overall consideration on the options.

2.8.3 Some viewpoints, such as "Traffic & Other Operational Consideration", would be of higher importance than others. The traffic factors are considered as the core of this Project as to improve the existing road section to cope with the future traffic growth. The existing site constraints and strengthening of the structures also critically govern the feasibility of alignment options. Therefore "Engineering Consideration" is considered as secondary and followed by other considerations. (i.e. weighting order for the viewpoints: **Traffic & Other Operational Consideration > Engineering Consideration > Other Considerations**).

2.8.4 Base weighting for the viewpoints are described below:

- **Traffic & Other Operational Consideration** – Both the "Permanent Traffic Arrangement" and the "Alignment Design Standard" factors critically affect the final performance of the improvement. The "Traffic Impact at Construction Stage" is important in that the already congested TWR should not be critically affected during construction. To summarize, this viewpoint is the determining factor and is therefore assigned a more than pass mark percentage of 55%.

- **Engineering Consideration** – This viewpoint compares the pros and cons on the engineering scheme of the road improvement options and is assigned a percentage of 25%.

- **Other Consideration** – The factors under this viewpoint generally compare the road improvement options in a boarder sense. This viewpoint is assigned a percentage of 20%.

2.8.5 Based on the above weighting (55%:25%:20%), sub-weighting for the factors under each viewpoint are determined. The overall marking and overall ranking are illustrated below:

Table 2-14 Overall Marking and Overall Ranking for Identified Options

Viewpoints	Weighting					Options						
	Base	Sensitivity Tests				1	1A	2	2A	2B	3	3A
		A	B	C	D*							
Traffic & Other Operational Consideration	**55%**	**50%**	**60%**	**50%**	**50%**	Failed screening-weaving analysis	Failed screening-weaving analysis			Failed screening-road vert. clearance check		
i. Permanent Traffic Arrangement	20%	20%	20%	20%	20%			1	1		1	2
ii. Alignment Design Standard	25%	20%	30%	20%	20%			3	1		2	1
iii. Traffic Impact at Construction Stage	5%	5%	8%	5%	5%			1	2		3	3
iv. Other Operational Consideration	5%	5%	2%	5%	5%			2	2		2	1
Engineering Consideration	**25%**	**30%**	**20%**	**27%**	**25%**							
v. Bridge Scheme	8%	10%	7%	9%	8%			1	2		3	3
vi. Noise Mitigation Measure	8%	10%	7%	9%	8%			1	2		3	3
vii. Utilities and Drainage Impact	5%	5%	3%	5%	5%			1	1		2	2
viii. Impact on Other Elements	4%	5%	3%	4%	4%			1	1		3	2
Other Considerations	**20%**	**20%**	**20%**	**23%**	**25%**							
ix. Land Requirements	3%	4%	4%	3%	3%			3	3		2	1
x. Environmental Impacts	5%	4%	4%	8%	10%			1	2		3	3
xi. Capital and Recurrent Cost	5%	4%	4%	5%	5%			1	2		4	3
xii. Maintenance Consideration	5%	4%	4%	5%	5%			1	1		3	2
xiii. Time for Completion	2%	4%	4%	2%	2%			1	2		4	3
Overall Mark - <u>Base Weighting</u>:								**1.61**	**1.44**		**2.29**	**2.00**
Overall Mark – Sensitivity Test A:								1.53	1.50		2.34	2.08
Overall Mark – Sensitivity Test B:								1.70	1.44		2.29	1.98
Overall Mark – Sensitivity Test C:								1.51	1.49		2.34	2.10
Overall Mark – Sensitivity Test D:								1.51	1.49		2.34	2.10
Overall Ranking :								**2**	**1**		**4**	**3**

Remarks: Low score & rank 1= most preferable;
High score & rank 4= least preferable
* Hypothetic sensitivity test for Environmental Impacts

2.8.6 **Option 2A** is ranked as the most preferable road alignment option in accordance with the selected base weighting. Furthermore, Sensitivity Tests A to D with different weightings are conducted and shown in **Table 2-14** above. Sensitivity Test D is a hypothetic testing with a relatively higher percentage to "Environmental Impacts". It is found that the overall ranking among the options remains the same order.

2.8.7 Given that the sub-ranking of Environmental Impacts in Option 2 is more preferable than the recommended Option 2A, the two options are actually quite similar. The main differences are the design speed and the width of the bridge. Option 2A introduces a larger structure footprint at construction phase. Nonetheless during operation phase, it may have better air quality under a higher vehicle speed scenario.

Conclusion

2.8.8 The alternative road improvement options are described under Section 2.6 of this Report. Based on weaving analysis from traffic impact assessment, Options 1 and 1A were considered infeasible and were not taken into consideration in the ranking. Option 2B was also not further considered due to infeasibility on the bridge scheme. Viewpoints have been set out in Section 2.8.1 above and the major factors that affect ranking of the road improvement options have been identified and compared. With weighting for each viewpoint established in **Table 2-14** above, the recommended option is Option 2A - Separate Viaduct Option on West Side of TWR (Design Speed 70km/hr).

2.8.9 Option 2A is considered the best road improvement option based on the fact that this scheme will yield the best traffic performance upon its implementation. The additional lane in this scheme is to occupy one of the segregated lanes of KCR. From results of traffic survey, there is over one full lane of capacity to receive this additional lane. With respect to the compliance on alignment design standard, this Option 2A is in compliance on all aspects. The required construction, such as the bridges and the noise mitigation measures, is less extensive than that required under Option 3 and 3A but is only marginally more extensive than Option 2. Bridge G is required to be stitch-jointed to existing TWR flyover. To minimize differential movement, the bearing types and their positioning are proposed to be in line with the existing structure. Subsequent liaison and agreement with the authorities are to be made.

2.9 Construction Method and Engineering Requirements

2.9.1 This section introduces the key aspects of the works and the planning of the construction.

2.9.2 The construction of the recommended alignment Option 2A under this Project mainly involves a separate flyover structure connecting KT I/C upramp to KCR, widening of TWR, installation of noise barriers on the aforementioned proposed structures, demolition and reprovision of existing footbridge NF303, demolition of existing Public Works Regional Laboratory (subject to the termination of the allocation), relocation of the bus stop outside subway NS10A and associated works such as utility diversion, street lighting and landscaping works.

Flyover from KT I/C Upramp to KCR

2.9.3 The proposed link connecting TWR and KCR is a flyover in the form of a single cell prestressed concrete box girder. It consists of seven spans (maximum span of 54m) supported by piers and end abutments. The flyover is expected to be constructed by cast in-situ method.

2.9.4 The proposed flyover will be stitched to the TWR flyover deck to avoid forming a

longitudinal joint between the existing structure and the flyover. The monolithic stitched joint will be constructed at the latest stage after completion of the superstructure of the proposed flyover to link the two structures together.

2.9.5 Before the viaduct construction can commence, utility diversions will be required at pier and abutment locations.

2.9.6 The proposed flyover spans over KCR and Container Port Road South and goes under TK H/W. Sufficient horizontal clearance of minimum 2m will be maintained between the proposed flyover and the existing piers.

2.9.7 The piers are made of reinforced concrete supported on piled foundations. Piling construction will be either bored piles or pre-bored H-piles.

Widening of TWR at the Existing Upramp

2.9.8 A short section of Kowloon-bound TWR near existing KT I/C upramp will be widened. It is proposed to construct a new deck adjacent and parallel to the existing TWR bridge deck. The gap between the new and existing decks will be closed by a cast in-situ concrete stitch. To minimize the detrimental effect from the traffic vibration on the strength development and the structural integrity of the concrete stitch, concreting of the stitch will be carried out at night and one traffic lane of TWR will be temporarily closed. The structural articulation of the new deck will be compatible with the existing deck.

2.9.9 The new deck will be supported on reinforced concrete piers and portal frames spanning across the drainage reverse zone underneath. Public Works Regional Laboratory (Tsuen Wan) is in the vicinity of the proposed bridge work. Having considered works area for construction of the proposed bridge work and direct impacts to the laboratory buildings, temporary occupation of the laboratory area is required during the construction. The allocation of the land will be terminated before the commencement of the construction of this Project. The area will be reinstated by the allocatee (i.e. CGE/Standards & Testing, CEDD) to Lands Department according to the engineering condition.

Demolition and Reprovision of Existing Footbridge NF303

2.9.10 As the existing footbridge NF303 is in conflict with the proposed flyover, relocation of the footbridge is necessary. The new footbridge will be constructed to maintain the pedestrian access across KCR prior to demolition of the existing footbridge. The structural form of the new footbridge will be similar to the existing, i.e. warren truss steel bridge girder. Lifts will be provided in compliance with the guideline of barrier free access.

2.9.11 Foundation work will commence first. The abutments, piers and table tops construction will follow. The truss steel bridge girder is expected to be fabricated off site. The activity of lifting the bridge girders by the mobile crane will be carried out at night in accordance with the TTA scheme. The temporary closure of the KCR is expected. Construction of the footbridge's furniture, lift tower and staircases will follow.

2.9.12 Once the new footbridge is completed and opened to public, the demolition of the existing footbridge will commence. All non-structural elements such as roof panels and handrails will be firstly removed. The steel truss will be removed at night with temporary road closure. To dismantle the remaining structures including table tops, piers, staircases and abutments, metal scaffolding platform and protective enclosure will be erected.

Construction of Noise Barriers

2.9.13 The noise barriers (a combination of 5.5m high vertical, 5.5m high with 2.5m cantilevered barrier at 45 degree and 5.5m high with 3.5m cantilevered barrier at 45 degree types) are to be provided on the proposed flyover.

2.10 Works Programme

2.10.1 Construction of the Project should be commenced tentatively in 2018 and complete in 2021. The tentative construction programme of the Project is shown on **Appendix 2.1**.

2.11 Concurrent Project

2.11.1 There are six concurrent projects in the vicinity of the Project's works area, as summarized in **Table 2-15**.

Table 2-15 Major Concurrent Projects

Project	Planned Construction Period
Tsuen Wan Bypass, Widening of Tsuen Wan Road between Tsuen Tsing Interchange and Kwai Tsing Interchange, and associated Junction Improvement Works: and Retrofitting of Noise Barriers on Tsuen Wan Road	The implementation of Tsuen Wan Bypass is uncertain at this stage.
Widening of Yeung Uk Road between Tai Ho Road and Ma Tau Pa Road, Tsuen Wan	No physical interface
Replacement and Rehabilitation of Water Mains Stage 4, Mains in New Territories	The works are within the site boundary but the construction is Feb 2012-Nov 2015 which is before our tentative construction programme.
Extension of Footbridge Network in Tsuen Wan	No physical interface
Cycle Track between Tsuen Wan and Tuen Mun	No physical interface
Reconstruction and Improvement of Tuen Mun Road	No physical interface
Planned Landslip Prevention and mitigation works for a man-made slop (feature no. 11NW-A/C516) located at Lai King Hill Road near Ha Kwai Chung Polyclinic	Works will be carried out within the period from January 2013 to December 2014 that before our tentative construction programme.

2.11.2 At this stage, consideration of concurrent projects for cumulative environmental will only takes into account those with available implementation programmes. Cumulative impacts from the concurrent projects, if any, have been assessed in the individual sections of this EIA study.

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3. AIR QUALITY IMPACT

3.1 Introduction

3.1.1 This section identifies potential air quality impacts that may arise from the construction and operation of the Project. Fugitive dust impact during the construction phase and the potential air quality impact arising from the operation phase of the Project have been assessed. Where necessary, appropriate mitigation measures will be recommended to reduce the impacts contributed by the Project to the identified Air Sensitive Receivers (ASRs) so as to satisfy the corresponding environmental legislations and guidelines.

3.2 Environmental Legislation, Standards and Criteria

3.2.1 The relevant criteria and standards as specified in the following legislation and guidelines shall be followed in evaluating the air quality impact assessment in this study:

- Environmental Impact Assessment Ordinance (EIAO) (Cap.499.S16), EIAO-TM, Annexes 4 and 12;
- Air Pollution Control Ordinance (APCO) (Cap. 311);
- Air Pollution Control (Construction Dust) Regulation;
- Requirement set out under Clause 3.4.4 of the EIA Study Brief (No. ESB-242/2012).

Air Quality Objectives & EIAO-TM

3.2.2 The Air Pollution Control Ordinance (APCO) (Cap 311) provides a regulatory framework for controlling air pollutants from a variety of stationary and mobile sources and it encompasses an Air Quality Objectives (AQOs), effective in 2014.

3.2.3 The AQOs stipulate the concentrations for a range of pollutants, namely sulphur dioxide (SO_2), respirable suspended particulates (RSP), fine suspended particulates (FSP), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO) and lead (Pb). The AQOs are summarised in **Table 3-1**.

Table 3-1 Hong Kong Air Quality Objectives

Pollutant	Concentration Limit (µg/m^3) Averaging Time[(i)(v)]				
	10-min	1 Hour	8 Hours	24 Hours	1 Year [(iv)]
Sulphur Dioxide	500 (3)	-	-	125 (3)	-
Respirable Suspended Particulates [(ii)]	-	-	-	100 (9)	50
Fine Suspended Particulates [(iii)]	-	-	-	75 (9)	35
Nitrogen Dioxide	-	200 (18)	-	-	40
Ozone	-	-	160 (9)	-	
Carbon Monoxide	-	30,000	10,000	-	
Lead	-	-	-	-	0.5

Notes: (i) All measurements of the concentration of gaseous air pollutants, i.e., sulphur dioxide, nitrogen dioxide, ozone and carbon monoxide, are to be adjusted to a reference temperature of 293 Degrees Kelvin and a reference pressure of 101.325 kilopascal.

(ii) Respirable suspended particulates mean suspended particles in air with a nominal aerodynamic diameter of 10 µm or less.

(iii) Fine suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 2.5 µm or less.

(iv) Arithmetic means.

(v) The numbers in brackets ( ) refer to number of exceedances allowed per year.

3.2.4 The Annex 4 of EIAO-TM stipulates that hourly Total Suspended Particulate (TSP) level should not exceed 500µg/m^3 measured at 298K and 101.325kPa (one atmosphere) for the

construction dust impact assessment. 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 the Air Pollution Control (Construction Dust) Regulation.

3.2.5 Guidelines for conducting air quality assessment are stipulated in Annex 12 of EIAO-TM, including the determination of ASRs, the assessment methodology, baseline study and impact prediction and assessment.

Air Pollution Control (Construction Dust) Regulation

3.2.6 Under the Air Pollution Control (Construction Dust) Regulation, the contractors should inform Environmental Protection Department (EPD) for any notifiable and regulatory works. Notifiable works are site formation, reclamation, demolition, foundation works and superstructure construction for buildings and road construction. Regulatory works are building renovation, road opening and resurfacing, slope stabilisation, and other activities including stockpiling, dusty materials handling, excavation, concrete works, etc. As both notifiable works and regulatory works are included in this Project, contractors and site agents should inform the EPD for carrying out construction works and should adopt dust control measures to reduce dust emissions to the acceptable level.

3.3 Existing Environmental Context

3.3.1 The Project is located in the existing urban area of Kwai Chung. The land uses within the study area consists predominately of urban residential, institutional, industrial and commercial areas according to Kwai Chung Outline Zoning Plan (OZP) No. S/KC/28. Residential areas with a number of public housing estates, private premises and schools at Lai King Hill are mainly located to the east of the proposed flyover, while major industrial areas are located to the northwest of the Project.

3.3.2 In close vicinity to the west of the proposed flyover is Kwai Chung Container Terminal (KCCT), which consists of nine container terminals with 24 berths. The container terminals occupy 279 hectares of coastal areas along Rambler Channel and on Stonecutters Island, as well as 7,694 meters of deep water frontage. Total handling capacity of the container terminals is about 20 million TEUs[1] per year. It is the main port facility in Hong Kong and is the third busiest container port in the world. It has been anticipated that emission associated with the marine vessels and the operation of KCCT is one of the major sources of air pollution in the existing Kwai Tsing District. Given the arrival number of marine vessels reaching KCCT would keep growing in the coming years, air pollution due to marine vessels and KCCT would still be dominant.

3.3.3 Apart from the emissions from the marine vessels and KCCT, vehicular emissions from open road section of the Project and nearby heavily trafficked road network (e.g. Tsuen Wan Road, Kwai Chung Road, Tsing Kwai Highway and Kwai Tsing Road) as well as industrial emissions at the northern west to the Project would also contribute to air pollution issue within the study area. Details of air pollution emission sources identified within the 500 metres study area in this Project are discussed in **Section 3.6**.

3.3.4 The new flyover is proposed to be constructed in order to resolve the forecasted traffic congestion on the south bound carriageway of Tsuen Wan Road (TWR) between Kwai Tsing Interchange (KT I/C) and Kwai Chung Road (KCR) during peak hours in the future. Due to the implementation of this Project, more free traffic flow and improvement in the overall vehicular emission from those road sections are anticipated.

3.4 Existing Background Air Quality Review

3.4.1 The nearest EPD Air Quality Monitoring Station to the study area is Kwai Chung Air Quality Monitoring Station (KCAQMS). The background air quality levels applicable to this Project could make reference to the latest 5-year data (2009 to 2013) recorded at KCAQMS, as summarised in **Table 3-2**.

Table 3-2 5-year Background Air Quality Data from Kwai Chung Air Quality Monitoring Station

Pollutant	Year	Maximum Concentration (μg/m^3) Averaging Time			
		1-Hour	24-Hour	8-Hour	Annual
NO_2	2009	260 [40]	200.3	N/A	64.4
	2010	280 [34]	159.1	N/A	64.9
	2011	290 [28]	164.7	N/A	66.9
	2012	292 [32]	147	N/A	63.8
	2013	306 [42]	161	N/A	68.9
	5-year mean	**285.6**	166.4	N/A	**65.8**
	AQOs	200 (18)	N/A	N/A	40
RSP	2009	210	180.4 [6]	N/A	46.6
	2010	628[(6)]	505.2 [7][(6)]	N/A	45
	2011	204	119.8 [9]	N/A	48.3
	2012	179	145.3 [4]	N/A	42.1
	2013	231	150.6 [20]	N/A	46.3
	5-year mean	290.4	**220.3**	N/A	45.7
	AQOs	N/A	100 (9)	N/A	50
FSP [(3)]	2009	- [(2)]	- [(2)]	N/A	- [(2)]
	2010	- [(2)]	- [(2)]	N/A	- [(2)]
	2011	164	98.6 [12]	N/A	35.5
	2012	143	82.7 [4]	N/A	29.2
	2013	197	126.6 [24]	N/A	32.2
	3-year mean [(3)]	168	**102.6**	N/A	32.3
	AQOs	N/A	75 (9)	N/A	35
SO_2	2009	269	112.3 [0]	N/A	21.4
	2010	211	94.2 [0]	N/A	21.4
	2011	228	85 [0]	N/A	21.1
	2012	232	88.3 [0]	N/A	16.5
	2013	254	104.6 [0]	N/A	20.2
	5-year mean	238.8	96.9	N/A	20.1
	AQOs	N/A	125 (3)	N/A	N/A
O_3	2009	N/A	N/A	146.6	32.6
	2010	N/A	N/A	166.0	28.4
	2011	N/A	N/A	135.8	28.3
	2012	N/A	N/A	174.6	30.3
	2013	N/A	N/A	140.6	30.0
	5-year mean	N/A	N/A	152.7	29.9
	AQOs	N/A	N/A	160	N/A
TSP	2009	N/A	144	N/A	70
	2010	N/A	234	N/A	71
	2011	N/A	149	N/A	71
	2012	N/A	166	N/A	66
	2013	N/A	168	N/A	66
	5-year mean	N/A	172.2	N/A	68.8
	Annex 4 of EIAO-TM	500	N/A	N/A	N/A

Notes:
(1) Values bolded and underlined had exceeded the prevailing AQOs value.

[1] TEU is Twenty-foot Equivalent Unit, which is an inexact unit of cargo capacity

(2) "-" indicated no data is available for the corresponding periods.
(3) No data of FSP were available from 2009 to 2010 at Kwai Chung EPD Air Quality Monitoring Station, 3 year average from 2011 to 2013 are adopted.
(4) Number in ( ) indicate the number of exceedance allowed to comply with the AQOs.
(5) Number in [ ] indicate the number of exceedance recorded.
(6) The maximum 1-hour and 24-hour average RSP concentrations recorded in Year 2010 was due to a dust storm originated from Northern China.

3.4.2 The table above indicates that the maximum daily SO_2, annual and the maximum 8-hour O_3, annual RSP and annual FSP recorded at KCAQMS are well within the AQOs in the past five years. However, maximum hourly NO_2, annual NO_2, daily maximum RSP and daily FSP exceed the AQOs from year 2009 to 2013.

3.4.3 Concentrations of the maximum hourly NO_2 for the past 5 years ranged from 260μg/m^3 to 306μg/m^3 with exceedance frequency of AQOs by at least 28 times, which is far more than the allowance stipulated in the AQOs of less than 18 times per year. For annual NO_2, an average value of 65.8μg/m^3 is calculated over the past 5 years. This value is much higher than the AQO of 40μg/m^3.

3.4.4 Exceedances of AQOs could be found also in both the maximum daily RSP and FSP from 2009 to 2013. The record of FSP at Kwai Chung monitoring station was not available until 2011. The maximum daily FSP has an average value of 102.6μg/m^3 ranging from 82.7μg/m^3 to 126.6μg/m^3 all of which were above the AQO of 75μg/m^3. The number of exceedance in 2011 and 2013 is beyond the limit of 9 times under the AQO.

3.4.5 The data recorded at KCAQMS indicated that before the commencement of the proposed project, maximum hourly and annual average NO_2, maximum daily average RSP and FSP have already exceeded the AQOs as prevailing air quality conditions.

3.5 Construction Phase Assessment

3.5.1 This section presents the assessment of potential air quality impacts associated with the construction phase of the Project. The assessment has been conducted in accordance with the requirements given in Clause 3.4.4 and Section 3 of Appendix B of the EIA Study Brief (No. ESB-242/2012).

3.5.2 According to the Clause 3.4.4 of the EIA Study Brief, a quantitative assessment is required only if the project will give rise to significant construction dust impacts at the ASRs likely to exceed the recommended limits in the TM, despite the incorporation of the dust control measures proposed. In this project, based on the assessment of the construction phase air quality impact and the recommendation of construction phase mitigation measures in the following sections, it is expected that no significant construction dust impact would be generated during the construction stage and no exceedance of relevant AQOs is expected. Therefore, the construction dust impacts are assessed qualitatively.

Evaluation of Construction Phase Air Quality Impact

3.5.3 Fugitive dust will be potentially generated by heavy construction activities during the construction phase, including excavation works, earth movement, stockpiling, loading and unloading, etc. The major dust-emitting construction activities of the Project have been identified and listed as follows:

- Construction of an additional traffic lane (Bridge H);
- Modification of existing slip roads (Bridge G);
- Demolition of the existing footbridge NF303;
- Construction of footbridge and associated footpath reprovision;

- Relocation and modification of existing bus lay-by; and
- Modification of Kwai Chung Road.

3.5.4 The preliminary programme of heavy construction activities and the corresponding locations of dust emission work are shown in **Appendix 3-1**. The tentative schedule of construction will commence in the first quarter of 2018 and complete by the third quarter of 2021.

3.5.5 Dust-emitting activities would be carried out at different construction periods according to the construction programme with minimum overlapping. In general, the active heavy construction areas typically range from $100m^2$/month to $1300m^2$/month. Among the maximum construction area of $1300m^2$/month, $1200m^2$/month are mainly from road works of Bridge H, while the remaining $100m^2$/month are the stockpiling area. In fact, the active heavy construction areas from road works of Bridge H will only occupy approximately $300m^2$ per week. The extents of the active construction works are generally small, comparing to the usual construction sites. Also, there would be limited quantity of equipment being adopted on-site, including breaker, excavator, and concrete mixer. Parallel construction activity and overlapping of different work stages should be avoided as far as practicable. Hence, the concurrent open area involved for each procedure of work would be constrained by the number of equipment adopted. In addition, majority components of the proposed flyover are pre-casted for on-site installation. Part of the construction and demolition (C&D) materials generated would be reused and backfilled on-site. Therefore, concrete batching and transporting dusty materials is minimised.

3.5.6 In this connection, the number of parallel heavy construction activities would be avoided as far as practicable, and the adverse air quality impact to the surrounding sensitive receivers would be minimised. As a result, it is anticipated that there is no adverse impact from fugitive dust emitted from the heavy construction activities.

3.5.7 In view of the relatively small project scale, the abundant margin of the relevant standards, and the topographic nature of the nearest ASRs which locate at a relative higher elevations over the construction works area, significant dust generation from the construction of the Project is not anticipated, especially after the implementation of good site practices and sufficient dust suppression measures stipulated under the Air Pollution Control (Construction Dust) Regulation. Therefore, adverse impact is not anticipated at the ASRs and quantitative dust impact assessment is considered not necessary.

Construction Phase Mitigation Measures

3.5.8 As no massive earthworks and excavation works are required during the construction of the Project, adverse air quality impact arising from the fugitive dust is not anticipated. Dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation, and good site practices should be implemented to further minimise the construction dust generated. The following dust suppression measures should be incorporated by the Contractor to control the dust nuisance throughout the construction phase.

- Every temporary access road shall be paved with concrete, bituminous materials, hardcores or metal plates, and kept clear of dusty materials; or sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet.
- Any stockpile of dusty materials shall be covered entirely by impervious sheeting, placed in an area sheltered on the top and the 3 sides, or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet. The materials should

be removed or backfilled or reinstated where practicable within 24 hours of the excavation or unloading.

- All dusty materials shall be sprayed with water or a dust suppression chemical immediately prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet.
- Vehicles used for transporting dusty materials should be covered with tarpaulin or similar material, and the cover should extend over the edges of the sides and tailboards.
- Vehicle wheel washing facilities should be provided at each construction site exit. Immediately before leaving a construction site, every vehicle shall be washed to remove any dusty materials from its body and wheels.
- Where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle.
- The speed of vehicles on unpaved road within the site should be controlled to not higher than 10 km/hr.
- Routing of vehicles and positioning of construction plants should be arranged at maximum possible distances from the sensitive receivers.
- Every stock of more than 20 bags of cement and dry pulverized fuel ash (PFA) shall be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3 sides.
- 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 any vent or exhaust should be fitted with the an effective fabric filter or equivalent air pollution control system.
- Exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shotcrete or other suitable surface stabilizer within 6 months after the last construction activity on the construction site or part of the construction site where the exposed earth lies.

3.5.9 The abovementioned requirements are recommended to be incorporated into the contract specification for the civil work. In addition, a monitoring and audit programme during the construction phase should be implemented by the Contractors to ensure that the construction dust impacts are well managed and recorded, and thus to be controlled within the acceptable criteria.

3.5.10 In accordance with Section I Clause 3 (ii) in Appendix B of the EIA Study Brief (No. ESB-242/2012), a monitoring and audit programme for the construction phase of the Project shall be devised to verify the effectiveness of the control measures proposed so as to ensure proper construction dust control. Detailed requirements for the monitoring and audit programme are presented separately on the EM&A Manual.

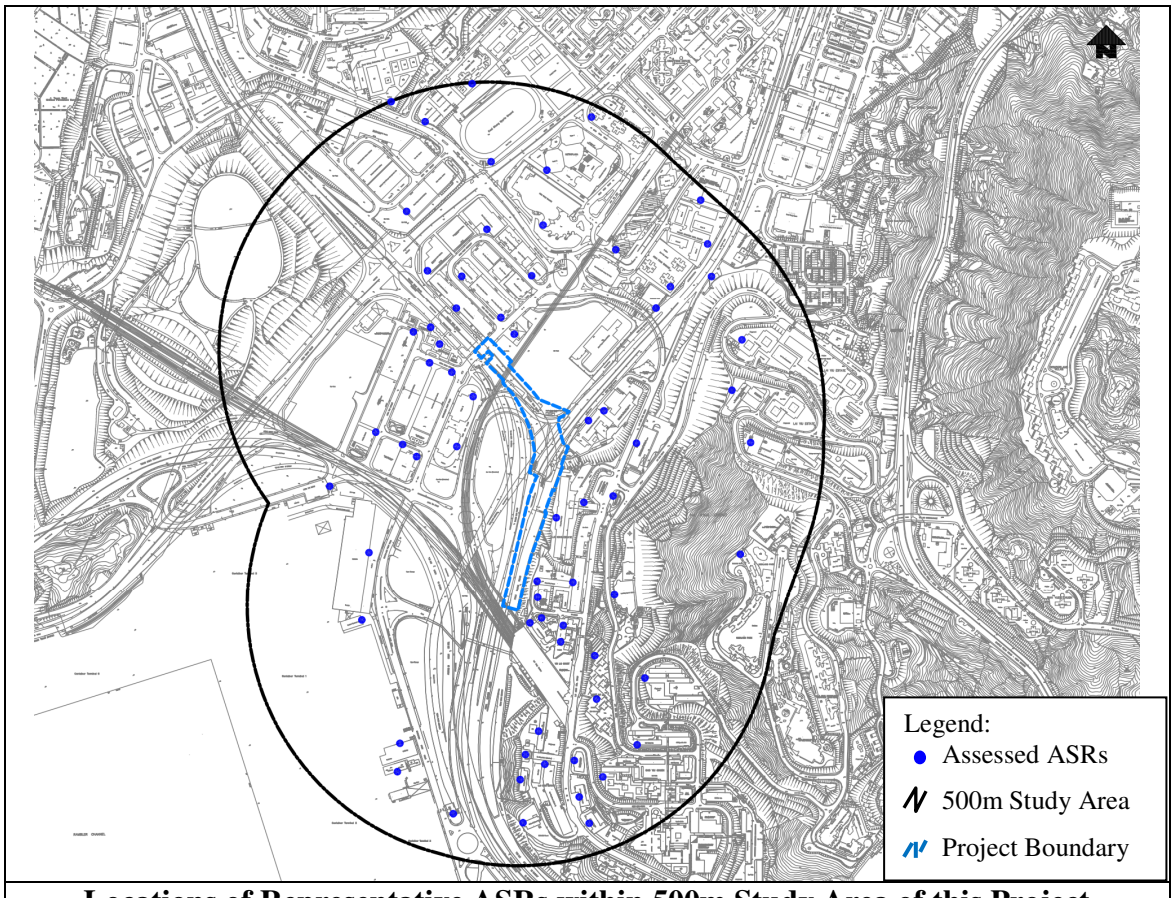
3.6 Operational Phase Assessment

3.6.1 Potential air quality impacts arising from the operation phase of the Project will be described in this section. Background air quality estimation, identification of air pollution sources and representative ASRs, and the methodology adopted for the assessment will be presented. The assessment is conducted in accordance with Clause 3.4.3 and Appendix B of the EIA Study Brief (No. ESB-242/2012).

3.6.2 The flyover is planned to be in operation in year 2021. With the consideration of air quality improvement schemes implemented by the government, such as "A Clean Air Plan for Hong Kong" which aims to tackle roadside air pollution and to reduce marine emissions, the first year of operation (year 2021) is anticipated to be the worst assessment year for the Project, in terms of potential air quality impact.

Identification of Air Sensitive Receivers

3.6.3 With reference to Section 3.4.4 of EIA Study Brief (No. ESB-242/2012), study area for air quality impact assessment should be defined by a distance of 500 metres away from the project boundary. ASRs are identified in accordance with Annex 12 of 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 worship, libraries, courts of law, sports stadiums or performing arts centres. The graph below illustrates the general distribution of ASRs identified within the 500m study area.



Locations of Representative ASRs within 500m Study Area of this Project

3.6.4 The existing ASRs have been identified with reference to the latest information showing on the survey maps, topographic maps, aerial photos and land status plans. Various site surveys have been undertaken to verify and confirm with the above desktop studies.

3.6.5 The planned ASRs have been identified with reference to the latest information including those earmarked on the Kwai Chung Outline Zoning Plan (OZP S/KC/28) and other relevant published land use plans, including plans and drawings published by Lands Department and any land use and development applications approved by the Town Planning Board.

3.6.6 Details of the identified representative ASRs are shown in **Figure 3.1** and summarised in **Table 3-3** below. ASRs identified in this assessment have different degree of sensitivity to the potential air pollution impact. Land use with reference to the OZP classification type for each ASR has been provided.

3.6.7 In general, ASRs identified as "Residential" (R) or "Government, Institution or Community" (G/IC) would be more sensitive to the potential air pollution impact when comparing to the "Industrial" areas (I). In addition, areas identified as "Other Specified Uses" (OU) are situated within the container terminal, where the potential air pollution impact is more likely to be dominated by the adjacent marine traffic and cargo terminal operation, instead of the inland road network and this Project in Kwai Chung area, which are remotely located at about 250m away.

Table 3-3 Representative Air Sensitive Receivers

ASRs ID	Representative ASRs Description	Land Use [(i)]	Assessment Height (Above Ground) (m) [(ii)]	Shortest Horizontal Distance to the Project Boundary (m)	Existing / Planned
A001	Kwai Tsing Theatre	G/IC	1.5 ,5 ,10	246	Existing
A002	Not used	-	-	-	-
A003	Kwai Tsing District Police Headquarters & Divisional Police Station	G/IC	1.5 ,5 ,10	483	Existing
A004	Proposed Residential (Group E) 1 Development at Ex-Kwai Chung Police Married Quarters at Kwai Yi Road	R	1.5 ,5 ,10	448	Planned
A005	Kwai Fong Terrace Block 2	R	16.4 ,19.9 ,24.9	339	Existing
A006	Kwai Yi Road Playground & Sports Ground	O	1.5	290	Existing
A007	Tin Hau Temple	RE	1.5 ,5 ,10	393	Existing
A008	Lai Yiu Estate Fu Yiu House	R	1.5 ,5 ,10	379	Existing
A009	TWGHs Ko Ho Ning Memorial Primary School	G/IC	1.5 ,5 ,10	332	Existing
A010	Kwai Chung Methodist College	G/IC	1.5 ,5 ,10	354	Existing
A011	Lingnam Dr. Chung Wing Kwong Memorial Secondary School	G/IC	1.5 ,5 ,10	78	Existing
A012	Lai King Catholic Secondary School	G/IC	1.5 ,5 ,10	47	Existing
A013	Ho Kwai Chung Polyclinic & Special Education Services Centre	G/IC	1.5 ,5 ,10	131	Existing
A014	Lai King Hill Road North Sitting-out Area	G/IC	1.5	112	Existing
A015	Lai King Estate Wo King House	R	1.5 ,5 ,10	62	Existing
A016	Lai King Estate Fung King House	R	1.5 ,5 ,10	21	Existing
A017	Lai King Estate Ming King House	R	1.5 ,5 ,10	21	Existing
A018	Lai King Estate Yat King House	R	1.5 ,5 ,10	89	Existing
A019	HKEAA Lai King Assessment Centre	G/IC	1.5 ,5 ,10	30	Existing
A020	Lai King Restaurant Playground	O	1.5	46	Existing
A021	Lai King Restaurant	C	1.5 ,5 ,10	32	Existing
A022	Not Used	-	-	-	-
A023	Yuet Lai Court - Lai Hung House (Block D)	R	1.5 ,5 ,10	172	Existing
A024	Yuet Lai Court - Lai Wah House (Block B)	R	1.5 ,5 ,10	230	Existing
A025	Lai King Estate - Yeung King House	R	1.5 ,5 ,10	239	Existing
A026	Lai King Estate - On King House	R	1.5 ,5 ,10	282	Existing
A027	Lai King Estate - Flatted Factories	I	1.5 ,5 ,10	331	Existing

ASRs ID	Representative ASRs Description	Land Use (i)	Assessment Height (Above Ground) (m) (ii)	Shortest Horizontal Distance to the Project Boundary (m)	Existing / Planned
A028	China Holiness College	G/IC	1.5 ,5 ,10	415	Existing
A029	OUHK CITA Learning Centre	G/IC	1.5 ,5 ,10	313	Existing
A030	Lai King Community Hall	G/IC	1.5 ,5 ,10	383	Existing
A031	Asbury Methodist Primary School	G/IC	1.5 ,5 ,10	438	Existing
A032	Mariners' Club	OU	1.5 ,5 ,10	398	Existing
A033	Container Terminal 2 Office	OU	1.5 ,5 ,10	364	Existing
A034	Container Terminal 2 Workshop	OU	1.5 ,5 ,10	324	Existing
A035	Container Terminal 5 Administration Building	OU	16.5 ,20 ,25	276	Existing
A036	Container Terminal 5 Godown	OU	16.5 ,20 ,25	278	Existing
A037	Container Terminal 5 Office	OU	1.5 ,5 ,10	387	Existing
A038	Fidelity Godown	OU	1.5 ,5 ,10	249	Existing
A039	Kerry (Kwai Chung) Godown	I	1.5 ,5 ,10	228	Existing
A040	Cargo Consolidation Complex	I	21.3 ,24.8 ,29.8	226	Existing
A041	Ever Gain Plaza Tower 1	I	47.9 ,51.4 ,56.4	146	Existing
A042	Ever Gain Plaza Tower 2	I	47.9 ,51.4 ,56.4	63	Existing
A043	Kwai Shun Industrial Centre North Tower	I	1.5 ,5 ,10	60	Existing
A044	Golden Industrial Building	I	1.5 ,5 ,10	91	Existing
A045	Kwai Shun Street Cooked Food Market	I	1.5 ,5 ,10	70	Existing
A046	Kwai Shun Street Playground	G/IC	1.5	98	Existing
A047	Kwai Tak Industrial Building Block 2	I	1.5 ,5 ,10	126	Existing
A048	Profit Industrial Building	I	1.5 ,5 ,10	85	Existing
A049	Join-in Hang Sing Centre	I	1.5 ,5 ,10	46	Existing
A050	Petrol Station Office at Container Port Road	OU	1.5 ,5 ,10	40	Existing
A051	Marvel Industrial Building Block B	I	5.5 ,9 ,14	178	Existing
A052	Wing Hang Industrial Building	I	7.5 ,11 ,16	295	Existing
A053	Kwai Shing Swimming Pool	I	1.5 ,5 ,10	499	Existing
A054	Hing Shing Road Basketball Court	I	1.5	440	Existing
A055	Kwai Chung Sports Ground	G/IC	1.5	345	Existing
A056	Kwai Chung Plaza Block 1	R	1.5 ,5 ,10	476	Existing
A057	New Kwai Fong Gardens Block A	R	1.5 ,5 ,10	297	Existing
A058	Hibiscus Park Block 2	R	5.1 ,8.6 ,13.6	498	Existing
A059	Highland Park Block 6	R	3.3 ,6.8 ,11.8	384	Existing
A060	Cho Yiu Chuen Kai Min Lau	R	1.5 ,5 ,10	279	Existing
A061	Cho Yiu Chuen Kai Hang Lau	R	1.5 ,5 ,10	350	Existing
A062	Cho Yiu Chuen Chung Ling Sheh	R	1.5 ,5 ,10	364	Existing
A063	Lai King Estate - Lok King House (Block 7)	R	1.5 ,5 ,10	305	Existing
A064	Wing Hong Factory Building	I	1.5 ,5 ,10	132	Existing
A065	Metroplaza Tower 2	C	1.5 ,5 ,10	348	Existing
A066	Yin Lai Court - Yin Kwong House (Block A)	R	1.5 ,5 ,10	91	Existing
A067	Yin Lai Court - Yin Tak House (Block B)	R	1.5 ,5 ,10	102	Existing
A068	Wah Fung Industrial Centre	I	6.5 ,10 ,15	213	Existing
A069	Fook Yip Building	I	1.8 ,5.3 ,10.3	149	Existing
A070	Lai King Sports Centre	R	1.5	174	Existing

Notes: (i) R – Residential, I – Industrial, C – Commercial, G/IC – Government / Institution / Community, O – Open Space, OU – Other Specified Uses, T – MTR Station, RE - Religious

(ii) The assessment heights are adjusted to the corresponding assessment level or fresh air intake point, such as locations above the following facilities:-

- Car parking podium
- Ground floor lobby
- Shopping centre with non-openable window façade

Identification of Pollution Sources and Key Pollutants

3.6.8 Major sources of air quality impact associated with the operation of the Project include the followings:

- Vehicular emissions in associated with the operation of the proposed carriageway (the Project).
- Vehicular emission arising from the existing roads networks within the 500m study area from the Project boundary.
- Chimney emissions from the nearby factories within the study area.
- Background air pollution levels for the assessment year (Year 2021) estimated by the PATH model.

Vehicular Emission from Open Road

3.6.9 Vehicular emission comprises a number of air pollutants, including Nitrogen Oxides (NO_x), Respirable Suspended Particulates (RSP), Sulphur Dioxide (SO_2), Carbon Monoxide (CO), Lead (Pb), etc. Motor vehicles are the major causes of high concentrations of RSP and NO_x at street level in Hong Kong and these two pollutants are considered as key air quality pollutants for road projects. For other pollutants, due to the low concentration in vehicular emission, they are not considered as key pollutants for the purpose of this study. The characteristics of these pollutants are briefly described below:

Nitrogen Dioxide (NO_2)

3.6.10 NO_x are major pollutants created by the use of fossil fuel combustion. According to the 2012 Environmental Performance Report published by EPD, road transport is the major NO_x contributor of the total emissions. Hence, NO_2 is considered as one of the key air pollutants for the operational air quality impact assessment of the Project.

Respirable Suspended Particulates (RSP)

3.6.11 RSP refers to the suspended particulates with a nominal aerodynamic diameter of 10μm or less. According to the 2012 Environmental Performance Report published by EPD, road transport is the second largest RSP contributor of the total emission. Hence, RSP is also considered as a key air pollutant for the operational air quality assessment of the Project.

Fine Suspended Particulates (FSP)

3.6.12 FSP refers to the suspended particulates with a nominal aerodynamic diameter of 2.5μm or less, which can be suspended in the air and cause adverse impact to the human health. FSP is newly introduced in the prevailing AQO effective from January 2014. Hence, FSP is one of the key pollutants for the operational air quality assessment of the Project.

Sulphur Dioxide (SO_2)

3.6.13 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. With the use of ULSD, according to the 2011 Environmental Performance Report released by EPD, road transport is the smallest share of SO_2 emission sources in 2009 and only constitutes 0.5% of the total SO_2 emission. 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%. Road transport is therefore anticipated only a very small amount of SO_2 emission contribution. With the adoption of low-sulphur and ultra-low-sulphur fuel

under the existing government policy, SO_2 is not a critical air pollutant of concern.

Carbon Monoxide (CO)

3.6.14 CO is a typical pollutant emitted during fossil fuel combustion and comes mainly from vehicular emissions. With reference to the "Air Quality in Hong Kong 2012", the highest 1-hour average (2,670µg/m^3) and the highest 8-hour average (2,345µg/m^3) were both measured at the Tsuen Wan station; these values were around 8.9% and 23.5% of the respective AQOs. In view that there is still a large margin to the AQOs, CO would not be a critical air pollutant of concern.

Ozone (O_3)

3.6.15 O_3 is produced from photochemical reaction between NO_x and Volatile Organic Compounds (VOCs) in the presence of sunlight. Concentration of O_3 is governed by both precursors and atmospheric transport from other areas. When precursors transport along under favorable 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 NO to give NO_2 and thus results in O_3 removal. As it takes few hours for these photochemical reactions to take place, O_3 recorded in one area could be attributed to VOCs and NO_x emissions from another area, which may be distant from the project site. Hence, O_3 is a regional air pollution problem and is not a primary pollutant emitted from vehicular emissions. O_3 is therefore not considered as a key air pollutant for the operational air quality assessment of a road project.

Lead (Pb)

3.6.16 The sale of leaded petrol has been banned in Hong Kong since April 1999. According to the "Air Quality in Hong Kong 2012", the measured ambient Pb concentrations were ranging from 11ng/m^3 to 57ng/m^3. The measured concentrations were well below the AQO. Therefore, lead is not considered as a critical air pollutant of concern.

3.6.17 In this Project, the major pollutant sources are from vehicular emissions. Among the pollutants mentioned above, NO_2, RSP, and FSP are the major air pollutants that would be generated. The time averaged concentrations of these pollutants are calculated and assessed as stipulated in the prevailing AQOs. All road links included in this assessment are illustrated in **Figure 3.2** while traffic flow data can refer to **Appendix 3-2**.

3.6.18 It is identified that only the road links listed below have changes in traffic volume and travelling speed between the "With Project" and "Without Project" scenarios as shown in **Figure 3.3**:

- 58S - Kwai Chung Road
- 92S - Tsuen Wan Road
- 93S - Kwai Chung Road
- 94S2 - Kwai Chung Road
- 95S - Kwai Chung Road
- 96S - Flyover from Kwai Tsing Interchange to Kwai Chung Road

3.6.19 From the traffic forecast of "With Project" and "Without Project" scenarios in Year 2021, it is anticipated that the total traffic volume will remain unchanged and there will be no additional increase in traffic flow drawn by the Project. Instead, traffic congestion and travelling speed will be improved after the implementation of the Project. In view of these,

it is unlikely that additional adverse air quality impacts would be induced by the proposed project to the existing environment. The comparisons of traffic flows and traffic speeds between "With Project" and "Without Project" scenarios on the above identified roads sections in concern are shown in **Table 3-4** below.

Table 3-4 Comparison of Road Traffic Flows and Traffic Speeds between "With Project" and "Without Project" Scenarios

Road ID	Road Name	Section	Bound	Year 2021 "Without Project" Scenario			Year 2021 Design "With Project" Scenario		
				Daily Total Traffic	Traffic at Peak Hour	Traffic Speed at Peak Hour	Daily Total Traffic	Traffic at Peak Hour	Traffic Speed at Peak Hour
58S	Kwai Chung Rd	Under Tsing Kwai Highway	SB	72,051	5,220	55.48	71,860	5,218	55.50
92S	Tsuen Wan Rd	KT I/C Upramp - KCR Upramp	SB	72,765	5,272	30	54,055	3,917	47.67
93S	Kwai Chung Rd	Flyover from KT I/C upramp - KCR	SB	13,302	960	70	31,821	2,313	54.54
94S2	Kwai Chung Rd	TWR - Tsing Kwai Highway Upramp	SB	58,749	4,260	43.66	40,039	2,905	57.74
95S	Kwai Chung Rd	Tsing Kwai Highway - KCR	SB	58,749	4,260	43.66	40,039	2,905	57.74
96S	Flyover from KT I/C to Kwai Chung Rd	KT I/C - KCR	SB	-	-	-	18,710	1,355	49.03

Industrial Chimney Emissions

3.6.20 As mentioned in **Section 3.3**, the project site is located in the vicinity of the major industrial area in Kwai Chung District, industrial chimney emissions is one of the major sources of air quality impact in the project site.

3.6.21 The chimney inventory is mainly developed with reference to the previous EIA study "Tsuen Wan Bypass, Widening of Tsuen Wan Road between Tsuen Tsing Interchange and Kwai Tsing Interchange and Associated Junction Improvement Works" (EIA-152/2008).

3.6.22 Site visits were conducted in September 2013, in order to update and validate the chimney information. In addition, chimney survey was carried out within the study area to collect updated information of chimney emissions. Details of the site visits and chimney surveys are shown in **Appendix 3-3**. There are 5 chimneys identified within the study area. Locations of these chimneys are illustrated in **Figure 3.4.**

Determination of Worst Assessment Year in Air Quality Impact Assessment

3.6.23 According to EIA Study Brief ESB-242/2012, the air pollution impacts of future road traffic shall be calculated based on the highest emission strength from the road within the next 15 years upon commencement of operation of the Project (i.e. Year 2021 to 2036).

3.6.24 In order to identify the worst assessment year, the trend of emission inventory from Year 2021 to 2036 was studied by using EMFAC-HK V2.6, under "Without Project" and "With Project" scenarios. The emission inventory for NO_x, RSP and FSP under "Without Project" and "With Project" scenarios are shown in **Table 3-5** and **Table 3-6** respectively. The corresponding road types are illustrated in **Figure 3.2**.

3.6.25 The results indicate that there is a trend with decreasing emissions of NO_x, RSP and FSP from Years 2021 to 2036 for different types of vehicles under both scenarios. Total emissions of NO_x contributing from all road types within the study area are predicted. Take urban trunk road as example, predicted NO_x level would drop by about 42% from Years 2021 to 2029, and 44% from Years 2029 to 2036. On the other hand, RSP and FSP emissions do not show a significant drop from Years 2021 to 2029, but a drop of around 40% from Years 2029 to 2036.

3.6.26 Comparing the predicted trend of emissions of NO_x with that of RSP and FSP, NO_x emission from the urban trunk road under "With" Project shall be reduced from Year 2021 onward, while RSP and FSP emissions shall be increased by 1% to 2% in Year 2029 and 2036. This slight rising emission trend of RSP and FSP is mainly due to the increase of vehicular travelling speed under "With" Project scenario, when the traffic congestion has been relieved when this Project is in place.

3.6.27 From the EMFAC analysis, the optimal vehicular travelling speed for the least RSP and FSP emission is around 40km/h. When the speed is faster than 40km/h, a positive growing relationship between the RSP/FSP emission and the vehicular travelling speed has been observed.

3.6.28 Notwithstanding such slight increase in RSP/FSP emission under "With" Project scenario, the predicted RSP and FSP concentrations are well within the AQOs based on the results presented in **Section 3.6.105**, and thus it is not of the primary concern in this project.

Table 3-5 Total Emission Inventory for "Without" Project Scenario

Year	Total Emission (g/day)				
	Expressway	Urban District Distributor	Urban Local Distributor	Urban Primary Distributor	Urban Trunk Road
NOx					
2021	110154.8	71299.1	54890.5	24772.3	87413.3
2029	77078.7	50379.3	36765.0	17294.4	51095.0
2036	46569.2	29662.5	22999.3	9945.4	28462.6
RSP					
2021	4432.3	2257.2	1959.3	804.5	3001.2
2029	4608.3	2216.2	1903.4	826.2	2594.4
2036	2746.2	1410.2	1217.7	497.7	1540.2
FSP					
2021	4075.1	2071.4	1798.9	739.5	2757.7
2029	4242.0	2039.2	1751.4	760.4	2386.6
2036	2529.7	1299.2	1121.9	458.3	1418.1

Table 3-6 Total Emission Inventory for "With" Project Scenario

Year	Total Emission (g/day)				
	Expressway	Urban District Distributor	Urban Local Distributor	Urban Primary Distributor	Urban Trunk Road
NOx					
2021	110154.8	71299.1	54890.5	24772.3	83537.3
2029	77078.7	50379.3	36765.0	17294.4	50285.5
2036	46569.2	29662.5	22999.3	9945.4	28081.7
RSP					
2021	4432.3	2257.2	1959.3	804.5	2934.7
2029	4608.3	2216.2	1903.4	826.2	2643.8

Year	Total Emission (g/day)				
	Expressway	Urban District Distributor	Urban Local Distributor	Urban Primary Distributor	Urban Trunk Road
2036	2746.2	1410.2	1217.7	497.7	1557.5
FSP					
2021	4075.1	2071.4	1798.9	739.5	2696.7
2029	4242.0	2039.2	1751.4	760.4	2431.7
2036	2529.7	1299.2	1121.9	458.3	1433.9

Table 3-7 Predicted Total Traffic Volume in Assessment Years

Road Type / Year	Total Traffic Volume per Day					
	Expressway	Urban District Distributor	Urban Local Distributor	Urban Primary Distributor	Urban Trunk Road	Total
2021	749642	523783	550249	186247	517496	2527417
2029	786216	548924	576138	195180	542534	2648992
2036	819635	571931	599874	203389	565488	2760317

3.6.29 Despite of the growth in traffic volume in the assessment year as shown in **Table 3-7** above, the vehicular emission is decreasing. The decreasing trend of NO_x, RSP and FSP emissions from Years 2021 to 2036 is mainly due to the government's air quality improvement policies/programmes. The major vehicle exhaust emission control programmes included in EMFAC-HK V2.6 are:

- The tightening of vehicle emission standards for first-registered vehicles;
- The particulate removal device retrofit programme for pre-Euro diesel vehicles and Euro I franchised buses;
- The introduction of ultra-low sulphur diesel;
- I/M program using remote sensing and dynamometer testing for petrol/ LPG vehicles;
- Mandatory retirement of pre-Euro IV diesel commercial vehicles including ex-gratia payment, mandatory retirement of pre-Euro IV diesel commercial vehicles in phases and the 15-year limit on service life of new diesel commercial vehicles;
- Retrofitting franchised buses with selective catalytic reduction (SCR) Devices; and
- Subsidy programme for the replacement of catalytic converters and oxygen sensors on LPG/petrol taxi and LPG light bus.

3.6.30 NO_x consist of nitrogen monoxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O), and it is the major pollutant that would be generated from the vehicular emissions. RSP and FSP would also be generated from the vehicular emissions. However, their daily emissions are comparatively smaller than the NO_x daily emissions. As mentioned in **Section 3.4**, annual average NO_2 concentration remains high in the existing environment and it exceeds the AQO. Hence NO_2 is the pollutant of primary concern among all other pollutants in this study.

3.6.31 In this connection, Year 2021 was selected as the worst assessment year in terms of on-road vehicular emission, within 15 years after the Project commencement.

Projected Background Air Quality Result of Year 2021 by PATH Model

3.6.32 PATH is a regional air quality model developed by EPD to simulate air quality over Hong Kong against the Pearl River Delta (PRD) as background. For EIA applications, it simulates wind field, pollutant emissions, transportation and chemical transformation and outputs pollutant concentrations over Hong Kong and the PRD region at a fine grid size of 1.5km. PATH model has been adopted in different EIAs projects for projecting background air quality in the future years within the study area. In the Project, available PATH data are Year 2015 and 2020.

3.6.33 In order to incorporate the updated marine vessel information and to avoid the double counting effects of vehicular emissions, a re-run of the PATH model for the Year 2021 has been conducted for the background air quality concentrations within the study area. The re-run was based on the PATH emission inventory for Year 2020 as shown in **Appendix 3-4** while the assumptions were shown in **Appendix 3-5**.

3.6.34 In this study, the 500m study area covers 4 grids of PATH model, including grids (25, 30), (25, 31), (26, 30) and (26, 31) as shown in **Figure 3.5.** A summary of the projected background concentrations in Year 2021 is shown in **Table 3-8** below. It shows that the 1-hour and annual NO_2 background level marginally comply with the AQOs, especially at grids (25, 30) and (25, 31), in which local vehicular emissions contributed by the road network and this Project at Kwai Chung area have not been taken into account.

Table 3-8 Summary of Predicted Results from PATH Model in Year 2021

Pollutant	Averaging Time	Concentration Limits in AQOs ($\mu g/m^3$) (i)	Year 2021 PATH Model Concentration ($\mu g/m^3$) (ii)			
			Grid (25,30)	Grid (25,31)	Grid (26,30)	Grid (26,31)
RSP	24-hour	100 (9)	100 [1]	97 [0]	98 [0]	96 [0]
	Annual	50	43	41	40	40
FSP	24-hour	75 (9)	77 [1]	75 [0]	76 [1]	74 [0]
	Annual	35	31	29	29	28
Nitrogen Dioxide (NO_2)	1-hour	200 (18)	244 [10]	234 [12]	241 [6]	238 [6]
	Annual	40	39	30	29	26

Notes: (i) The numbers in brackets ( ) refer to number of exceedances allowed per year.
(ii) The numbers in brackets [ ] refer to number of exceedances of the background concentration.

Assessment Methodology

3.6.35 The overall methodology for the air quality impact assessment within study areas is as follows:

- EMFAC-HK is adopted to determine the emission factors for 16 vehicular classes, details are shown in **Appendix 3-6**.
- Use of near field dispersion model (i.e. CALINE4) for open road sources within the study area including adjacent road networks.
- Use of near field dispersion model (i.e. ISCST3) for volume sources to quantify the air quality impacts at local scale from sources including emissions from noise enclosure portals.

Determination of Vehicular Emissions from Open Roads

3.6.36 CALINE4 model was developed by US Environmental Protection Agency (USEPA) and is commonly adopted to estimate the vehicular emissions from the open road sources. The hourly emission rates of each vehicle class (in g/VMT) and each road section have been

determined using the emission factors obtained from the EMFAC-HK model, in which the consideration of the hourly traffic flow and the distance travelled had been included. The composite vehicular emission factor for each road link in the assessment Year 2021 is given in **Appendix 3-7**.

3.6.37 Refer to **Section 3.6.22 – Section 3.6.34**, PATH model results were adopted as the background concentrations for different pollutants in grids (25, 30), (25, 31), (26, 30) and (26, 31). Four different sets of MM5 hourly meteorological data were adopted for the assessment in the corresponding grids. The pollution impacts at ASRs have been estimated using CALINE4 and ISCST3 models and the corresponding 1-year hourly MM5 data, which fall within the same grid of the ASRs.

3.6.38 The stability classes were calculated using PCRAMMET model issued by USEPA.

3.6.39 With the generation of stability class data, a full set one year meteorological data extracted from MM5 data, including the followings were adopted in the CALINE4 model:

- Temperature
- Wind speed
- Wind direction
- Stability class
- Mixing height
- Surface roughness (Z_0): 370cm.
- Standard deviations for different stability classes: $\sigma \times (Z_0/15\ cm)^{0.2}$

where Stability Class A (σA) = 22.5°
Stability Class B (σB) = 22.5°
Stability Class C (σC) = 17.5°
Stability Class D (σD) = 12.5°
Stability Class E (σE) = 7.5°
Stability Class F (σF) = 3.8°

3.6.40 In view of the constraint of the CALINE4 model in modelling elevated roads higher than 10m, the road heights of elevated road sections in excess of 10m high above local ground or water surface, have been set to 10m in the CALINE4 model as a worst-case assumption.

Assessment Height

3.6.41 The concentrations of NO_2, RSP and FSP generated by the open road emissions at the lowest 3 assessment levels above the local ground at the representative ASRs were estimated within the study area.

3.6.42 The lowest 3 assessment levels of the ASRs are basically defined as 1.5m, 5m and 10m above ground. However, the assessment levels for each ASR had been adjusted according to the podium height and terrain on which the ASRs are located. The exact assessment heights of each ASR can be referred to **Table 3-3**.

3.6.43 The ASRs located in area with higher terrain have been elevated in the model and the details are described in the model set up section below.

Model Set Up

3.6.44 The terrain of the assessment areas is not flat, some ASRs on Lai King Hill, including Lai King Estate and Cho Yiu Chuen, are located relatively higher than the ground levels at the Kwai Fong and Kwai Chung districts. Given CALINE4 has constraint to simulate the

terrain effects, 2 sets of CALINE4 models were used to simulate the elevation difference of the roads in order to consider cumulative impacts contributed to the ASRs in the hilly areas by the local roads and the Project.

3.6.45 The first set of model includes all the open roads within the study area and excludes the local roads in the hilly regions such as Lai King Estate, Cho Yiu Chuen and the nearby areas. These selected local roads at ground level are shown in **Figure 3.6**. Heights of the subject ASRs are with reference to the ground level of the flat land in container terminal areas, i.e. 5.5mPD.

3.6.46 Another set of model only includes local roads on hilly areas and assumed that the ASRs heights are considered as 1.5m, 5m and 10m above the ground. The road links located on Lai King Hill included in this set of model are shown in **Figure 3.7**. The ASRs located on lower areas are assumed to be the same as that in the hilly areas. This method could consider the combined impacts of road sources on lower levels and the local roads on hilly areas to the ASRs which are located at higher terrain.

Emissions from Industrial Sources

3.6.47 A Gaussian dispersion namely ISCST3, which is generally recognized by USEPA and EPD, is adopted to estimate the chimney emissions from the industrial buildings within the 500m study area. The chimneys emissions are treated as point source in the ISCST3 model. As mentioned in **Section 3.6.21**, 5 chimneys were identified within the study area and all of these point sources emission have been inputted in to the ISCST3 model.

3.6.48 To maintain the consistency with the meteorological conditions adopted in PATH model, Year 2010 MM5 meteorological data were adopted in ISCST3 model.

3.6.49 In order to assess the cumulative air quality impacts, assessments for chimney emissions from nearby industrial factories were conducted at 1.5m, 5 m and 10m above ground level.

3.6.50 NO_x, RSP, and FSP concentrations at different ASRs were obtained using the ISCST3 dispersion model. OLM is adopted for converting NO_x to NO_2 from the predicted O_3 level from PATH.

Cumulative Impact

3.6.51 Cumulative air quality impact at each ASR identified in this Project are estimated by adding the modelling evaluation results from background air quality by PATH model, open road vehicular emission by CALINE4, as well as industrial emission by ISCST3. The applicable 1-hour, 24-hour and annual average cumulative concentrations of NO_2, RSP and FSP at each ASR at different levels including 1.5m, 5m and 10m above ground would be presented. The predicted cumulative impact levels of different pollutants at each ASR would be compared against the stipulated AQOs.

3.6.52 With reference to EPD's "Guidelines on Choice of Models and Model Parameters", the Ozone Limiting Method (OLM) was adopted for converting NO_x to NO_2 from the predicted O_3 level from PATH. A tailpipe emission NO_2/NO_x ratio of 7.5% was adopted. The equation of NO_2/NO_x conversion is as follow:

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

where	$[NO_2]_{pred}$	is the predicted NO_2 concentration
	$[NOx]_{pred}$	is the predicted NOx concentration
	MIN	means the minimum of the two values within the brackets
	$[O_3]_{PATH}$	is the representative O_3 background concentration

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

Cumulative Impact for "Without Project" Scenario in Year 2021

3.6.53 In previous section, background air quality conditions in Year 2021 has been studied without taking into account the local vehicular emissions contributed by the road network and this Project in Kwai Chung area.

3.6.54 In order to evaluate the overall prevailing air quality conditions with concerned vehicular emissions, cumulative air quality study was conducted by incorporating air quality impacts estimated from CALINE4, ISCST3 and PATH background results at different levels (i.e. 1.5m, 5m and 10m above ground) under "Without Project" scenario at Year 2021. Results are shown in **Table 3-9** to **Table 3-11.** Detailed results for separated grids at different levels are presented in **Appendix 3-8**.

3.6.55 The results show that no exceedance of 19th highest 1-hour NO_2, 10th highest daily RSP and FSP, annual average RSP and FSP were identified at all ASRs in all grids.

3.6.56 On the other hand, exceedances of annual NO_2 at some ASRs were identified at 1.5m, 5m and 10m levels in Grid (25, 30) and Grid (25, 31), but none in Grid (26, 31) and Grid (26, 30). Most of the ASRs exceeding the AQOs are located near to the KCCT and largely affected by the marine emission. The highest level was observed at ASR A032, i.e. Mariners' Club, next to KCCT.

3.6.57 As mentioned in **Section 3.3**, KCCT is located to the west of the project site, which falls within the Grid (25,30) and Grid (25,31) of the assessment area. In this regards, the existing high concentrations of NO_2 in these 2 grids are mainly contributed by the marine emissions from the KCCT area.

3.6.58 Contour plots under "Without Project" scenario at 10m above ground for the hourly and annual average NO_2, daily and annual average RSP and FSP are shown in **Figure 3.8** to **Figure 3.16**. 10m above ground is selected for comparison as it is the closest height to the proposed flyover, which is about 14mPD.

Table 3-9 Predicted Cumulative Air Pollutants Concentrations under "Without Project" Scenario at 1.5m above Ground in Year 2021

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (µg/m³)		RSP Conc. (µg/m³)		FSP Conc. (µg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A001	1.5	191.1	**40.8**	76.0	41.3	57.1	29.5
(25,31)	A003	1.5	188.7	39.6	75.9	41.2	57.1	29.3
(25,31)	A004	1.5	187.6	**46.4**	76.2	41.5	57.3	29.6
(25,31)	A005	16.4	187.8	37.3	75.8	41.1	56.9	29.3
(25,31)	A006	1.5	190.0	**49.7**	76.4	41.7	57.3	29.8
(25,31)	A007	1.5	196.6	**42.7**	76.4	41.5	57.4	29.6
(26,31)	A008	1.5	182.9	30.4	74.7	39.9	56.1	28.4
(26,31)	A009	1.5	182.8	29.5	74.7	39.8	56.1	28.3
(26,31)	A010	1.5	181.8	28.8	74.7	39.8	56.1	28.3
(25,31)	A011	1.5	197.3	**43.3**	76.4	41.5	57.4	29.6
(25,31)	A012	1.5	198.2	**44.3**	76.5	41.6	57.4	29.7
(25,31)	A013	1.5	197.1	**42.0**	76.3	41.4	57.3	29.5
(25,31)	A014	1.5	193.9	**43.5**	76.5	41.3	57.5	29.5
(25,31)	A015	1.5	194.6	**41.9**	76.2	41.3	57.3	29.5
(25,31)	A016	1.5	193.7	**41.0**	76.3	41.4	57.2	29.5
(25,30)	A017	1.5	190.3	**45.5**	79.6	43.0	59.8	30.6
(25,30)	A018	1.5	191.0	**46.3**	79.6	43.1	59.8	30.7

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,30)	A019	1.5	189.0	**44.8**	79.5	43.0	59.7	30.6
(25,30)	A020	1.5	188.0	**43.8**	79.4	42.9	59.6	30.5
(25,30)	A021	1.5	186.8	**43.6**	79.4	42.9	59.6	30.5
(25,30)	A023	1.5	192.1	**42.2**	79.4	42.9	59.7	30.5
(25,30)	A024	1.5	191.2	**41.7**	79.4	42.9	59.6	30.5
(25,30)	A025	1.5	187.7	**44.0**	79.5	43.0	59.8	30.6
(25,30)	A026	1.5	187.8	**43.3**	79.5	42.9	59.8	30.5
(25,30)	A027	1.5	186.5	**41.9**	79.4	42.8	59.6	30.5
(25,30)	A028	1.5	183.7	**40.7**	79.3	42.8	59.5	30.4
(25,30)	A029	1.5	187.4	**43.4**	79.5	42.9	59.7	30.5
(25,30)	A030	1.5	187.0	**42.2**	79.4	42.8	59.7	30.5
(25,30)	A031	1.5	186.4	**41.6**	79.4	42.8	59.6	30.4
(25,30)	A032	1.5	186.2	**61.1**	81.0	44.0	60.8	31.5
(25,30)	A033	1.5	183.7	**54.2**	80.0	43.5	60.2	31.0
(25,30)	A034	1.5	183.7	**55.2**	80.0	43.5	60.2	31.1
(25,30)	A035	16.5	183.7	**49.4**	79.6	43.2	59.8	30.8
(25,30)	A036	16.5	184.4	**50.4**	79.7	43.3	59.8	30.8
(25,31)	A037	1.5	189.1	**50.5**	77.0	41.7	57.9	29.8
(25,31)	A038	1.5	187.4	**47.7**	76.5	41.6	57.5	29.7
(25,31)	A039	1.5	188.4	**48.7**	76.6	41.7	57.5	29.8
(25,31)	A040	21.3	181.7	39.7	76.0	41.2	57.1	29.3
(25,31)	A041	47.9	180.2	33.3	75.6	40.9	56.8	29.1
(25,31)	A042	47.9	180.0	33.2	75.4	40.9	56.6	29.1
(25,31)	A043	1.5	186.8	**53.2**	76.9	41.9	57.8	30.0
(25,31)	A044	1.5	185.7	**49.0**	76.7	41.6	57.6	29.7
(25,31)	A045	1.5	185.8	**49.2**	76.6	41.6	57.6	29.7
(25,31)	A046	1.5	185.7	**48.7**	76.6	41.6	57.5	29.7
(25,31)	A047	1.5	185.3	**48.8**	76.7	41.6	57.6	29.7
(25,31)	A048	1.5	196.6	**44.8**	76.2	41.6	57.2	29.7
(25,31)	A049	1.5	196.6	**47.0**	76.3	41.7	57.3	29.8
(25,31)	A050	1.5	197.4	**44.1**	76.3	41.6	57.3	29.7
(25,31)	A051	5.5	197.6	**44.8**	76.3	41.6	57.3	29.7
(25,31)	A052	7.5	186.7	**42.6**	76.0	41.4	57.2	29.5
(25,31)	A053	1.5	177.2	37.6	75.7	41.2	56.8	29.3
(25,31)	A054	1.5	184.9	38.8	75.9	41.3	57.0	29.4
(25,31)	A055	1.5	187.4	**45.0**	76.1	41.6	57.1	29.7
(25,31)	A056	1.5	189.3	38.3	75.9	41.2	57.1	29.3
(25,31)	A057	1.5	191.8	**41.9**	76.2	41.4	57.1	29.6
(25,31)	A058	5.1	178.1	35.2	75.5	41.0	56.7	29.2
(26,30)	A059	3.3	184.4	29.7	75.5	40.1	56.7	28.5
(25,30)	A060	1.5	192.0	**40.8**	79.4	42.8	59.6	30.4
(25,30)	A061	1.5	190.3	**41.0**	79.4	42.8	59.6	30.4
(25,30)	A062	1.5	190.6	**41.3**	79.4	42.8	59.6	30.4
(25,30)	A063	1.5	196.7	**46.9**	80.2	43.2	60.3	30.8
(25,31)	A064	1.5	194.7	**43.8**	76.2	41.5	57.2	29.6
(25,31)	A065	1.5	187.6	38.9	75.9	41.2	57.1	29.3
(25,30)	A066	1.5	188.3	**44.5**	79.4	43.0	59.7	30.6
(25,30)	A067	1.5	187.9	**44.3**	79.4	42.9	59.6	30.5
(25,31)	A068	6.5	188.6	**41.8**	76.1	41.3	57.2	29.5
(25,31)	A069	1.8	190.6	**46.2**	76.3	41.5	57.3	29.7
(25,30)	A070	1.5	189.0	**42.1**	79.5	42.9	59.7	30.5

Note:
[Bold] data has exceeded the AQO.

Table 3-10 Predicted Cumulative Air Pollutants Concentrations under "Without Project" Scenario at 5m above Ground in Year 2021

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. ($\mu g/m^3$)		RSP Conc. ($\mu g/m^3$)		FSP Conc. ($\mu g/m^3$)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A001	5	190.6	**40.2**	76.0	41.3	57.1	29.4
(25,31)	A003	5	188.1	39.1	75.9	41.2	57.0	29.3
(25,31)	A004	5	187.5	**43.1**	76.1	41.3	57.2	29.5
(25,31)	A005	19.9	184.4	36.2	75.7	41.1	56.9	29.2
(25,31)	A007	5	192.2	39.9	76.3	41.3	57.2	29.4
(26,31)	A008	5	182.9	30.1	74.7	39.9	56.1	28.3
(26,31)	A009	5	182.7	29.3	74.7	39.8	56.1	28.3
(26,31)	A010	5	181.7	28.5	74.7	39.8	56.0	28.3
(25,31)	A011	5	196.8	**42.7**	76.4	41.4	57.3	29.6
(25,31)	A012	5	197.2	**43.6**	76.4	41.5	57.4	29.6
(25,31)	A013	5	192.9	38.9	76.2	41.2	57.2	29.3
(25,31)	A015	5	193.8	**40.8**	76.2	41.3	57.3	29.4
(25,31)	A016	5	188.8	39.8	76.2	41.3	57.2	29.4
(25,30)	A017	5	189.3	**44.8**	79.5	43.0	59.7	30.6
(25,30)	A018	5	189.6	**45.3**	79.5	43.0	59.8	30.6
(25,30)	A019	5	187.9	**44.2**	79.4	43.0	59.7	30.6
(25,30)	A021	5	186.6	**43.1**	79.4	42.9	59.6	30.5
(25,30)	A023	5	192.3	**41.7**	79.4	42.9	59.6	30.5
(25,30)	A024	5	191.3	**41.4**	79.4	42.8	59.6	30.5
(25,30)	A025	5	187.1	**43.2**	79.5	42.9	59.7	30.5
(25,30)	A026	5	186.7	**42.6**	79.4	42.9	59.7	30.5
(25,30)	A027	5	184.9	**41.4**	79.3	42.8	59.6	30.4
(25,30)	A028	5	182.4	**40.5**	79.3	42.8	59.5	30.4
(25,30)	A029	5	186.9	**42.2**	79.4	42.9	59.6	30.5
(25,30)	A030	5	186.8	**41.4**	79.4	42.8	59.6	30.4
(25,30)	A031	5	186.3	**40.9**	79.3	42.8	59.6	30.4
(25,30)	A032	5	183.2	**58.9**	80.9	43.8	60.7	31.4
(25,30)	A033	5	183.7	**53.7**	80.0	43.4	60.2	31.0
(25,30)	A034	5	183.7	**54.6**	80.0	43.5	60.2	31.1
(25,30)	A035	20	182.7	**48.6**	79.5	43.2	59.7	30.7
(25,30)	A036	20	184.2	**49.1**	79.6	43.2	59.8	30.8
(25,31)	A037	5	188.4	**47.9**	76.9	41.6	57.7	29.7
(25,31)	A038	5	187.3	**45.7**	76.4	41.5	57.4	29.6
(25,31)	A039	5	187.3	**46.9**	76.5	41.6	57.5	29.7
(25,31)	A040	24.8	181.3	38.3	75.9	41.1	57.1	29.3
(25,31)	A041	51.4	180.3	33.1	75.6	40.9	56.8	29.1
(25,31)	A042	51.4	180.2	33.0	75.4	40.9	56.6	29.1
(25,31)	A043	5	185.4	**49.8**	76.7	41.7	57.6	29.8
(25,31)	A044	5	184.8	**47.2**	76.5	41.5	57.5	29.6
(25,31)	A045	5	185.6	**49.5**	76.7	41.6	57.6	29.7
(25,31)	A047	5	184.2	**47.5**	76.6	41.5	57.6	29.6
(25,31)	A048	5	196.2	**45.3**	76.2	41.7	57.2	29.8
(25,31)	A049	5	195.6	**44.9**	76.3	41.6	57.2	29.7
(25,31)	A050	5	196.5	**43.5**	76.3	41.5	57.3	29.6
(25,31)	A051	9	194.6	**43.1**	76.2	41.5	57.2	29.6
(25,31)	A052	11	186.1	**40.8**	75.9	41.3	57.0	29.4
(25,31)	A053	5	177.2	37.0	75.6	41.1	56.8	29.3
(25,31)	A056	5	187.8	37.2	75.8	41.1	57.0	29.3
(25,31)	A057	5	189.6	**40.4**	76.1	41.3	57.1	29.4
(25,31)	A058	8.6	178.1	35.0	75.5	41.0	56.7	29.2
(26,30)	A059	6.8	184.2	29.7	75.5	40.1	56.7	28.5
(25,30)	A060	5	191.6	**40.6**	79.3	42.8	59.6	30.4
(25,30)	A061	5	190.3	**40.6**	79.3	42.8	59.6	30.4

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,30)	A062	5	190.1	**40.9**	79.4	42.8	59.6	30.4
(25,30)	A063	5	195.5	**46.5**	80.1	43.2	60.3	30.7
(25,31)	A064	5	194.6	**42.9**	76.2	41.5	57.2	29.6
(25,31)	A065	5	187.4	38.6	75.9	41.2	57.0	29.3
(25,30)	A066	5	187.5	**43.7**	79.4	42.9	59.6	30.5
(25,30)	A067	5	187.5	**43.6**	79.4	42.9	59.6	30.5
(25,31)	A068	10	188.1	**40.3**	76.0	41.3	57.1	29.4
(25,31)	A069	5.3	189.4	**43.8**	76.2	41.4	57.3	29.5

Note:
[Bold] data has exceeded the AQO.

Table 3-11 Predicted Cumulative Air Pollutants Concentrations under "Without Project" Scenario at 10m above Ground in Year 2021

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A001	10	189.2	38.8	75.9	41.2	57.0	29.3
(25,31)	A003	10	185.4	37.7	75.8	41.1	57.0	29.3
(25,31)	A004	10	187.3	39.1	75.9	41.2	57.0	29.3
(25,31)	A005	24.9	180.6	35.2	75.7	41.0	56.8	29.2
(25,31)	A007	10	187.9	37.5	76.0	41.2	57.1	29.3
(26,31)	A008	10	182.9	29.4	74.7	39.8	56.1	28.3
(26,31)	A009	10	182.5	28.9	74.7	39.8	56.1	28.3
(26,31)	A010	10	181.5	28.1	74.6	39.8	56.0	28.3
(25,31)	A011	10	195.6	**41.2**	76.2	41.3	57.3	29.5
(25,31)	A012	10	195.5	**41.8**	76.3	41.4	57.3	29.5
(25,31)	A013	10	187.6	36.5	75.9	41.1	57.0	29.2
(25,31)	A015	10	188.0	38.8	76.0	41.2	57.1	29.3
(25,31)	A016	10	187.0	38.2	76.0	41.2	57.1	29.3
(25,30)	A017	10	186.9	**43.8**	79.4	42.9	59.6	30.5
(25,30)	A018	10	188.7	**43.8**	79.4	42.9	59.7	30.5
(25,30)	A019	10	186.7	**43.2**	79.3	42.9	59.6	30.5
(25,30)	A021	10	185.8	**42.3**	79.3	42.9	59.5	30.5
(25,30)	A023	10	192.2	**40.9**	79.4	42.8	59.6	30.4
(25,30)	A024	10	191.3	**40.8**	79.4	42.8	59.6	30.4
(25,30)	A025	10	186.8	**42.2**	79.4	42.9	59.6	30.5
(25,30)	A026	10	186.5	**41.7**	79.4	42.8	59.6	30.4
(25,30)	A027	10	183.6	**40.8**	79.3	42.8	59.5	30.4
(25,30)	A028	10	182.3	**40.3**	79.2	42.8	59.5	30.4
(25,30)	A029	10	186.4	**40.9**	79.3	42.8	59.6	30.4
(25,30)	A030	10	186.1	**40.4**	79.3	42.8	59.6	30.4
(25,30)	A031	10	185.0	**40.1**	79.3	42.8	59.5	30.4
(25,30)	A032	10	181.2	**55.6**	80.8	43.6	60.7	31.1
(25,30)	A033	10	183.3	**52.4**	79.9	43.4	60.1	30.9
(25,30)	A034	10	183.3	**53.2**	79.9	43.4	60.1	31.0
(25,30)	A035	25	181.1	**47.3**	79.4	43.1	59.6	30.7
(25,30)	A036	25	183.6	**47.4**	79.5	43.1	59.6	30.7
(25,31)	A037	10	183.5	**46.7**	76.7	41.5	57.7	29.6
(25,31)	A038	10	186.9	**44.1**	76.3	41.4	57.4	29.5
(25,31)	A039	10	186.7	**44.9**	76.4	41.5	57.4	29.6
(25,31)	A040	29.8	180.8	36.7	75.8	41.0	56.9	29.2
(25,31)	A041	56.4	181.0	33.0	75.6	40.9	56.8	29.1
(25,31)	A042	56.4	180.8	32.9	75.5	40.9	56.7	29.1
(25,31)	A043	10	183.6	**46.3**	76.4	41.5	57.5	29.6

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. ($\mu g/m^3$)		RSP Conc. ($\mu g/m^3$)		FSP Conc. ($\mu g/m^3$)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A044	10	183.6	**45.2**	76.3	41.4	57.4	29.5
(25,31)	A045	10	184.2	**47.1**	76.5	41.5	57.5	29.6
(25,31)	A047	10	182.9	**45.3**	76.4	41.4	57.5	29.5
(25,31)	A048	10	194.7	**43.5**	76.2	41.6	57.2	29.7
(25,31)	A049	10	189.9	**42.4**	76.1	41.4	57.2	29.5
(25,31)	A050	10	191.4	**42.0**	76.1	41.4	57.2	29.5
(25,31)	A051	14	187.8	**40.4**	76.0	41.3	57.1	29.4
(25,31)	A052	16	185.2	38.4	75.7	41.2	56.9	29.3
(25,31)	A053	10	177.2	35.9	75.6	41.1	56.7	29.2
(25,31)	A056	10	179.4	35.8	75.7	41.0	56.8	29.2
(25,31)	A057	10	188.8	38.8	75.9	41.2	57.1	29.3
(25,31)	A058	13.6	178.1	34.6	75.4	41.0	56.6	29.1
(26,30)	A059	11.8	184.2	29.6	75.5	40.1	56.7	28.5
(25,30)	A060	10	191.2	**40.2**	79.3	42.8	59.5	30.4
(25,30)	A061	10	190.4	**40.2**	79.3	42.8	59.6	30.4
(25,30)	A062	10	188.4	**40.3**	79.3	42.8	59.6	30.4
(25,30)	A063	10	193.8	**45.4**	79.9	43.1	60.2	30.7
(25,31)	A064	10	191.2	**41.5**	76.1	41.4	57.2	29.5
(25,31)	A065	10	186.8	37.7	75.8	41.1	57.0	29.3
(25,30)	A066	10	187.0	**42.6**	79.3	42.9	59.6	30.5
(25,30)	A067	10	187.0	**42.4**	79.3	42.9	59.5	30.5
(25,31)	A068	15	179.8	38.4	75.8	41.2	57.0	29.3
(25,31)	A069	10.3	187.6	**40.8**	76.0	41.3	57.1	29.4

Note:
[Bold] data has exceeded the AQO.

3.6.59 Among the concerned air pollutants under this study, annual average NO_2 is concluded to be the only parameter which exceeds the AQO at the worst assessment year (Year 2021) under "Without Project" scenario. In order to investigate the contribution proportion from background air quality, open road vehicular emission, as well as industrial emission to the cumulative annual average NO_2 concentration at each ASR, breakdown of modelling results of PATH, CALINE4 and ISCST3 are summarised in **Table 3-12** below. Detailed contribution breakdown table for all air pollutants (NO_2, RSP and FSP) are presented in **Appendix 3-9**.

3.6.60 Annual average NO_2 concentration at most of the identified ASRs in this Project is dominated by background air pollutant level (i.e. by PATH model). Marine emission is the main contributor for the high background level in most areas. It is considered in the PATH model in a conservative way, assuming to be no reduction from Year 2021 to 2036. The Open road vehicular emission (by CALINE4) also provide noticeable contribution to the cumulative annual NO_2 concentration at some ASRs (ASRs A032 – A036), due to higher proportion of heavy vehicles travelling on the nearby Container Port Road in the close vicinity to the KCCT area. Contribution from industrial emission (by ISCST3) is relatively insignificant in this region.

Table 3-12 Breakdown of Total NO_2 Annual Average Concentration under "Without Project" Scenario in Year 2021

Grid	Height Above Ground (m)	ASR		Total NO_2 Annual Average Concentration ($\mu g/m^3$)	Breakdown of Impact		
					Background Emission ($\mu g/m^3$)	Road Emission ($\mu g/m^3$)	Chimney Emission ($\mu g/m^3$)
(25,30)	1.5	Min	A028 (China Holiness College)	**40.66**	38.66	1.99	0.02
		Max	A032 (Mariners' Club)	**61.06**	38.66	22.38	0.02
	5	Min	A028 (China Holiness College)	**40.49**	38.66	1.81	0.02
		Max	A032 (Mariners' Club)	**58.90**	38.66	20.23	0.02
	10	Min	A031 (Asbury Methodist Primary School)	**40.12**	38.66	1.45	0.01
		Max	A032 (Mariners' Club)	**55.58**	38.66	16.90	0.02
(25,31)	1.5	Min	A042 (Ever Gain Plaza Tower 2)	33.18	29.77	3.18	0.23
		Max	A043 (Kwai Shun Industrial Centre North Tower)	**53.23**	29.77	23.35	0.11
	5	Min	A042 (Ever Gain Plaza Tower 2)	33.01	29.77	3.01	0.24
		Max	A043 (Kwai Shun Industrial Centre North Tower)	**49.77**	29.77	19.89	0.11
	10	Min	A042 (Ever Gain Plaza Tower 2)	32.94	29.77	2.94	0.23
		Max	A045 (Kwai Shun Street Cooked Food Market)	**47.10**	29.77	17.02	0.32

Notes:
No exceedance at Grid (26,30) and (26,31)
Exceedance of AQO has been **Bold**.

Study of Air Quality for "Without Project" Scenario in Selected Assessment Years from 2021 to 2036

3.6.61 In previous section, prevailing air quality impact at the worst-year 2021 associated with this Project has been studied. Exceedance of annual NO_2 occurs at a number of ASRs. In order to investigate the future prevailing air quality conditions and the tendency of cumulative results across the 15-year assessment year, further study at Year 2029 and 2036 have been conducted.

3.6.62 The predicted prevailing air quality results of Year 2021, 2029 and 2036 demonstrate that concentrations for all pollutants are well within AQOs except the annual NO_2 concentration which exceeds the AQO limit of 40$\mu g/m^3$ for some ASRs. Detailed simulation results of NO_2 for these three years are listed in **Appendix 3-10**. Contour plots of NO_2 are presented in **Figure 3.17 to Figure 3.20.**

3.6.63 Despite the exceedance of annual NO_2 concentration in the three selected years, the overall air quality situation is gradually improving as years forward, which can be observed from increasing number of ASRs complying with the AQO, as shown in **Table 3-13**.

3.6.64 In Year 2036, ASRs identified with predicted exceedance of annual NO_2 concentrations mainly locate in the PATH grids (25, 30) and (25, 31), which are near the KCCT. This corresponds with the observation above that air pollution contributed by the marine emissions associated with KCCT operation shall persist, while contribution by the vehicular and industrial emissions shall be eventually reduced.

Table 3-13 Numbers of Predicted Annual Average NO_2 Concentration in Compliance of AQOs under "Without Project" Scenario in Different Grids

Grid	No. of ASRs Assessed in Corresponding Grid	Heights (m)	No. of ASRs in Compliance of AQOs in Annual Average NO_2 Concentration under "Without Project" Scenario		
			2021	2029	2036
(25,30)	26	1.5	0	0	5
	24	5	0	0	8
	24	10	0	6	10
(25,31)	38	1.5	10	17	37
	33	5	13	19	33
	33	10	18	25	33
(26,30)	1	1.5	1	1	1
	1	5	1	1	1
	1	10	1	1	1
(26,31)	3	1.5	3	3	3
	3	5	3	3	3
	3	10	3	3	3

Cumulative Impact for "With Project" Scenario in Year 2021

3.6.65 In view of the fact that Year 2021 is concluded to be the worst assessment year across the 15 years upon commencement of operation of the Project, and also due to the continuous air quality improving trend when years forward, cumulative air quality impact under "With Project" scenario has been conducted in Year 2021.

3.6.66 Cumulative results incorporating air quality impacts estimated from CALINE4, ISCST3 and PATH background results at different levels (i.e. 1.5m, 5m and 10m above ground) under "With Project" scenario at Year 2021 are presented in **Table 3-14** to **Table 3-16**. Detailed results for separated grids in different levels are presented in **Appendix 3-11**.

3.6.67 Similar to the "Without Project" scenario, no exceedances of 1-hour NO_2, daily RSP and FSP, as well as annual average RSP and FSP at all ASRs within the four grids under "With Project" scenario was identified. Only exceedances of annual average NO_2 at some ASRs were identified at 1.5m, 5m and 10m levels in Grid (25, 30) and Grid (25, 31), and no exceedance in Grid (26, 30) and Grid (26, 31). The largest exceedance of annual NO_2 was again observed at ASR A032, i.e. Mariners' Club.

3.6.68 Contour plots under "With Project" scenario at 1.5m and 10m above ground for the hourly and annual average NO_2, the daily and annual average RSP, and the daily and annual average FSP are shown in **Figure 3.21** to **Figure 3.38**.

Table 3-14 Predicted Cumulative Air Pollutants Concentrations under "With Project" Scenario at 1.5m above Ground in Year 2021

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. ($\mu g/m^3$)		RSP Conc. ($\mu g/m^3$)		FSP Conc. ($\mu g/m^3$)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A001	1.5	191.1	**40.8**	76.0	41.3	57.1	29.5
(25,31)	A003	1.5	188.7	39.6	75.9	41.2	57.1	29.3
(25,31)	A004	1.5	187.6	**46.4**	76.2	41.5	57.3	29.6
(25,31)	A005	16.4	187.8	37.3	75.8	41.1	56.9	29.3
(25,31)	A006	1.5	190.0	**49.7**	76.4	41.7	57.3	29.8
(25,31)	A007	1.5	196.6	**42.7**	76.4	41.5	57.4	29.6
(26,31)	A008	1.5	182.8	30.4	74.7	39.9	56.1	28.4
(26,31)	A009	1.5	182.7	29.5	74.7	39.8	56.1	28.3
(26,31)	A010	1.5	181.7	28.8	74.7	39.8	56.1	28.3
(25,31)	A011	1.5	197.3	**43.3**	76.4	41.5	57.4	29.6
(25,31)	A012	1.5	198.3	**44.3**	76.5	41.6	57.4	29.7
(25,31)	A013	1.5	197.0	**42.0**	76.3	41.4	57.3	29.5
(25,31)	A014	1.5	193.7	**43.5**	76.5	41.3	57.5	29.5
(25,31)	A015	1.5	194.6	**41.8**	76.2	41.3	57.3	29.5
(25,31)	A016	1.5	193.0	**40.9**	76.3	41.4	57.2	29.5
(25,30)	A017	1.5	190.4	**45.4**	79.6	43.0	59.8	30.6
(25,30)	A018	1.5	191.0	**46.2**	79.6	43.1	59.8	30.6
(25,30)	A019	1.5	189.1	**44.8**	79.5	43.0	59.7	30.6
(25,30)	A020	1.5	188.0	**43.8**	79.4	42.9	59.6	30.5
(25,30)	A021	1.5	186.8	**43.6**	79.4	42.9	59.6	30.5
(25,30)	A023	1.5	192.1	**42.2**	79.4	42.9	59.7	30.5
(25,30)	A024	1.5	191.2	**41.7**	79.4	42.9	59.6	30.5
(25,30)	A025	1.5	187.7	**43.9**	79.5	43.0	59.8	30.6
(25,30)	A026	1.5	187.7	**43.3**	79.5	42.9	59.8	30.5
(25,30)	A027	1.5	186.5	**41.9**	79.4	42.8	59.6	30.5
(25,30)	A028	1.5	183.7	**40.7**	79.3	42.8	59.5	30.4
(25,30)	A029	1.5	187.3	**43.4**	79.5	42.9	59.7	30.5
(25,30)	A030	1.5	187.0	**42.2**	79.4	42.8	59.7	30.5
(25,30)	A031	1.5	186.4	**41.6**	79.4	42.8	59.6	30.4
(25,30)	A032	1.5	186.2	**61.0**	81.0	44.0	60.8	31.5
(25,30)	A033	1.5	183.7	**54.1**	80.0	43.5	60.2	31.0
(25,30)	A034	1.5	183.7	**55.1**	80.0	43.5	60.2	31.1
(25,30)	A035	16.5	183.7	**49.4**	79.6	43.2	59.8	30.8
(25,30)	A036	16.5	184.4	**50.3**	79.7	43.3	59.9	30.8
(25,31)	A037	1.5	189.1	**50.4**	77.0	41.7	57.9	29.8
(25,31)	A038	1.5	187.4	**47.6**	76.5	41.6	57.5	29.7
(25,31)	A039	1.5	188.4	**48.7**	76.6	41.7	57.5	29.8
(25,31)	A040	21.3	181.7	39.6	76.0	41.2	57.1	29.3
(25,31)	A041	47.9	180.1	33.2	75.6	40.9	56.8	29.1
(25,31)	A042	47.9	179.9	33.2	75.4	40.9	56.6	29.1
(25,31)	A043	1.5	186.8	**53.2**	76.9	41.9	57.8	30.0
(25,31)	A044	1.5	185.7	**49.0**	76.7	41.6	57.6	29.7
(25,31)	A045	1.5	185.8	**49.2**	76.6	41.6	57.6	29.7
(25,31)	A046	1.5	185.7	**48.7**	76.6	41.6	57.5	29.7
(25,31)	A047	1.5	185.3	**48.8**	76.7	41.6	57.6	29.7
(25,31)	A048	1.5	196.6	**44.8**	76.2	41.6	57.2	29.7
(25,31)	A049	1.5	196.6	**47.0**	76.3	41.7	57.3	29.8
(25,31)	A050	1.5	197.4	**44.1**	76.3	41.6	57.3	29.7
(25,31)	A051	5.5	197.6	**44.8**	76.3	41.6	57.3	29.7
(25,31)	A052	7.5	186.7	**42.6**	76.0	41.4	57.2	29.5
(25,31)	A053	1.5	177.2	37.6	75.7	41.2	56.8	29.3
(25,31)	A054	1.5	184.9	38.8	75.9	41.3	57.0	29.4
(25,31)	A055	1.5	187.4	**45.0**	76.1	41.6	57.1	29.7

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A056	1.5	189.3	38.3	75.9	41.2	57.1	29.3
(25,31)	A057	1.5	191.8	**41.9**	76.2	41.4	57.1	29.6
(25,31)	A058	5.1	178.1	35.2	75.5	41.0	56.7	29.2
(26,30)	A059	3.3	184.4	29.7	75.5	40.1	56.7	28.5
(25,30)	A060	1.5	192.0	**40.8**	79.4	42.8	59.6	30.4
(25,30)	A061	1.5	190.3	**41.0**	79.4	42.8	59.6	30.4
(25,30)	A062	1.5	190.6	**41.3**	79.4	42.8	59.6	30.4
(25,30)	A063	1.5	196.7	**46.8**	80.2	43.2	60.3	30.8
(25,31)	A064	1.5	194.7	**43.8**	76.2	41.5	57.2	29.6
(25,31)	A065	1.5	187.6	38.9	75.9	41.2	57.1	29.3
(25,30)	A066	1.5	188.3	**44.4**	79.4	43.0	59.6	30.6
(25,30)	A067	1.5	187.9	**44.2**	79.4	42.9	59.6	30.5
(25,31)	A068	6.5	188.6	**41.8**	76.1	41.3	57.2	29.5
(25,31)	A069	1.8	190.6	**46.2**	76.3	41.5	57.3	29.7
(25,30)	A070	1.5	188.9	**42.1**	79.5	42.9	59.7	30.5

Note: Exceedances of AQO are made **bold**.

Table 3-15 Predicted Cumulative Air Pollutants Concentrations under "With Project" Scenario at 5m above Ground in Year 2021

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A001	5	190.6	**40.2**	76.0	41.3	57.1	29.4
(25,31)	A003	5	188.1	39.1	75.9	41.2	57.0	29.3
(25,31)	A004	5	187.5	**43.1**	76.1	41.3	57.2	29.5
(25,31)	A005	19.9	184.4	36.2	75.7	41.1	56.9	29.2
(25,31)	A007	5	192.2	39.9	76.3	41.3	57.2	29.4
(26,31)	A008	5	182.9	30.1	74.7	39.9	56.1	28.3
(26,31)	A009	5	182.6	29.3	74.7	39.8	56.1	28.3
(26,31)	A010	5	181.6	28.5	74.7	39.8	56.0	28.3
(25,31)	A011	5	196.8	**42.7**	76.4	41.4	57.3	29.5
(25,31)	A012	5	197.3	**43.5**	76.4	41.5	57.4	29.6
(25,31)	A013	5	192.4	38.9	76.2	41.2	57.2	29.3
(25,31)	A015	5	193.6	**40.7**	76.2	41.3	57.3	29.4
(25,31)	A016	5	188.9	39.8	76.2	41.3	57.2	29.4
(25,30)	A017	5	189.5	**44.7**	79.5	43.0	59.7	30.6
(25,30)	A018	5	189.5	**45.3**	79.5	43.0	59.8	30.6
(25,30)	A019	5	187.9	**44.1**	79.4	43.0	59.7	30.6
(25,30)	A021	5	186.6	**43.0**	79.3	42.9	59.6	30.5
(25,30)	A023	5	192.3	**41.7**	79.4	42.9	59.6	30.5
(25,30)	A024	5	191.2	**41.4**	79.4	42.8	59.6	30.5
(25,30)	A025	5	187.1	**43.2**	79.5	42.9	59.7	30.5
(25,30)	A026	5	186.7	**42.6**	79.4	42.9	59.7	30.5
(25,30)	A027	5	184.9	**41.4**	79.3	42.8	59.6	30.4
(25,30)	A028	5	182.4	**40.5**	79.3	42.8	59.5	30.4
(25,30)	A029	5	186.9	**42.2**	79.4	42.9	59.6	30.5
(25,30)	A030	5	186.8	**41.4**	79.4	42.8	59.6	30.4
(25,30)	A031	5	186.2	**40.9**	79.3	42.8	59.6	30.4
(25,30)	A032	5	183.2	**58.9**	80.9	43.8	60.7	31.3
(25,30)	A033	5	183.7	**53.7**	80.0	43.4	60.2	31.0
(25,30)	A034	5	183.7	**54.6**	80.0	43.5	60.2	31.1
(25,30)	A035	20	182.7	**48.5**	79.5	43.2	59.7	30.7
(25,30)	A036	20	184.2	**49.1**	79.6	43.2	59.8	30.8
(25,31)	A037	5	188.4	**47.9**	76.9	41.6	57.7	29.7

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A038	5	187.3	**45.6**	76.4	41.5	57.4	29.6
(25,31)	A039	5	187.3	**46.9**	76.5	41.6	57.5	29.7
(25,31)	A040	24.8	181.3	38.2	75.9	41.1	57.1	29.3
(25,31)	A041	51.4	180.2	33.0	75.6	40.9	56.8	29.1
(25,31)	A042	51.4	180.2	33.0	75.4	40.9	56.6	29.1
(25,31)	A043	5	185.4	**49.7**	76.7	41.7	57.6	29.8
(25,31)	A044	5	184.8	**47.2**	76.5	41.5	57.5	29.6
(25,31)	A045	5	185.6	**49.5**	76.7	41.6	57.6	29.7
(25,31)	A047	5	184.2	**47.5**	76.6	41.5	57.6	29.6
(25,31)	A048	5	196.2	**45.3**	76.2	41.7	57.2	29.8
(25,31)	A049	5	195.6	**44.9**	76.3	41.6	57.2	29.7
(25,31)	A050	5	196.5	**43.5**	76.3	41.5	57.3	29.6
(25,31)	A051	9	194.6	**43.1**	76.2	41.5	57.2	29.6
(25,31)	A052	11	186.1	**40.8**	75.9	41.3	57.0	29.4
(25,31)	A053	5	177.2	37.0	75.6	41.1	56.8	29.3
(25,31)	A056	5	187.8	37.2	75.8	41.1	57.0	29.3
(25,31)	A057	5	189.6	**40.4**	76.1	41.3	57.1	29.4
(25,31)	A058	8.6	178.1	35.0	75.5	41.0	56.7	29.2
(26,30)	A059	6.8	184.2	29.7	75.5	40.1	56.7	28.5
(25,30)	A060	5	191.6	**40.6**	79.3	42.8	59.6	30.4
(25,30)	A061	5	190.3	**40.6**	79.3	42.8	59.6	30.4
(25,30)	A062	5	190.1	**40.9**	79.4	42.8	59.6	30.4
(25,30)	A063	5	195.5	**46.4**	80.1	43.2	60.3	30.7
(25,31)	A064	5	194.6	**42.9**	76.2	41.5	57.2	29.6
(25,31)	A065	5	187.4	38.6	75.9	41.2	57.0	29.3
(25,30)	A066	5	187.5	**43.7**	79.4	42.9	59.6	30.5
(25,30)	A067	5	187.4	**43.5**	79.4	42.9	59.6	30.5
(25,31)	A068	10	188.1	**40.3**	76.0	41.3	57.1	29.4
(25,31)	A069	5.3	189.4	**43.8**	76.2	41.4	57.3	29.5

Note: Exceedances of AQO are made **bold**.

Table 3-16 Predicted Cumulative Air Pollutants Concentrations under "With Project" Scenario at 10m above Ground in Year 2021

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,31)	A001	10	189.2	38.8	75.9	41.2	57.0	29.3
(25,31)	A003	10	185.4	37.7	75.8	41.1	57.0	29.3
(25,31)	A004	10	187.3	39.1	75.9	41.2	57.0	29.3
(25,31)	A005	24.9	180.6	35.1	75.7	41.0	56.8	29.2
(25,31)	A007	10	187.9	37.5	76.0	41.2	57.1	29.3
(26,31)	A008	10	182.8	29.4	74.7	39.8	56.1	28.3
(26,31)	A009	10	182.4	28.9	74.7	39.8	56.1	28.3
(26,31)	A010	10	181.4	28.1	74.6	39.8	56.0	28.3
(25,31)	A011	10	194.6	**41.1**	76.2	41.3	57.3	29.5
(25,31)	A012	10	195.3	**41.8**	76.3	41.4	57.3	29.5
(25,31)	A013	10	187.4	36.4	75.9	41.1	57.0	29.2
(25,31)	A015	10	187.8	38.7	76.0	41.2	57.1	29.3
(25,31)	A016	10	186.9	38.2	76.0	41.2	57.1	29.3
(25,30)	A017	10	186.9	**43.7**	79.4	42.9	59.6	30.5
(25,30)	A018	10	188.5	**43.8**	79.4	42.9	59.7	30.5
(25,30)	A019	10	186.7	**43.2**	79.3	42.9	59.6	30.5
(25,30)	A021	10	185.8	**42.3**	79.3	42.9	59.5	30.5
(25,30)	A023	10	192.2	**40.9**	79.4	42.8	59.6	30.4

Grid	ASR ID	Height above Ground (m)	NO_2 Conc. (μg/m³)		RSP Conc. (μg/m³)		FSP Conc. (μg/m³)	
			19th Max. 1-hour	Annual	10th Daily	Annual	10th Daily	Annual
(25,30)	A024	10	191.2	**40.8**	79.4	42.8	59.6	30.4
(25,30)	A025	10	186.8	**42.2**	79.4	42.9	59.6	30.5
(25,30)	A026	10	186.5	**41.7**	79.3	42.8	59.6	30.4
(25,30)	A027	10	183.6	**40.8**	79.3	42.8	59.5	30.4
(25,30)	A028	10	182.3	**40.2**	79.2	42.8	59.5	30.4
(25,30)	A029	10	186.4	**40.9**	79.3	42.8	59.6	30.4
(25,30)	A030	10	186.0	**40.4**	79.3	42.8	59.6	30.4
(25,30)	A031	10	185.0	**40.1**	79.3	42.8	59.5	30.4
(25,30)	A032	10	181.2	**55.5**	80.8	43.6	60.7	31.1
(25,30)	A033	10	183.3	**52.3**	79.9	43.4	60.1	30.9
(25,30)	A034	10	183.2	**53.1**	79.9	43.4	60.1	31.0
(25,30)	A035	25	181.1	**47.2**	79.4	43.1	59.6	30.7
(25,30)	A036	25	183.6	**47.3**	79.5	43.1	59.6	30.7
(25,31)	A037	10	183.5	**46.7**	76.7	41.5	57.7	29.6
(25,31)	A038	10	186.9	**44.0**	76.3	41.4	57.4	29.5
(25,31)	A039	10	186.7	**44.9**	76.4	41.5	57.4	29.6
(25,31)	A040	29.8	180.8	36.6	75.8	41.0	56.9	29.2
(25,31)	A041	56.4	181.0	33.0	75.6	40.9	56.8	29.1
(25,31)	A042	56.4	180.8	32.9	75.5	40.9	56.7	29.1
(25,31)	A043	10	183.6	**46.3**	76.4	41.5	57.5	29.6
(25,31)	A044	10	183.6	**45.1**	76.3	41.4	57.4	29.5
(25,31)	A045	10	184.2	**47.1**	76.5	41.5	57.5	29.6
(25,31)	A047	10	182.9	**45.3**	76.4	41.4	57.5	29.5
(25,31)	A048	10	194.7	**43.5**	76.2	41.6	57.2	29.7
(25,31)	A049	10	189.9	**42.4**	76.1	41.4	57.2	29.5
(25,31)	A050	10	191.4	**42.0**	76.1	41.4	57.2	29.5
(25,31)	A051	14	187.8	**40.4**	76.0	41.3	57.1	29.4
(25,31)	A052	16	185.2	38.4	75.7	41.2	56.9	29.3
(25,31)	A053	10	177.2	35.9	75.6	41.1	56.7	29.2
(25,31)	A056	10	179.4	35.8	75.7	41.0	56.8	29.2
(25,31)	A057	10	188.8	38.8	75.9	41.2	57.1	29.3
(25,31)	A058	13.6	178.1	34.6	75.4	41.0	56.6	29.1
(26,30)	A059	11.8	184.0	29.6	75.5	40.1	56.7	28.5
(25,30)	A060	10	191.2	**40.2**	79.3	42.8	59.5	30.4
(25,30)	A061	10	190.4	**40.2**	79.3	42.8	59.6	30.4
(25,30)	A062	10	188.4	**40.3**	79.3	42.8	59.6	30.4
(25,30)	A063	10	193.6	**45.4**	79.9	43.1	60.2	30.7
(25,31)	A064	10	191.2	**41.5**	76.1	41.4	57.2	29.5
(25,31)	A065	10	186.8	37.7	75.8	41.1	57.0	29.3
(25,30)	A066	10	187.0	**42.6**	79.3	42.9	59.5	30.5
(25,30)	A067	10	186.9	**42.4**	79.3	42.9	59.5	30.5
(25,31)	A068	15	179.8	38.4	75.8	41.2	57.0	29.3
(25,31)	A069	10.3	187.6	**40.8**	76.0	41.3	57.1	29.4

Note: Exceedances of AQO are made **bold**.

3.6.69 Similar to "Without Project" scenario, breakdown modelling results conducted by PATH model, CALINE4 and ISCST3 under "With Project" scenario are summarised in **Table 3-17** below. Detailed contribution breakdown table for all studied air pollutants (NO_2, RSP and FSP) are presented in **Appendix 3-12**.

3.6.70 From the table below, annual average NO_2 concentration at most ASRs under "With Project" scenario is also dominated by background air quality level (i.e. by PATH model), which is similar to "Without Project" scenario. Open road vehicular emission (by CALINE4) also results in high levels of NO_2 at some ASRs (e.g. ASRs A032 – A036), due

to higher proportion of heavy vehicles passing by the nearby Container Port Road in the close vicinity of the KCCT area. Contribution from industrial emission (by ISCST3) in this region is relatively insignificant.

Table 3-17 Breakdown of Total NO_2 Annual Average Concentration under "With Project" Scenario in Year 2021

Grid	Height Above Ground (m)	ASR	Total NO_2 Annual Average Concentration ($\mu g/m^3$)	Breakdown of Impact		
				Background Emission ($\mu g/m^3$)	Road Emission ($\mu g/m^3$)	Chimney Emission ($\mu g/m^3$)
(25,30)	1.5	Min. at A028 (China Holiness College)	**40.65**	38.66	1.98	0.02
		Max. at A032 (Mariners' Club)	**61.02**	38.66	22.35	0.02
	5	Min. at A028 (China Holiness College)	**40.48**	38.66	1.81	0.02
		Max. at A032 (Mariners' Club)	**58.87**	38.66	20.20	0.02
	10	Min. at A031 (Asbury Methodist Primary School)	**40.12**	38.66	1.44	0.01
		Max. at A032 (Mariners' Club)	**55.58**	38.66	16.87	0.02
(25,31)	1.5	Min. at A042 (Ever Gain Plaza Tower 2)	33.15	29.77	3.15	0.23
		Max. at A043 (Kwai Shun Industrial Centre North Tower)	**53.20**	29.77	23.32	0.11
	5	Min. at A042 (Ever Gain Plaza Tower 2)	32.99	29.77	2.98	0.24
		Max. at A043 (Kwai Shun Industrial Centre North Tower)	**49.74**	29.77	19.86	0.11
(25,31)	10	Min. at A042 (Ever Gain Plaza Tower 2)	32.91	29.77	2.92	0.23
		Max. at A045 (Kwai Shun Street Cooked Food Market)	**47.08**	29.77	17.00	0.32

Notes:
No exceedance at Grid (26,30) and (26,31)
Exceedance of AQO has been **Bold**.

Comparison of Annual Average NO_2 Concentrations between "With Project" and "Without Project" Scenarios in Year 2021

3.6.71 As concluded in the above discussion, annual average NO_2 concentration in Grid (25, 30) and Grid (25, 31) is the only parameter exceeding the AQO under both "Without Project" and "With Project" scenarios. Exceedance at most of the ASRs is dominated by the high background air quality concentration in Kwai Chung area, with respect to the marine emission and KCCT operation. Open-road vehicular emissions also provide noticeable contribution to some in-land ASRs.

3.6.72 In order to investigate whether the operation of the Project will provide any adverse impact to the prevailing air quality conditions, annual average NO_2 concentration has been compared between "Without Project" and "With Project" scenarios, as tabulated into **Table 3-18**. Detailed comparison can be referred to **Appendix 3-13**.

Table 3-18 Difference of Annual Average NO_2 between "Without Project" and "With Project" Scenarios in Year 2021

Grid	ASR ID	Representative ASRs Description	Difference of Annual Average NO_2 Conc. ($\mu g/m^3$) between "Without Project" and "With Project" scenarios		
			1.5m	5m	10m
(25, 31)	A001	Kwai Tsing Theatre	-0.005	-0.005	-0.006
(25, 31)	A003	Kwai Tsing District Police Headquarters & Divisional Police Station	-0.011	-0.01	-0.011
(25, 31)	A004	Proposed Residential (Group E) 1 Development at Ex-Kwai Chung Police Married Quarters at Kwai Yi Road	-0.011	-0.012	-0.014
(25, 31)	A005	Kwai Fong Terrace Block 2	-0.023	-0.024	-0.026
(25, 31)	A006	Kwai Yi Road Playground & Sports Ground	-0.016	-	-
(25, 31)	A007	Tin Hau Temple	-0.007	-0.01	-0.015
(26, 31)	A008	Lai Yiu Estate Fu Yiu House	-0.020	-0.02	-0.018
(26, 31)	A009	TWGHs Ko Ho Ning Memorial Primary School	-0.013	-0.012	-0.011
(26, 31)	A010	Kwai Chung Methodist College	-0.007	-0.007	-0.006
(25, 31)	A011	Lingnam Dr. Chung Wing Kwong Memorial Secondary School	-0.071	-0.072	-0.077
(25, 31)	A012	Lai King Catholic Secondary School	-0.087	-0.093	-0.092
(25, 31)	A013	Ho Kwai Chung Polyclinic & Special Education Services Centre	-0.023	-0.039	-0.046
(25, 31)	A014	Lai King Hill Road North Sitting-out Area	-0.036	-	-
(25, 31)	A015	Lai King Estate Wo King House	-0.092	-0.075	-0.052
(25, 31)	A016	Lai King Estate Fung King House	-0.078	-0.028	-0.005
(25, 30)	A017	Lai King Estate Ming King House	-0.033	-0.028	-0.024
(25, 30)	A018	Lai King Estate Yat King House	-0.034	-0.029	-0.021
(25, 30)	A019	HKEAA Lai King Assessment Centre	-0.029	-0.026	-0.022
(25, 30)	A020	Lai King Restaurant Playground	-0.021	-	-
(25, 30)	A021	Lai King Restaurant	-0.024	-0.022	-0.018
(25, 30)	A023	Yuet Lai Court - Lai Hung House (Block D)	-0.004	-0.004	-0.004
(25, 30)	A024	Yuet Lai Court - Lai Wah House (Block B)	-0.004	-0.004	-0.003
(25, 30)	A025	Lai King Estate - Yeung King House	-0.013	-0.012	-0.011
(25, 30)	A026	Lai King Estate - On King House	-0.014	-0.013	-0.011
(25, 30)	A027	Lai King Estate - Flatted Factories	-0.012	-0.011	-0.01
(25, 30)	A028	China Holiness College	-0.008	-0.008	-0.008
(25, 30)	A029	OUHK CITA Learning Centre	-0.005	-0.005	-0.005
(25, 30)	A030	Lai King Community Hall	-0.004	-0.004	-0.004
(25, 30)	A031	Asbury Methodist Primary School	-0.003	-0.003	-0.003
(25, 30)	A032	Mariners' Club	-0.031	-0.032	-0.031
(25, 30)	A033	Container Terminal 2 Office	-0.045	-0.045	-0.046
(25, 30)	A034	Container Terminal 2 Workshop	-0.046	-0.047	-0.051
(25, 30)	A035	Container Terminal 5 Administration Building	-0.053	-0.057	-0.063
(25, 30)	A036	Container Terminal 5 Godown	-0.051	-0.055	-0.062
(25, 31)	A037	Container Terminal 5 Office	-0.028	-0.029	-0.031
(25, 31)	A038	Fidelity Godown	-0.037	-0.04	-0.04
(25, 31)	A039	Kerry (Kwai Chung) Godown	-0.054	-0.055	-0.059
(25, 31)	A040	Cargo Consolidation Complex	-0.079	-0.079	-0.079
(25, 31)	A041	Ever Gain Plaza Tower 1	-0.058	-0.049	-0.039
(25, 31)	A042	Ever Gain Plaza Tower 2	-0.029	-0.025	-0.021
(25, 31)	A043	Kwai Shun Industrial Centre North Tower	-0.029	-0.034	-0.04
(25, 31)	A044	Golden Industrial Building	-0.022	-0.023	-0.025
(25, 31)	A045	Kwai Shun Street Cooked Food Market	-0.012	-0.013	-0.015
(25, 31)	A046	Kwai Shun Street Playground	-0.007	-	-
(25, 31)	A047	Kwai Tak Industrial Building Block 2	-0.009	-0.01	-0.012
(25, 31)	A048	Profit Industrial Building	-0.006	-0.006	-0.008
(25, 31)	A049	Join-in Hang Sing Centre	-0.010	-0.012	-0.014

Grid	ASR ID	Representative ASRs Description	Difference of Annual Average NO_2 Conc. ($\mu g/m^3$) between "Without Project" and "With Project" scenarios		
			1.5m	5m	10m
(25, 31)	A050	Petrol Station Office at Container Port Road	-0.022	-0.022	-0.022
(25, 31)	A051	Marvel Industrial Building Block B	-0.004	-0.005	-0.006
(25, 31)	A052	Wing Hang Industrial Building	-0.003	-0.003	-0.004
(25, 31)	A053	Kwai Shing Swimming Pool	-0.002	-0.002	-0.002
(25, 31)	A054	Hing Shing Road Basketball Court	-0.002	-	-
(25, 31)	A055	Kwai Chung Sports Ground	-0.002	-	-
(25, 31)	A056	Kwai Chung Plaza Block 1	-0.003	-0.004	-0.004
(25, 31)	A057	New Kwai Fong Gardens Block A	-0.009	-0.011	-0.013
(25, 31)	A058	Hibiscus Park Block 2	-0.002	-0.003	-0.003
(26, 30)	A059	Highland Park Block 6	-0.004	-0.004	-0.003
(25, 30)	A060	Cho Yiu Chuen Kai Min Lau	-0.002	-0.002	-0.002
(25, 30)	A061	Cho Yiu Chuen Kai Hang Lau	-0.002	-0.002	-0.002
(25, 30)	A062	Cho Yiu Chuen Chung Ling Sheh	-0.003	-0.003	-0.003
(25, 30)	A063	Lai King Estate - Lok King House (Block 7)	-0.014	-0.014	-0.013
(25, 31)	A064	Wing Hong Factory Building	-0.005	-0.006	-0.007
(25, 31)	A065	Metroplaza Tower 2	-0.005	-0.004	-0.005
(25, 30)	A066	Yin Lai Court - Yin Kwong House (Block A)	-0.019	-0.017	-0.013
(25, 30)	A067	Yin Lai Court - Yin Tak House (Block B)	-0.017	-0.015	-0.012
(25, 31)	A068	Wah Fung Industrial Centre	-0.005	-0.005	-0.007
(25, 31)	A069	Fook Yip Building	-0.008	-0.01	-0.012
(25, 30)	A070	Lai King Sports Centre	-0.009	-	-

3.6.73 As concluded from the above Tables, the differences between "Without Project" and "With Project" range from -0.002 $\mu g/m^3$ (at ASRs A055 at 1.5m) to -0.093 $\mu g/m^3$ (at ASR A012 at 5m) at Grid (25, 31). All comparison results yield negative data, which indicates that air quality improvement could be expected under "With Project" scenario. This modelling result is consistent with the re-disturbed traffic volume of affected trunk road sections as shown in **Table 3-4**.

3.6.74 Considering the environmental benefit in terms of air quality improvement in NO_2 with this Project at the worst-case year (2021), and also the continuous improvement of air quality conditions from Year 2021 to 2036, it can be concluded that no adverse air quality impact of NO_2 shall be imposed with this Project.

3.6.75 As shown in **Table 3-5** and **Table 3-6**, emission inventories of RSP and FSP shall slightly increase and reach the maximum in Year 2029 among the three assessment years under both "With" and "Without" Project scenario, which is different from the continuous decreasing trend of NO_x over these years. Still, concentrations of RSP and FSP are well within AQOs and thus it is not of the primary concern.

Mitigation Measures and Residual Impacts

3.6.76 The exceedances of annual average NO_2 are mainly resulted from the relatively high concentration of background air pollution in Kwai Chung District. The Project would not impose any adverse air quality impact to the assessment area. Instead, this Project will bring up environmental benefits to all representative ASRs, in terms of the decrease of annual average NO_2 concentration compared to "Without Project" scenario. Therefore, no mitigation measures would be applied under the Project. Also, no residual impact for the project during operation phase is anticipated.

3.7 Environmental Monitoring and Audit Requirements

Construction Phase

3.7.1 In order to ensure that the construction dust impacts are controlled to within the required criteria, a monitoring and audit programme during the construction phase should be implemented. Detailed requirements for the monitoring and audit programme are given separately in the EM&A Manual.

Operation Phase

3.7.2 The results of the operational air quality impact assessment related to vehicular emissions indicated that no adverse impact would be generated during the operation phase of this Project. Therefore, the EM&A works related to traffic air quality for the operational phase is considered not necessary.

3.8 Conclusions

Construction Phase

3.8.1 As no massive earthworks and excavation works are required during the construction of the Project, and dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation, and good site practices should be implemented to further minimise the construction dust generated, significant adverse air quality impact arising from the fugitive dust is not anticipated.

Operation Phase

3.8.2 The results of the operational air quality impact assessment related to vehicular emissions indicated no exceedance of RSP, FSP as well as NO_2 hourly average concentration criterion is anticipated. Some ASRs would exceed annual average NO_2 concentration limit in AQOs under both "Without Project" and "With Project" scenarios, which was mainly resulted from the high background pollutants' concentrations in this district. Marine emission rather than vehicular emission is concluded to the be major contributor to the high background level in most areas, mainly due to the pollutants emitted from the Kwai Chung Container Terminal nearby.

3.8.3 Comparison study between the two scenarios has been conducted. Results concluded that some environmental benefits would be contributed by the Project to the existing environment, which is mainly due to the improvement of traffic flow and vehicles travelling speed after the implementation of the proposed Project. As a result, the project is not anticipated in causing any adverse air quality impact and in fact will bring about improvements in terms of air quality impacts to the nearby sensitive receivers, as compared to the existing and future baseline conditions.

Overall

3.8.4 An air quality impact assessment has been conducted in accordance to the criteria and guidelines as stated in Annexes 4 and 12 of the EIAO-TM. The predicted results showed that environmental benefits instead of adverse air quality impact associated with operational phases of this Project are anticipated.

4. NOISE IMPACT

4.1 Introduction

4.1.1 This section presents the assessment of potential noise impact associated with the construction and operation phases of the Project. During the operation phase, noise sensitive receivers within 300m of the project boundary have been identified and the noise impact on these receivers has been assessed in detail. Noise mitigation measures, where necessary, have been recommended accordingly to reduce the identified noise impacts to acceptable levels.

4.1.2 Since the Project does not include fixed noise sources such as ventilation systems of tunnels or other 'fixed plants', noise impact generated by fixed noise sources is not anticipated. Noise impact during the operational phase is mainly contributed by road traffic noise.

4.2 Environmental Legislation, Standards and Guidelines

Construction Phase

4.2.1 In Hong Kong, control of construction noise is carried out under the Noise Control Ordinance (NCO) and the two subsidiary Technical Memoranda on Noise from Percussive Piling (PP-TM) and Noise from Construction Work Other Than Percussive Piling (GW-TM). Construction Noise Permit (CNP) is required for carrying out percussive piling at daytime on any day not being a general holiday and for carrying out general construction works during restricted hours (i.e. 1900 to 0700 hours on a day not being a general holiday and at any time on a general holiday).

4.2.2 An additional technical memorandum, the Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM), deals with the control of noise generated by Specified Powered Mechanical Equipment (SPME) and Prescribed Construction Works (PCWs) in designated areas. SPME includes hand-held breaker, bulldozer, concrete lorry mixer, dump truck and hand-held poker, vibratory; PCWs include erection/dismantling of formwork/scaffolding, loading/unloading or handling of rubble, wooden boards, steel bars, wood or scaffolding material, and hammering.

Percussive Piling

4.2.3 Percussive piling is prohibited during restricted hours, i.e. 1900 to 0700 hours on any day not being a general holiday and at any time on a general holiday. A CNP, under the NCO, is required for percussive piling works during non-restricted hours, i.e. between 0700 and 1900 hours on any day not being a general holiday. The PP-TM is used in examining the application of a CNP for percussive piling during non-restricted hours.

General Construction Works (other than Percussive Piling) during restricted hours

4.2.4 For construction activities (other than percussive piling) taking place within restricted hours, i.e. 1900 to 0700 hours on any day not being a general holiday and at any time on a general holiday, a CNP, under the NCO, is required.

4.2.5 The GW-TM is used in examining the application of a CNP for general construction works other than percussive piling during restricted hours. The Noise Control Authority (NCA) may issues a CNP if the Corrected Noise Levels (CNLs), taking into account the correction factors such as acoustic reflections etc., are not greater than the Acceptable Noise Levels (ANLs) as stated in the GW-TM. The ANLs, depending on the Area Sensitivity Rating

(ASR) of the NSRs, are defined in GW-TM and are presented below in **Table 4-1**.

Table 4-1 Basic Noise Levels for ANLs

ASR / Time Period	A	B	C
All days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the daytime and evening (0700 to 2300 hours)	60	65	70
All days during the night-time (2300 to 0700 hours)	45	50	55

4.2.6 It is the Contractor's responsibility to ensure compliance with the NCO and the relevant TMs in case of any construction activities during restricted hours. There is no guarantee that a CNP will be issued for the project construction. The NCA will consider a well justified CNP application, once filed, for construction work within restricted hours as guided by the relevant TMs issued under the NCO. The NCA will take into account of contemporary conditions / situations of adjoining land uses and any previous complaints against construction activities at the site before making his decision in granting a CNP. Nothing in this EIA shall bind the NCA in making his decision. If a CNP is to be issued, the NCA shall include in it any condition he thinks fit. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution action under the NCO.

General Construction Works (other than Percussive Piling) during non-restricted hours

4.2.7 For construction activities outside restricted hours, the "Technical Memorandum on Environmental Impact Assessment Process" (EIAO-TM) stipulates noise standards as shown **Table 4-2**.

Table 4-2 Construction Noise Standards during Non-restricting Hours

Uses	**Noise Standards [1] , $L_{eq\ (30\ mins)}$ dB(A)**	
	Non-restricted hours: 0700 to 1900 hours on any day not being a Sunday or general holiday	**Restricted hours:** 1900 to 0700 hours or any time on Sundays or general holiday
All domestic premises including temporary housing accommodation	75	See Note [2]
Hotels and hostels	75	
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	70 65 (During examinations)	

Notes:
[1] The above standards apply to uses that rely on opened windows for ventilation.
[2] The criteria laid down in the relevant technical memoranda under the NCO for designated areas and construction works other than percussive piling may be used for planning purpose. A CNP shall be required for the carrying out construction work during the period.

Operation Phase - Road Traffic Noise

4.2.8 Road traffic noise criteria are listed in Table 1A, Annex 5 of the EIAO-TM, which provides guidance on acceptable road traffic noise levels at various types of noise sensitive buildings. The relevant criteria are shown in **Table 4-3**. These standards apply to uses which rely on opened windows for ventilation.

Table 4-3 Road Traffic Noise Assessment Criteria Specified in the EIAO-TM

Uses	Road Traffic Noise Assessment Criteria – Peak Hour Traffic ($L_{10,(1\text{-hour})}$) / dB(A)
Domestic Premises	70
Hotels and Hostels	70
Offices	70
Educational Institutions	65
Places of public worship and courts of law	65
Diagnostic rooms and wards of hospitals, clinics, convalescences and homes for the aged	55

4.3 Description of the Environment

4.3.1 The existing land uses in the vicinity of the project site are mainly residential, commercial, and educational uses. Road traffic noise in the area is mainly emanated from Tsing Kwai Highway, Kwai Chung Road, and Tsuen Wan Road.

4.4 Noise Sensitive Receivers (NSRs)

4.4.1 For operational noise impact assessment, a spatial scope of 300m from the proposed Project Boundary has been included as the Study Area.

4.4.2 NSRs have been identified in accordance with Annexes 5 and 13 of the EIAO-TM which can include domestic premises, temporary housing accommodation, educational institutions, nurseries, hospitals, medical clinics, homes for the aged, convalescent homes, places of public worship, libraries, courts of law, performing arts centres, having direct line-of-sight and substantial angle of view to the Project Area. Sensitive receivers present within the 300m study area boundary have been identified. Relevant land uses were identified on the corresponding Outline Zoning Plans and no planned noise sensitive receivers were identified.

4.4.3 For the purpose of noise assessment, the first layer of noise sensitive receivers located closest to the project boundary within the 300m study area, and with direct line of sight to the Project, have been selected as representative NSRs for noise prediction and evaluation.

4.4.4 **Figure 4.1** illustrates the project boundary and 300m study area boundary together with the identified representative NSRs whereas noise assessment points at each identified NSR are demonstrated in **Figure 4.2**. Details for the identified NSRs are summarized in **Table 4-4**. Photographs of the identified NSRs are shown in **Appendix 4-1**.

Table 4-4 Identified Representative Noise Sensitive Receivers

NSR ID	Property Name	Land Use	Ground Level (mPD)	No. of Noise Sensitive Storeys	1st Floor Assess-ment Point (mPD)	Assessment for Construction Phase/ Operational Phase #	Notes
NSR1	New Kwai Fong Gardens Block A	Residential	6.7	32	22.4	O	
NSR2	Lingnam Dr. Chung Wing Kong Memorial Secondary School	Educational Institution	5.4	6	9.6	C,O	*
NSR3	Lai King Catholic Secondary School	Educational Institution	5.4	6	9.6	C,O	*
NSR4	Ha Kwai Chung Polyclinic and Special Services Centre	Clinic	27.8	6	29.0	C,O	*
NSR5	Fung King House	Residential	15.3	14	19.3	C,O	
NSR6	Wo King House	Residential	15.3	14	19.3	C,O	
NSR7	Ming King House	Residential	27.4	15	31.4	C,O	
NSR8	Yat King House	Residential	27.4	23	31.4	C,O	
NSR9	HKEAA-Lai King Assessment Centre	Educational Institution	30.1	6	37.3	C,O	*
NSR10	Yin Lai Court - Yin Kwong House (Block A)	Residential	34	35	39.2	C,O	
NSR11	Yin Lai Court - Yin Tak House (Block B)	Residential	34	35	39.2	C,O	
NSR12	Yuet Lai Court - Lai Hung House	Residential	59.7	22	63.8	O	
NSR13	Yuet Lai Court - Lai Ha House	Residential	62.6	22	63.8	O	
NSR14	Yuet Lai Court - Lai Wah House	Residential	62.6	22	63.8	O	
NSR15	Yuet Lai Court - Lai Wan House	Residential	62.9	22	63.8	O	
NSR16	Yeung King House (Block 5)	Residential	25.8	15	29.8	O	
NSR17	On King House (Block 6)	Residential	25.8	14	29.8	O	
NSR18	Clothing Industry Training Centre	Educational Institution	40.1	6	44.3	O	*

Notes:
C = Construction Phase, O = Operation Phase
* Air-conditioning systems were noted on site

4.4.5 According to site observations, window-type air-conditioners or central air conditioning system have been installed at Lingnam Dr. Chung Wing Kong Memorial Secondary School (NSR2), Lai King Catholic Secondary School (NSR3), Ha Kwai Chung Polyclinic and Special Services Centre (NSR4), HKEAA-Lai King Assessment Centre (NSR9) and Clothing Industry Training Centre (NSR18).

4.4.6 Notwithstanding the provision of air conditioners at these NSRs (NSR 2, 3, 4, 9, 18), it is also possible for these sites to rely on opened window for ventilation. Therefore, these sites are still considered as NSRs for noise impact assessment.

4.5 Assessment Methodology

Constructional Phase

4.5.1 Methodology for assessing noise from the construction activities associated with the proposed works is developed based on the GW-TM and is summarised as follows:

- Location of appropriate NSRs with respect to the work sites;
- Determination of distance attenuation and screening effects to NSRs from notional noise source of relevant work sites;
- Prediction of construction noise levels at NSRs in the absence of any mitigation measures;
- Proposal of mitigation measures and determination of their effectiveness; and
- Determination of the residual impacts.

4.5.2 Various construction work activities will not take place concurrently despite being in the same work task, e.g. excavation, namely Activity 1 ("Act 1"), and concreting, namely Activity 2 ("Act 2") for the task of bored piles construction. The activity with maximum noise level within the same work task is considered in construction noise evaluation. In order to provide a realistic assessment, the percentages of powered mechanical equipment (PME) operation on site have also been considered when calculating the cumulative Sound Power Levels (SWL) for the construction activities. Construction noise levels at the NSRs have been assessed on a monthly basis with respect to the individual noise levels induced by the construction work tasks.

4.5.3 Potential construction noise impact is anticipated tentatively from year 2018 to year 2021. The assessment of noise impact during daytime general construction works, excluding percussive piling, between 0700 and 1900 hours on weekdays, i.e. non-restricted hours as defined in NCO, will follow Table 1B of EIAO-TM noise standards, which are $L_{Aeq(30\text{-}min)}$ 75 dB(A) for domestic premises, hotels and hostels; and $L_{Aeq(30\text{-}min)}$ 70 dB(A) for educational institutions during normal hours, and $L_{Aeq(30\text{-}min)}$ 65 dB(A) during examination periods. There is no applicable standard under EIAO-TM for clinic (Ha Kwai Chung Polyclinic and Special Services Centre). Reference is made to Table 1B of EIAO-TM noise standard for "Education institutions including kindergartens, nurseries and all others where unaided voice communication is required" for these uses, and the noise assessment criteria is taken to be $L_{Aeq(30\text{-}min)}$ 70dB(A). These standards apply to uses which rely on opened windows for ventilation.

4.5.4 In general, the current construction program has been formulated such that no work will be required in restricted hours as defined under NCO. However, due to traffic safety, the lifting of the footbridge truss in the demolition and reprovision of the footbridge, with the use of a mobile crane and lorry, as well as stitch joint installation in the construction of Bridge G and Bridge H, would be required to be carried out during restricted hours under NCO. For construction activities (other than percussive piling) taking place within restricted hours, i.e. 1900 to 0700 hours on any day not being a general holiday and at any time on a general holiday, a CNP, under the NCO, is required.

Operational Phase

4.5.5 The computer model RoadNoise 2000 was used to predict the traffic noise levels. This model adopts the methodology of "Calculation of Road Traffic Noise (CRTN)" (1988) published by the UK Department of Transport. CRTN takes into account all major parameters related to effective traffic noise prediction, including traffic flow and composition, road segment length and gradient, road surface, propagation characteristics, barrier and façade effects, as well as site layout settings etc. The road traffic noise are presented in terms of noise levels exceeded for 10% of the one-hour period for the hour having the peak traffic flow ($L_{10(1\text{-hour})}$ dB(A)).

4.5.6 Calculations of predicted road traffic noise have been based on the peak hour flows projected within a 15-year period upon commencement of operation, year 2021. For worst-case scenario evaluation, the assessment year was chosen to be year 2036, corresponding to the year with the maximum projected peak hour traffic flow within 15 years from commencement of operation. The peak flow of traffic within the study area would be at 0800 to 0900.

4.5.7 The traffic forecast at the peak hour (0800-0900) was provided by the Project Traffic Consultant and have been submitted to Transport Department for approval. The peak hour traffic flows at assessment year 2036 is shown in **Appendix 4-2** while the agreement letter from Transport Department on the use of the projected traffic data for this study is attached in **Appendix 4-3**.

4.5.8 For the purpose of the road traffic noise assessment, the roads within 300m from the proposed road alignments of the Project are included in the assessment. All roads are described as one of the following:

- "Designated Project (DP) Roads" are the roads that are completely new or existing road sections that have major modifications and would cause significant traffic noise impact.
- "Other Roads" are the roads that are unchanged or subject to minor changes by the Project or roads that not classified as a material change under the Project.

4.5.9 As mentioned in Section 1, there are two main parts to the Project, summarised in **Table 4-5**, with locations shown in **Figure 4.1**.

Table 4-5 Road Types of the Project Roads

Project Section	Road Description	Road Type
Bridge G	Minor widening of Tsuen Wan Road Flyover near existing Kwai Tsing Interchange Upramp	Trunk road
Bridge H	A new single lane flyover with 6.0m width from Tsuen Wan Road (southbound- fast lane) to Kwai Chung Road	Trunk road

4.5.10 The work on Bridge G involves minor widening of the bridge deck of the Tsuen Wan Road Flyover. This represents a short section of the road where the nature and the traffic composition of the road would not be changed, i.e. total number of traffic lanes would not be increased. As mentioned in **Section 1.2.2**, traffic flow on Bridge G would be reduced because part of the traffic would be diverted to Bridge H, the traffic noise impact from Bridge G would be considered insignificant in view of the traffic noise level with the minor widening work from Bridge G would be less than that without the minor widening works. Therefore, Bridge G is not included in the DP roads and is classified as "Other Roads" in the operation noise assessment.

4.5.11 Bridge H is a designated project (DP) as it is a new bridge with more than 100m in length between abutments in accordance to Item A.8 of Schedule 2 of the EIAO. It is therefore classified as a "DP Road" for the purposes of noise assessment.

4.5.12 In this regard, for the purposes of this noise impact assessment, only Bridge H is considered to be a "DP Road". "Other Roads" include Bridge G and all existing roads.

4.5.13 Existing noise mitigation measures include noise barriers on Tsing Kwai Highway and Kwai Chung Road, and low noise road surfacing (LNRS) on portions of Tsing Kwai Highway, Kwai Chung Road and Tsuen Wan Road were identified and adopted in the traffic noise model. The locations of these noise mitigation measures and relevant correspondence with the Highways Department (HyD) can be found in **Appendix 4-4**.

4.5.14 **Appendix 4-5** shows the road plot of the traffic noise model which incorporated identified existing mitigation measures by HyD as well as recommended mitigation measures for the Project.

4.5.15 The following scenarios for traffic noise prediction model are presented:

- Unmitigated scenario at assessment year (2036); and
- Mitigated scenario at assessment year (2036)

4.5.16 In accordance with Annex 5 and Annex 13 of the EIAO-TM and the EIA study brief, direct noise mitigation measures would be proposed for the DP Roads if there would be an adverse environmental impact. If exceedance of the relevant road traffic noise criteria is predicted and is contributed significantly by the DP Roads, direct mitigation measures are required to reduce the noise from the DP Roads to a level which:

- Is not higher than the noise criteria; and
- Has no significant contribution to the overall noise from Other Roads, if the cumulative noise level (i.e. noise from the DP Roads together with Other Roads) exceeds the noise criteria

4.5.17 In cases where direct noise mitigation measures alone are not adequate in mitigating noise to a level in compliance with the EIAO-TM noise criteria, indirect technical remedies for existing NSRs may be adopted. Eligibility of the affected premises for indirect technical remedies is determined with reference to the following three criteria, all of which must be satisfied:

(a) The predicted overall noise level exceeds the noise standard in accordance with EIAO-TM (e.g. 70 dB(A) for domestic premises and 65 dB(A) for educational institutions, all in $L_{10(1hour)}$); and

(b) The predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, i.e. the total traffic noise level existing before the works to construct the road were commenced; and

(c) The contribution from the DP Roads to the increase in the predicted overall noise level is at least 1.0 dB(A).

4.6 Identification of Environmental Impacts

Construction Noise

4.6.1 The potential sources of noise impact during the construction phase of the Project would be the use of PME for various construction activities. As broadly indicated in the construction program shown in **Appendix 2-1**, the construction of the project would tentatively start in early 2018 and lasts for about 44 months. Location of works area is also provided in **Figure 4.3**. The key construction noise activities include:

- Site mobilisation, and preparation (for all Works Areas)
- Construction of Bridge H (within Works Areas D, E & F)
- Noise barrier construction (within Works Areas D, E & F)
- Widening works on Bridge G (within Works Area A)
- Demolition of existing footbridge (within Works Areas D & E)
- Reprovision of footbridge (within Works Areas B & C)
- Relocation/modification of existing bus lay-by (within Works Areas D & E)
- Modification of Kwai Chung Road (outside Fung King House) (within Works Area D)
- Completion of works (for all Works Areas)

4.6.2 Tentative construction period of the Project is from year 2018 to year 2021. Nearby project "Replacement and Rehabilitation of Water Mains Stage 4, Mains in New Territories – Investigation, Design and Construction (Contract No. 11/WSD/11) is anticipated to end at the fourth quarter of 2015 according to the correspondence with the appropriate authorities. Relevant correspondence is provided in **Appendix 4-6**. Therefore, no concurrent noise impact due to the nearby construction works is anticipated.

Operation Phase

4.6.3 Identified potential operational noise from the project includes road traffic noise from the proposed roads and existing roads. Peak traffic flow in the 300m study area occurs in year 2036 (15 years after the commencement of the Project) at 0800-0900 in the morning, thus the traffic forecast for this time period is used for the prediction of the worst case scenario. A summary of the traffic flow data of 2036 at 0800-0900 can be found in **Appendix 4-2**.

4.7 Prediction and Evaluation of Environmental Impacts

Construction Phase

4.7.1 The maximum construction noise levels at the representative NSRs during the construction phase of the Project, without noise mitigation applied, are shown in **Table 4-6** below. The PME plant inventories and detailed calculations are provided in **Appendix 4-7.**

Table 4-6 Maximum Noise Levels (dB(A)) during Construction without Noise Mitigation Measures

NSR	Description	Assessment Criteria, dB(A) [2]	Predicted Maximum Noise Levels, dB(A) [1]			
			2018	2019	2020	2021
NSR2	Lingnam Dr. Chung Wing Kong Memorial Secondary School	70/65	**70**	**70**	**68**	**68**
NSR3	Lai King Catholic Secondary School	70/65	**79**	**80**	**75**	**79**
NSR4	Ha Kwai Chung Polyclinic and Special Services Centre [3]	70	69	69	68	68
NSR5	Fung King House	75	**78**	**81**	**79**	**78**
NSR7	Ming King House	75	64	**80**	**79**	**75**
NSR8	Yat King House	75	65	75	73	70
NSR9	HKEAA-Lai King Assessment Centre	70/65	63	**77**	**75**	**72**
NSR10	Wo King House	75	61	71	69	66
NSR11	Ming King House	75	61	70	68	65

Notes:

[1] Predicted noise exceedance are highlighted in bold.

[2] Construction Noise Impact Assessment criteria for educational institutions are $L_{eq,30min}$ of 65dB(A) during examination period and 70dB(A) during normal school days.

[3] For clinic, construction noise impact assessment criteria are not available with reference to EIAO-TM. $L_{eq,30min}$ of 70dB(A) is adopted for this study.

4.7.2 Without adopting noise mitigation measures, construction noise impacts at some of the most affected NSRs are predicted to exceed the relevant criterion up to 10dB(A). Feasibility of providing noise reduction measures to minimise construction noise impact has been examined and discussed in the **Sections 4.8.1-4.8.12**.

Operation Phase

4.7.3 Based on the peak hour traffic flows in assessment year 2036 (peak hour traffic flow within 15 years upon commencement of the Project at the end of year 2021), the unmitigated traffic noise levels after completion of the Project at the representative NSRs were calculated and summarised in **Table 4-7**. Detailed modelling results at each level of each assessment point of the NSRs and associated calculations are presented in **Appendix 4-8**, which show that overall predicted noise level are largely contributed by the "Other Roads", not by the "DP roads".

4.7.4 Nevertheless, predicted noise levels under unmitigated scenario in Year 2036 due to the "DP roads" only, at some assessment points like NSR3, NSR4, NSR5 and NSR9, would still exceed the EIAO noise criteria. This constitutes non-compliance with the first criteria listed in **Section 4.5.16**. Therefore, direct noise mitigation measures are deemed necessary to reduce the road traffic noise impact, due to the "DP roads".

Table 4-7 Predicted Road Traffic Noise Levels at Each Identified NSR under the Unmitigated Scenario

NSR	Description	Noise Standard Under EIAO-TM, dB(A)	Range of Predicted Noise Level (Unmitigated) ($L_{10(1hour)}$, dB(A))			Direct Mitigation Measures Required? [1]
			Overall Noise Level	Predicted Noise Levels due to Other Roads	Predicted Noise Levels due to DP Roads only	
NSR1	New Kwai Fong Gardens Block A	70	70~77	70~77	33~56	No
NSR2	Lingnam Dr. Chung Wing Kong Memorial Secondary School	65	72~77	72~77	37~57	No
NSR3	Lai King Catholic Secondary School	65	70~81	70~81	54~66	Yes
NSR4	Ha Kwai Chung Polyclinic and Special Services Centre	55	69~80	69~80	51~60	Yes
NSR5	Fung King House	70	72~84	72~84	62~72	Yes
NSR6	Wo King House	70	57~76	57~76	33~57	No
NSR7	Ming King House	70	57~80	57~80	36~69	No
NSR8	Yat King House	70	55~76	55~76	35~63	No
NSR9	HKEAA-Lai King Assessment Centre	65	77~81	77~81	60~69	Yes
NSR10	Yin Lai Court - Yin Kwong House (Block A)	70	69~78	69~78	37~62	No
NSR11	Yin Lai Court - Yin Tak House (Block B)	70	69~78	69~78	38~61	No
NSR12	Yuet Lai Court - Lai Hung House	70	70~74	70~74	26~38	No
NSR13	Yuet Lai Court - Lai Ha House	70	67~75	67~75	32~49	No
NSR14	Yuet Lai Court - Lai Wah House	70	64~75	64~75	34~49	No
NSR15	Yuet Lai Court - Lai Wan House	70	66~74	66~74	34~48	No
NSR16	Yeung King House (Block 5)	70	74~78	74~78	38~53	No
NSR17	On King House (Block 6)	70	66~78	66~78	26~52	No
NSR18	Clothing Industry Training Centre	65	69~71	69~71	36~40	No

Notes:
[1] Direct mitigation measures are required if (a) noise level from DP roads only > noise standards under EIAO-TM; or (b) overall noise level> noise standards under EIAO-TM, and difference between overall noise levels and noise levels of Other Roads ≥ 1.0 dB(A)

4.8 Mitigation of Adverse Environmental Impacts

Construction Phase

4.8.1 A number of available construction noise mitigation measures have been considered in this assessment, including:

- selection and optimisation of construction programs, avoidance of parallel operation of noisy PME, and/or reduction in the proportion of usage of PME during noise sensitive periods such as school examination period;
- use of “quiet” PME and working methods;

- use of temporary at-source noise mitigation measures such as noise barriers, acoustic fabric, noise enclosures, noise jacket and mufflers; and
- use of good site practice to limit noise emission from construction site.

Selection and Programming of Construction Processes

4.8.2 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 parallel operation of noisy PME in order to minimize the total noise generated during construction periods. Limiting the quantity of PME to be operated concurrently and also their proportion of usage were recommended in the Project and incorporated in this assessment. The proposed quantity of PMEs and their proportion of usage have been confirmed feasible by the Project Engineer. In the case during school examination when 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.

Use of "Quiet" Alternative Plant and Working Methods

4.8.3 The use of particular plants with equipment noise levels quieter than those specified in the GW-TM can result in reduction of noise levels generated by the plant. The level of noise reduction achieved is dependent on the contractor's chosen methods of working. It is possible for the contractor to achieve noise reductions from the adopted working methodologies by specifying maximum limits of sound power level for specific plant.

4.8.4 "Quiet" plant is defined as a PME having actual Sound Power Levels (SWLs) lower than the values specified for PME in the GW-TM. SWLs for typical PMEs provided in the GW-TM and that for equivalent "quiet" plants are presented in **Table 4-8**.

4.8.5 The type of quiet PMEs adopted in this assessment is for reference only and to be confirmed by the contractors, in view of the actual construction conditions and programs. The contractors are allowed to use other types of quiet PMEs, which have the equivalent total SWLs, to meet their needs.

Table 4-8 Maximum SWLs for Selected "Quiet" PME and Alternative Plants

Identification Code in GW-TM	Descriptions of PME	SWL in GW-TM, dB(A)	"Quiet" PME example on QPME list [1]	SWL of "Quiet" PME, dB(A)
CNP 004	Asphalt Paver	109	EPD-01226 (VOLVO ABG5770)	104
CNP 081	Excavator, Wheeled/Tracked	112	EPD-01896 (HYUNDAI R80CR-9)	98
CNP 048	Mobile Crane	112	EPD-01516 (KOBELCO CKS900)	101
CNP 170	Poker, vibratory, hand held	113	Poker, vibratory, hand held (electric)	102
CNP 185	Road Roller	108	EPD-01806 (KANTO-TK KV25DS)	95

Note:
[1] QPME list available on the EPD website

Temporary Noise Barriers

4.8.6 The use of 3m high movable barriers can be located about 5m from PMEs. Whilst screening effects can be achieved at upper floors of NSRs, greater benefits result at lower floors where screening is the most effective. These temporary noise barriers will become more effective when located immediately adjacent to the working area, and can reduce the noise level by up to 5 dB(A) and 10 dB(A) for mobile and stationary plants, respectively. The Contractor shall be responsible for 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 PME. The minimum surface density of the movable noise barrier is 10 kg/m^2.

4.8.7 The grab and chisel piling plant is a noisy but stationary piece of equipment. A 8m high movable barrier with skid footing and a small cantilevered upper portion can be located within a few metres of the plant. It is estimated that movable noise barriers of this type can produce 10dB(A) of screening. With reference to Tsim Sha Tsui Station Northern Subway EIA Report, 2008, the use of acoustic fabric can also be considered as an alternative to reduce the noise level.

4.8.8 Depending on site situation, when temporary noise barriers are not practicable or noise reduction achieved is insufficient, noise jacket/muffler can be applied to cover the noisy part of the engine or at the engine exhaust of particular mobile plants respectively. It is assumed that temporary noise barriers of this type can provide screening effect of 5 dB(A) in the assessment.

4.8.9 A summary of the assumed noise reduction effects achieved by temporary noise barrier and acoustic fabric for certain items of PME are provided in **Table 4-9**.

Table 4-9 Noise Mitigation Measures for Certain PME during Construction Phase

Descriptions of PME	Mitigation Measures Proposed	Noise Reduction, dB(A)
Breaker, excavated mounted	Temporary Noise Barrier	5
Excavator/Loader, Wheeled/Tracked	Temporary Noise Barrier	5
Dump Truck, with grab, ≤38 tonne	Temporary Noise Barrier	5
Lorry	Temporary Nosie Barrier	5
Lorry with crane/grab	Temporary Nosie Barrier	5
Mobile Crane	Temporary Nosie Barrier Acoustic Fabric	5
Poker, vibratory, hand-held (electric)	Temporary Nosie Barrier	5
Piling, large diameter bored, grab and chisel	Temporary Noise Barrier[1] /Acoustic Fabric[2]	10
Road Roller	Temporary Noise Barrier	5
Concrete Lorry Mixer	Temporary Noise Barrier	5
Saw, chain, hand-held	Temporary Nosie Barrier	5
Concrete pump, lorry mounted	Temporary Nosie Barrier	5
Asphalt Paver	Temporary Noise Barrier	5
Air Compressor	Temporary Noise Barrier	5

Note:
[1] Temporary Noise Barrier of height not less than the equipment height to be provided to screen noisy part of equipment. It is anticipated that temporary noise barrier of 8m high with skid footing and a small cantilevered upper portion can be located within a few metres of these equipment.
[2] With reference to Tsim Sha Tsui Station Northern Subway EIA Report, 2008, the use of acoustic fabric can achieve 10dB(A) noise reduction for piling activities .

Good Site Practice

4.8.10 The use of good site practice/techniques can provide considerable reductions in noise emissions. Examples of these site practice include:

- use of well-maintained and regularly-serviced plant during the works;
- plant operating on intermittent basis should be turned off or throttled down when not in active use;
- plant that is 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 maintained adequately 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.

Assessment of Noise Impacts with the Application of Mitigation Measures

4.8.11 Construction noise calculations have been carried out with the incorporation of different noise mitigation measures as discussed above, as far as practicable according to the actual construction condition and limitation. Mitigation measures adopted in this assessment include:

- the use of quiet plants for PME (QPME);
- temporary noise barriers and acoustic fabric for PME, as well as noise jacket and mufflers to cover the noisy part of PME and at the engine exhaust of mobile plants respectively;
- limiting of the number of plants operated concurrently.

4.8.12 Construction noise levels at the selected NSRs (which are predicted to be the worst affected by the associated construction works) under the mitigated scenario are summarized in **Table 4-10** below. Detailed calculations of the construction noise impact assessment and complete PME inventory are provided in **Appendix 4-10**.

Table 4-10 Maximum Noise Levels (dB(A)) during Construction with Noise Mitigation Measures Adopted

NSR	Description	Assessment Criteria, dB(A) [2]	Predicted Maximum Noise Levels, dB(A) [1]			
			2018	2019	2020	2021
NSR2	Lingnam Dr. Chung Wing Kong Memorial Secondary School	70/65	62	61	61	56
NSR3	Lai King Catholic Secondary School	70/65	**70**	**69**	**68**	**70**
NSR4	Ha Kwai Chung Polyclinic and Special Services Centre [3]	70	61	62	61	56
NSR5	Fung King House	75	69	73	71	68
NSR7	Ming King House	75	60	72	70	67
NSR8	Yat King House	75	57	67	65	62
NSR9	HKEAA-Lai King Assessment Centre	70/65	57	**69**	**67**	64
NSR10	Wo King House	75	54	63	61	58
NSR11	Ming King House	75	53	61	60	56

Notes:
[1] Predicted noise exceedance are highlighted in bold.
[2] Construction Noise Impact Assessment criteria for educational institutions to be $L_{eq,30min}$ of 65dB(A) during examination period and 70dB(A) during normal school days.
[3] For clinic, construction noise impact assessment criteria are not available with reference to EIAO-TM. $L_{eq,30min}$ of 70dB(A) is adopted for this study.

Operation Phase

4.8.13 As stated in Section 6, Annex 13 of the EIAO-TM, there is a range of possible measures available to mitigate road traffic noise. For existing development, these include:

- treatment of source;
- alternative alignment;
- noise barrier/enclosure; and
- open-textured road surfacing (i.e. low noise road surfacing)

4.8.14 In view of practicality, roadside cantilevered and vertical noise barriers are considered to be an effective and practicable mitigation option for road traffic noise impact.

4.8.15 In general, concrete parapet walls of 0.8m or higher are adopted in this operational noise impact assessment along all elevated sections of existing and planned roads, except for the eastern sections of Tsuen Wan Road Flyover.

4.8.16 Direct noise mitigation measures such as vertical and cantilevered noise barriers, as well as semi-enclosures or full noise enclosures and LNRS have been considered for mitigating road traffic noise impact from DP Roads. However, LNRS would be re-provisioned for Bridge G after minor widening works and applied in the noise model as it is a standard provision for high-speed trunk road. Major steps in the design of noise mitigation measures for the compliance of noise standards stipulated in the EIAO-TM and the requirements of *EIAO Guidance Note No. 12/2005* regarding traffic noise impact assessment are as follows:

(a) The predicted peak hour traffic flows at Year 2036 (highest traffic volume within 15 operational years starting from Year 2021) are considered to evaluate traffic noise levels at all noise assessment points.

(b) "Baseline" study, which takes into account all existing representative site layouts, building developments, roads and the noise mitigation measures within the Noise Assessment Area at Year 2036, is conducted. Noise mitigation measures for the Project roads are not included in this "baseline" study (unmitigated scenario).

(c) Necessary direct noise mitigation measures along the DP Roads are considered based on the results from the "baseline" study.

(d) The necessity for the application of direct noise mitigation measures (noise barriers/ enclosures) is determined based on the following conditions:-

i) If the predicted overall noise levels at the noise assessment points do not exceed the specified noise standards in the EIAO-TM (refer to **Table 4-3** above), no direct noise mitigation measures along the DP Roads are required;

ii) If the predicted overall noise levels at the noise assessment points exceed the specified noise standards stipulated in the EIAO-TM, direct noise mitigation measures shall be considered, such that either requirement (1) or (2)+(3) below could be fulfilled:
(1) The mitigated overall noise level is not higher than the specified noise level standards in the EIAO-TM; or
(2) The mitigated noise level arising from the DP Roads only is not higher than the specified noise level standards in the EIAO-TM; and
(3) The contribution of the mitigated noise level arising from the DP Roads to the mitigated overall noise level is less than 1.0 dB(A).

4.8.17 Total number of dwellings, classrooms and other noise sensitive elements that will be benefited from and be protected by provision of direct noise mitigation measures is also determined as follows:

(a) Dwellings, classrooms and other noise sensitive elements that will benefit from provision of direct noise mitigation measures are those:

i) exposed to overall traffic noise levels exceeding the specified noise level standards in the EIAO-TM under the unmitigated scenario;

ii) benefited at least 1.0 dB(A) from the implementation of the direct noise mitigation measures.

(b) Dwellings, classrooms and other noise sensitive elements that will be protected by provision of direct noise mitigation measures are those:

i) exposed to overall traffic noise levels exceeding the specified noise level standards in the EIAO-TM under the unmitigated scenario;

ii) exposed to overall traffic noise levels complying with the specified noise level standards in the EIAO-TM with the implementation of the direct noise mitigation measures.

4.8.18 As presented in **Section 4.7** with regards to the road traffic noise prediction results under the unmitigated scenario, direct noise mitigation measures were required and designed on the east side along Bridge H as well as LNRS such that noise from the DP Roads is not higher than the relevant standards and has no significant contribution to the overall noise from other existing roads. According to the "Guidelines on Design of Noise Barriers" published by Highways Department and Environmental Protection Department, absorptive panels will be provided to the lower portion (i.e. 2 to 3 meters) of the proposed noise

screening structures in order to reduce the reflection of noise. Details of the proposed direct noise mitigation measures are described in **Table 4-11** and their location and cross-sections are shown in **Figures 4.4A** to **4.4C**.

Table 4-11 Summary of Proposed Noise Mitigation Measures

Proposed Noise Mitigation Measure			Road Name	Direction	Target NSRs
ID	Description	Length (m)			
A	5.5m high with 2.5m cantilevered barrier at 45°	85	Bridge H	Southbound	Lai King Catholic Secondary School, Ha Kwai Chung Polyclinic and Special Services Centre, and Fung King House
B	5.5m vertical barrier	20	Bridge H	Southbound	Lai King Catholic Secondary School, Ha Kwai Chung Polyclinic and Special Services Centre, and Fung King House
C	5.5m high with 2.5m cantilevered barrier at 45°	230	Bridge H	Southbound	Lai King Catholic Secondary School, Ha Kwai Chung Polyclinic and Special Services Centre, and Fung King House
D	5.5m high with 3.5m cantilevered barrier at 45°	45	Bridge H	Southbound	Fung King House, HKEAA-Lai King Assessment Centre
-	Low noise road surfacing [1]	-	Bridge H	-	Lai King Catholic Secondary School, Ha Kwai Chung Polyclinic and Special Services Centre, and Fung King House, HKEAA-Lai King Assessment Centre

Notes:

[1] LNRS is applied on highways with speed 70kph or above in general. Such mitigation measure has been included in both unmitigated scenario and mitigated scenario in road traffic noise impact analysis. The above table only describes the mitigation measures on designated project roads (Bridge H) that is under this noise impact assessment. Although Bridge G would not constitute any material change and is classified as non-DP road, it is also a high-speed trunk road, LNRS will be re-provisioned after minor widening works and be applied in noise model as well.

4.8.19 **Table 4-12** summarized the predicted road traffic noise level at each identified NSR with the proposed direct noise mitigation measures described in **Table 4-11**. Detailed results at each floor of each noise assessment point are presented in **Appendix 4-10**.

4.8.20 In **Table 4-12**, it shows that with the application of the proposed direct noise mitigation measures along the DP Roads, the predicted overall road traffic noise levels at all of the identified NSRs will comply with the noise standards stipulated in the EIAO-TM, or that the predicted road traffic noise level from the DP Roads only will not exceed the noise standards stipulated in the EIAO-TM and the contribution of traffic noise arising from the DP Roads to the overall noise level will be less than 1.0 dB(A). In this regard, the application of indirect technical remedies is considered to be not necessary.

Table 4-12 Predicted Road Traffic Noise Levels at Each Identified NSR under the Mitigated Scenario

NSR	Description	Noise Standard Under TM-EIAO, dB(A)	Range of Predicted Noise Level (Mitigated) ($L_{10(1hour)}$, dB(A))			Further Mitigation Measures Required? [1]
			Overall Noise Level	Predicted Noise Levels due to Other Roads	Predicted Noise Levels due to DP Roads only	
NSR1	New Kwai Fong Gardens Block A	70	70~77	70~77	32~52	No
NSR2	Lingnam Dr. Chung Wing Kong Memorial Secondary School	65	72~77	72~77	35~56	No
NSR3	Lai King Catholic Secondary School	65	70~81	70~81	44~59	No
NSR4	Ha Kwai Chung Polyclinic and Special Services Centre	55	69~80	69~80	44~54	No
NSR5	Fung King House	70	70~84	70~84	46~60	No
NSR6	Wo King House	70	57~76	57~76	33~42	No
NSR7	Ming King House	70	57~80	57~80	34~63	No
NSR8	Yat King House	70	55~76	55~76	35~52	No
NSR9	HKEAA-Lai King Assessment Centre	65	77~81	77~81	56~65	No
NSR10	Yin Lai Court - Yin Kwong House (Block A)	70	69~78	69~78	37~59	No
NSR11	Yin Lai Court - Yin Tak House (Block B)	70	69~78	69~78	38~58	No
NSR12	Yuet Lai Court - Lai Hung House	70	70~74	70~74	26~35	No
NSR13	Yuet Lai Court - Lai Ha House	70	67~75	67~75	32~49	No
NSR14	Yuet Lai Court - Lai Wah House	70	64~75	64~75	34~48	No
NSR15	Yuet Lai Court - Lai Wan House	70	66~74	66~74	34~47	No
NSR16	Yeung King House (Block 5)	70	74~78	74~78	37~50	No
NSR17	On King House (Block 6)	70	66~78	66~78	26~46	No
NSR18	Clothing Industry Training Centre	65	69~71	69~71	35~39	No

Notes:
[1] Further direct mitigation measures are required if (a) noise level from Project roads only > noise standards under EIAO-TM; or (b) overall noise level> noise standards under EIAO-TM, and difference between overall noise levels and noise levels of Other Roads ≥ 1.0 dB(A).

4.8.21 Total number of dwellings, classrooms and other noise sensitive elements that will be benefited from and be protected by provision of the direct noise mitigation measures are summarized in **Table 4.13**. As mentioned previously, noise contribution from the proposed DP Roads are relatively low as compared with the other existing roads. There is why the noise alleviation effectiveness contributed by the proposed mitigation measures appears to

be relatively insignificant as reflected by the number of estimated benefit and protection. Only 85 of the represented dwellings, classrooms and other noise sensitive elements will benefit from, and 18 of them will be protected by provision of the proposed noise mitigation measures.

Table 4-13 Total Number of Dwellings, Classrooms and Other Noise Sensitive Elements that will be Benefitted from and be Protected by Provision of the Direct Noise Mitigation Measures

NSR	Description	No. of Dwellings Represented	No. of Dwellings Exceeding EIAO Noise Criteria [1]	No. of Dwellings benefitted from noise mitigation measures [2]	No. of Dwellings Protected from Noise Mitigation Measures [3]
Residential Dwellings					
NSR1	New Kwai Fong Gardens Block A	128	126	0	0
NSR5	Fung King House	420	417	83	3
NSR6	Wo King House	280	133	0	0
NSR7	Ming King House	360	225	2	5
NSR8	Yat King House	506	288	0	10
NSR10	Yin Lai Court - Yin Kwong House (Block A)	105	94	0	0
NSR11	Yin Lai Court - Yin Tak House (Block B)	105	101	0	0
NSR12	Yuet Lai Court - Lai Hung House	88	86	0	0
NSR13	Yuet Lai Court - Lai Ha House	88	84	0	0
NSR14	Yuet Lai Court - Lai Wah House	88	82	0	0
NSR15	Yuet Lai Court - Lai Wan House	88	84	0	0
NSR16	Yeung King House (Block 5)	210	210	0	0
NSR17	On King House (Block 6)	182	56	0	0
	Sub-total	**2648**	**1986**	**85**	**18**
Classrooms					
NSR2	Lingnam Dr. Chung Wing Kong Memorial Secondary School	48	48	0	0
NSR3	Lai King Catholic Secondary School	48	48	0	0
NSR9	HKEAA-Lai King Assessment Centre	36	36	0	0
NSR18	Clothing Industry Training Centre	48	48	0	0
	Sub-total	**180**	**180**	**0**	**0**
Other Noise Sensitive Elements					
NSR4	Ha Kwai Chung Polyclinic and Special Services Centre	48	48	0	0
	Sub-total	**48**	**48**	**0**	**0**
	Total	**2876**	**2214**	**85**	**18**

Notes:
[1] Number of dwellings, classrooms and other noise sensitive exposed to overall road traffic noise levels exceeding the noise standards stipulated in the EIAO-TM (refer to **Table 4-3**).

[2] Dwellings, classrooms and other noise sensitive elements benefitted from noise mitigation measures are those exposed to overall road traffic noise exceeding noise standards stipulated in the EIAO-TM under unmitigated scenario and are benefited at least 1.0 dB(A) from the implementation of the noise mitigation measures.

[3] Dwellings, classrooms and other noise sensitive elements protected by noise mitigation measures are those exposed to overall road traffic noise exceeding noise standards stipulated in the EIAO-TM under unmitigated scenario and exposed to overall road traffic noise compiling with the noise standards stipulated in the EIAO-TM with the implementation of the noise mitigation measures.

4.9 Evaluation of Residual Impacts

Construction Phase

4.9.1 In view of the results listed in **Table 4-10** provided in **Appendix 4-9**, it can be noted that the predicted construction noise levels with noise mitigation measures at all NSRs would comply with the corresponding construction noise limits except NSR3 and NSR9 with exceedance during examination period.

4.9.2 The predicted residual impacts are associated with assessment criteria during examination periods, as summarized in **Table 4-14**.

Table 4-14 Predicted Residual Construction Noise Period during Examination Period

NSR		Predicted Residual Construction Noise Impact	
ID	**Description**	**Period [2]**	**Exceedance**
NSR3	Lai King Catholic Secondary School [1]	March 2018 to July 2018; December 2018 to January 2019; March to July 2019; April to July 2020; December 2020; May 2021 and July 2021 (Total 20 months)	3-5 dB(A) 1-3 dB(A) 1-2 dB(A) 1-3 dB(A) 1 dB(A) 1-2 dB(A)
NSR9	HKEAA-Lai King Assessment Centre[1]	January 2020; April 2020 (Total 2 months)	1-2 dB(A) 1 dB(A)

Notes:
[1] Air-conditioning systems were noted on site at these NSRs
[2] Examination period assumed to be December, January, March-July of each year

4.9.3 As shown in **Table 4-14** above, the predicted residual impact are limited to school examination periods, where the daytime construction noise criterion is 5dB lower than the normal daytime school criterion. Scheduling of construction works outside school examination period to less intrusive periods would definitely reduce the overall noise impacts at the NSRs and for ensuring compliance with the construction noise criterion at some of the NSRs. The Contractor shall liaise with the school representative(s) to obtain the examination schedule and avoid noisy construction activities during school examination period. Environmental and Audit requirements during construction of the Project would be discussed in **Section 4.10** below and separate Environmental Monitoring and Audit (EM&A) Manual.

Operation Phase

4.9.4 As shown in **Appendix 4.10**, the predicted noise levels at most assessment points would exceed the relevant traffic noise standard. However, the traffic noise contribution from the concerned DP Roads is less than 1.0 dB(A) such that the traffic noise impact arising from

the Project is considered insignificant. The noise exceedance is due to existing traffic on non-Project roads. Moreover, the traffic noise emanating from the concerned DP Roads would also comply with the relevant standard after mitigation that no further indirect mitigation measures is required.

4.10 Environmental Monitoring and Audit

4.10.1 Environmental monitoring and audit measures are recommended during the construction and first year of Project operation. Schedule and extent of the monitoring program is presented in the stand-alone Environmental Monitoring and Audit (EM&A) Manual. A proactive EM&A program is necessary to be provided by the contractor, in order to ensure that construction noise impact to the NSRs should be minimized as far as practicable. An appropriate path for noise complaints handling procedures is a key element of the EM&A program. Detailed implementation schedules of all mitigation measures are also provided in the EM&A Manual.

4.11 Conclusion

4.11.1 During construction phase, practical mitigation measures such as the use of QPME, temporary noise barriers, noise jackets, mufflers and limiting the number of plants operated concurrently, are proposed to minimise construction noise impact.

4.11.2 Further mitigation measures including good site practices as well as proper scheduling to avoid noisy construction during school examinations, can be adopted to further minimize the construction noise impact.

4.11.3 In the operational noise impact assessment, potential traffic noise impacts to the identified NSRs within the 300m study area have been evaluated based on the maximum traffic flow projection of 15 years after the completion of the Project (i.e. year 2036). It was predicted that the traffic noise levels arising from the Project at some NSRs exceed the EIAO criteria. As a result, direct noise mitigation measures such as cantilevered noise barriers, vertical noise barrier and LNRS have been proposed on the DP Roads for the compliance of noise criteria under the EIAO-TM. With the incorporation of the proposed direct noise mitigation measure, it is anticipated that the noise levels from the DP Roads at all of the identified NSRs will comply with the criteria.

4.11.4 Environmental monitoring and auditing should be implemented to ensure the application of necessary noise mitigation measures, noise monitoring, as well as to establish an appropriate path for noise complaints handling. EM&A Manual will be prepared separately from this report.

5. WATER QUALITY IMPACT

5.1 Introduction

5.1.1 This section presents a water quality impact assessment for the construction and operation of the Project, assessing the potential impacts and recommending mitigation measures, where necessary, in order to minimise the identified water quality impacts to an acceptable level.

5.2 Environmental Legislation, Standards and Guidelines

General

5.2.1 The EIAO-TM specifies the assessment method and criteria that are needed to be followed in the EIA study. It also provides details of the assessment criteria and guidelines that are relevant to the water quality impact assessment, including:

- Annex 6 Criteria for Evaluating Water Pollution; and
- Annex 14 Guidelines for Assessment of Water Pollution.

5.2.2 Furthermore, the Water Pollution Control Ordinance (Cap. 358) (WPCO) is also applicable to the water quality impact assessment of this Project.

5.2.3 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 (TM-DSS); and
- Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94).

Water Pollution Control Ordinance

5.2.4 The WPCO is the principal legislation to protect and control the water quality in Hong Kong. Under the ordinance, Hong Kong waters are classified into 10 Water Control Zones (WCZs), in which the corresponding statements of Water Quality Objectives (WQOs) are stipulated. The Project area is adjacent to the Victoria Harbour (Phase One) WCZ as indicated in **Figure 5.1** and the corresponding WQOs are summarised in **Table 5-1**.

Table 5-1 Summary of WQOs for Victoria Harbour (Phase One) WCZ

Parameter	Water Quality Objective	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 to exceed 1,000 per 100mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals between 7 and 21 days	Inland waters
Colour	Change due to human activity not to exceed 50 Hazen units	Inland waters
Depth-Averaged Dissolved Oxygen (DO)	Not less than 4.0mg/L for 90% of samples at a year	Marine waters
DO within 2m of the Seabed	Not less than 2.0mg/L for 90% of samples at a year	Marine waters
DO	Not less than 4.0mg/L	Inland waters
pH	To be in the range of 6.5 to 8.5, change due to human activity not to exceed 0.2	Marine waters
	Not to exceed the range of 6.0 to 9.0 due to human activity	Inland waters
Temperature	Change due to human activity not to exceed 2.0°C	Whole zone
Salinity	Change due to human activity not to exceed 10%	Whole zone
Suspended Solids (SS)	Not to raise the ambient level by 30% due to caused by human activity and shall not affect aquatic communities	Marine waters
	Annual median not to exceed 25mg/L due to human activity	Inland waters
Un-ionised Ammonia (UIA)	Annual mean not to exceed 0.021mg/L as un-ionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
Total Inorganic Nitrogen (TIN)	Annual mean depth-averaged inorganic nitrogen not to exceed 0.4mg/L	Marine waters
5-day Biochemical Oxygen Demand (BOD_5)	Not to exceed 5mg/L	Inland waters
Chemical Oxygen Demand (COD)	Not to exceed 30mg/L	Inland waters
Toxic substances	Should not attain such levels as to produce significant toxic 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

Water Supplies Department (WSD) Water Quality Criteria

5.2.5 Besides the WQOs set under the WPCO, the WSD specifies a set of water quality objectives at flushing water intakes as shown in **Table 5-2**.

Table 5-2 WSD Standards at Flushing Water Intakes

Parameter (in mg/l unless otherwise stated)	WSD Target Limit
Colour (Hazen Unit)	< 20
Turbidity (NTU)	< 10
Threshold Odour Number (odour unit)	< 100
Ammoniacal Nitrogen (NH_3-N)	< 1
Suspended Solids	< 10
Dissolved Oxygen	> 2
Biochemical Oxygen Demand	< 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 (TM-DSS)

5.2.6 Besides setting the WQOs, the WPCO controls effluent discharge into the WCZs through a licensing system. The TM-DSS provides guidance on permissible effluent discharges based on the type of receiving waters (foul sewers, inland / coastal / inshore / marine waters). The limits control the physical, chemical and microbial quality of effluents. Any sewage from the proposed construction and operation activities should comply with the standards for effluents discharged into the inshore waters of the Victoria Harbour (Phase One) WCZ.

ProPECC Notes

5.2.7 The Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94) was issued by the EPD to provide environmental guidelines for handling and disposal of construction site discharges. It provides good practice guidelines for dealing with various types of discharge from a construction site. Practices given in the ProPECC PN 1/94 should be followed during the construction phase in order to minimise the water quality impact due to construction site drainage.

5.3 Description of the Environment

5.3.1 According to the "Marine Water Quality in Hong Kong" in 2012, which is the latest available information from EPD at the moment of preparing this Report, after the commissioning of the Stonecutters Island Sewage Treatment Works (SCISTW) under the Harbour Area Treatment Scheme (HATS) Stage 1 in 2002, about 75% of the sewage around Victoria Harbour now receives chemically enhanced primary treatment, resulting in a 70% reduction of the pollution load (in terms of organic pollutants) into the harbour. In the Victoria Harbour WCZ, the 2012 WQOs compliance rate was 77% as compared with 50% in 2011. Victoria Harbour Water Control Zone had a higher overall compliance rate in which the improvement in 2012 was mainly due to high compliance rates with the Dissolved Oxygen (DO) objective. Compliance with the Total Inorganic Nitrogen (TIN) objective in 2012 remained at 30% as in 2011 and non-compliance are mainly observed at stations in the central and western parts of the Harbour. The overall annual average level of

TIN in Victoria Harbour increased could be due to a higher background TIN level under the influence of Pearl River discharge, the year-to-year normal range of fluctuation of the discharge from the Tolo Harbour Effluent Export Scheme and surface run-off, as well as the gradual increase in effluent discharged from the four preliminary treatment plants located in Hong Kong Island during the period.

5.3.2 The representative EPD's marine water quality monitoring stations within the Victoria Harbour (Phase One) WCZ are in vicinity of the Project area, including VM12 (Rambler Channel (South)), VM14 (Rambler Channel (North)) and VT8 (Rambler Channel for Typhoon Shelter). The location of these stations is shown in **Figure 5.1** and the recent monitoring data are summarised in **Table 5-3**. Further to description of marine water environment in **Section 5.3.1**, the water quality of Victoria Harbour has been on an improving trend during the last decade after implementation of the HATS Stage 1 at the end of 2001, in particular shown by consistent decreasing patterns of ammoniacal-nitrogen and BOD_5.

Table 5-3 Marine Water Quality Statistics for the Victoria Harbour (Phase One) WCZ in 2012 at VM12, VM14 and VT8

Parameter	EPD's Monitoring Station		
	VM12	VM14	VT8
Temperature (°C)	23.3 (15.9 - 28.3)	23.5 (16.0 – 28.5)	23.8 (17.4 – 28.6)
Salinity (ppt)	30.0 (26.0 – 32.6)	28.9 (21.2 – 32.5)	27.6 (18.2 – 32.0)
Dissolved Oxygen (mg/L)	6.0 (3.8 – 8.4)	6.2 (3.6 – 8.1)	6.3 (4.9 – 7.4)
Bottom Dissolved Oxygen (mg/L)	6.0 (3.5 – 8.4)	6.2 (3.3 – 8.1)	6.1 (4.2 – 7.3)
BOD_5 (mg/L)	0.4 (<0.1 – 1.0)	0.4 (<0.1 – 1.0)	0.6 (0.3 – 1.0)
SS (mg/L)	8.3 (2.5 – 16.0)	5.8 (2.1 – 13.3)	8.2 (3.0 – 16.0)
TIN (mg/L)	0.51 (0.34 – 0.85)	0.56 (0.32 – 1.08)	0.69 (0.31 – 1.15)
NH_3-N (mg/L)	0.190 (0.113 – 0.247)	0.159 (0.075 – 0.273)	0.155 (0.047 – 0.270)
Un-ionised Ammonia (mg/L)	0.004 (0.002 – 0.007)	0.003 (0.001 – 0.006)	0.003 (0.001 – 0.005)
Chlorophyll-*a* (µg/L)	1.3 (0.4 – 3.5)	1.4 (0.4 – 4.2)	3.4 (0.8 – 9.0)
E.coli (count/100mL)	410 (75 – 2,100)	360 (51 – 5,200)	710 (430 – 890)

Notes:
[1] Data presented are depth averaged (except as specified) and annual arithmetic means except for *E. coli* (geometric mean).
[2] Data in brackets indicate ranges.
[3] Underlined indicates occurrence of non-compliance with that parameter of WQOs.

5.3.3 To further improve the water quality of Victoria Harbour, the construction of HATS Stage 2A has been proceeded with a view to commissioning by the end of 2014. Upon commissioning, the sewage tunnels will collect the remaining 25% of the sewage currently generated daily from Hong Kong Island region, and convey the sewage to the SCISTW for

treatment. Therefore, it is anticipated that the marine water environment would be further improved.

5.4 Identification of Water Sensitive Receivers

5.4.1 To evaluate the potential water quality impacts from the Project, areas within 300m from the proposed Project site, and the adjacent water sensitive receivers (WSRs) within the Victoria Harbour (Phase One) WCZ are considered. No inland watercourse such as river or natural stream located within 300m from the Project site. The WSRs within the Victoria Harbour (Phase One) WCZ are identified as below and shown in **Figure 5.1**:-

- F1 – Kwai Chung Hospital Flushing Water Intake
- C1 – Kwai Chung Hospital Cooling Water Intake
- C2 – Tsuen Wan Cooling Water Intake
- TS1 – Rambler Channel Typhoon Shelter

5.5 Assessment Approach and Methodology

5.5.1 The criteria and guidelines for assessing water quality impacts as stated in Annexes 6 and 14 of the EIAO-TM have been followed.

5.5.2 The specific construction methods and operational activities of the Project have been reviewed and the 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 Project have been identified.

5.5.3 The identified pollution sources have been evaluated to determine the significance of impact to the adjacent water system and their representative sensitive receivers.

5.5.4 The potential cumulative impacts due to other related concurrent and planned projects activities or pollution sources within the assessment area have been assessed and mitigation measures proposed where required to control any water quality impacts to acceptable levels.

5.6 Identification of Potential Impacts

Construction Phase

5.6.1 The Project would involve construction of flyover as described in **Section 2**. Since no marine construction works are required, potential water pollution sources during the construction phase would be those generated from the land-based works activities including foundation piling, footings, columns, bridge decks, utilities work, general cleaning, wheel washing, dust suppression, etc.

5.6.2 Major potential sources of water quality impact associated with the land-based construction of the Project have been identified and described as follow:

- Construction site run-off during foundation piling;
- Accidental chemical spillage; and
- Sewage effluent produced by on-site workforce.

Construction Site Run-off

5.6.3 Construction site run-off may contain increased loads of sediments, other suspended solids and contaminants. Release of uncontrolled site run-off would increase the suspended solid levels and turbidity in the nearby water environment.

5.6.4 Potential pollution sources of site run-off comprise:

- Run-off and erosion from bare soil and earth, drainage channels, earth working areas and stockpiles;
- Wastewater from dust suppression sprays and wheel washing facilities at site entrances;
- Fuel, oil, solvents and lubricants from maintenance of construction machinery and equipment.

5.6.5 With a construction site area of approximately 23,500m^2 and return period of 50 years, the estimated peak hour flow would be 0.59m^3/s for rainfall duration of 3 minutes. Effluents including any site runoff into the drainage channels, are controlled to comply with the WPCO.

Accidental Chemical Spillage

5.6.6 The on-site general construction activities may cause contamination of the surface soils due to accidental spillage of chemicals used in construction works, which includes spent lubrication oil, diesel and solvents, etc. The contaminated soil particles may be washed away by construction site run-off or stormwater drainage which in turn causes water pollution.

Sewage Effluent

5.6.7 Potential impacts may arise from wastewater generated from eating areas, temporary sanitary facilities and waste disposal areas provided for the on-site construction workforce. The characteristics of the wastewater may include high levels of organics (ie. BOD_5), ammonia and *E. coli*. Assuming 150 workers on site with a daily sewage generation of 0.06 m^3 per capita in accordance with Sewerage Manual by Drainage Services Department (DSD), the estimated sewage would be 9m^3/day.

Operation Phase

5.6.8 The major source of potential impact would be surface runoff containing grit, oil and debris arising from road vehicles. With additional road area of approximately 4,200m^2 and return period of 50 years, the estimated peak surface runoff during storm would be 0.33m^3/s for rainfall duration of 3 minutes.

5.7 Prediction and Evaluation of Potential Impacts

Construction Phase

5.7.1 Potential sources of water quality impacts associated with the construction phase of the Project include:

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

Construction Site Run-off

5.7.2 Site run-off and drainage from the Site may contain suspended solids and other contaminants. Potential sources of water pollution from site run-off would comprise:

- Run-off from exposed bare soil and earth, drainage channels and stockpiles;
- Release of grouting and cement materials with rain wash;

- Wash water from dust suppression sprays and vehicle wheel washing; and
- Fuel, oil and lubricant from maintenance of construction vehicles and mechanical equipment.

5.7.3 Perimeter drains could be applied along the Site boundary to collect site run-off and also intercept run-off from outside.

5.7.4 Mitigation measures of good site practice shall be implemented to control construction site run-off, and to minimise the chance of introducing silt and other pollutants into the storm water drainage system. Silt removal facilities shall be provided and discharge license under WPCO shall be obtained prior to any discharge.

5.7.5 Since all construction works would be land-based in nature, with the implementation of adequate site drainage and provision of silt removal facilities, as well as control under WPCO, no unacceptable water quality impacts to WSRs are anticipated.

General Construction Activities and Accidental Spillage of Chemicals

5.7.6 General construction activities have the potential to cause water pollution as a result of stockpiling, accumulation of debris and rubbish, concrete dust, etc. Spillage of chemicals, such as oil and diesel from construction plant and equipment and paints, could also result in water quality impacts.

5.7.7 Nevertheless, it is considered that the impact of these activities to WSRs will be minimal provided that the site boundaries are well maintained with the aforesaid perimeter drains. Good construction and site management practices, such as sediment barriers, site drainage and waste disposal, will also limit the sediment and pollutants to acceptable levels.

Sewage Generated from On-Site Construction Workers

5.7.8 Sewage is characterised by high levels of BOD, ammonia and *E.coli*. Water quality impacts from sewage generated by the on-site workforce will be avoided if adequate sewage collection and disposal facilities, such as portable chemical toilets, are properly installed and maintained.

Operation Phase

5.7.9 The road surface runoff will be discharged to decked nullah leading to Rambler Channel via public storm drain. As incorporated in the design, the runoff will be collected by surface water drainage system and discharged to storm drains. The surface runoff can also be controlled by best management practice, etc (e.g. properly designed silt traps with appropriate spacing, sufficient cleaning frequency for silt traps and road gullies, etc). With adequate capacity to cater for treating all surface water and best management practice, it is envisaged that the water quality impact from the land-based operation will be minimal and further mitigation measure would be not be required.

5.8 Cumulative Impact

5.8.1 There are no major concurrent projects nearby and therefore it is envisaged that the cumulative impact is minimal.

5.9 Recommended Water Quality Mitigation Measures

Construction

5.9.1 General good site practice as described in the following is to be implemented as measures to minimise potential water quality impact during construction phase.

Construction Site Run-off and General Construction Activities

5.9.2 In accordance with the ProPECC PN 1/94, construction phase mitigation measures should include the following:

- At the establishment of works site, perimeter 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;

- 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. A sedimentation basin would be required when necessary. The detailed design of the silt / sand traps 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 the earthworks have been completed. 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 material) 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 rainstorm events;

- All vehicles and plant should be cleaned before leaving the Site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing facilities / bay should be provided at the exit of the 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;

- 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 6 of this EIA report; and

- All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds with adequate storage capacity to prevent spilled fuel oils.

5.9.3 Site drainage will be implemented according to the requirement and findings from Drainage Impact Assessment which has been submitted to and approved by DSD.

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

Effluent Discharge

5.9.5 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 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 100m 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.

Sewage Generated from On-Site Construction Workers

5.9.6 Portable chemical toilets and sewage holding tanks are recommended for the handling of the construction sewage generated by the workforce. A licensed contractor should be

employed to provide appropriate and adequate portable toilets and be responsible for appropriate disposal and maintenance.

Accidental Spillage of Chemicals

5.9.7 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 (Cap. 354C)* should be observed and complied with for control of chemical wastes.

5.9.8 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 only be undertaken within the areas appropriately equipped to control these discharges.

Operation

5.9.9 The surface runoff will be controlled by best management practice. Surface runoff collection system with silt traps and road gullies should be provided. The road should be designed to direct all surface runoff to the system. The capacity should be properly designed to cater for all surface water. Drainage will be implemented in accordance with the requirement and findings from Drainage Impact Assessment which has been submitted to and approved by DSD.

5.9.10 The system should be properly maintained and cleaned regularly to ensure good service condition in which Highways Department will be responsible for the maintenance of road drains.

5.10 Evaluation of Residual Impacts

5.10.1 Adverse residual impacts during the construction and operation phases of this Project would not be anticipated, provided that the above mitigation measures are implemented.

5.11 Environmental Monitoring and Audit Requirements

5.11.1 With the proper implementation of recommended mitigation measures, the adverse impact during construction and operation of the Project would be insignificant and hence environmental monitoring for water quality is not considered necessary but regular site inspection should be conducted at the construction and work area in order to ensure the mitigation measures are adequately implemented.

5.12 Conclusion

5.12.1 Potential water pollution sources have been identified as construction site run-off, sewage from workforce, and potential risk of chemical spillage. Adverse residual impacts would not be anticipated with the implementation of adequate mitigation measures including the construction site practices in accordance with the EPD's *ProPECC PN 1/94 Construction Site Drainage*, provision and management of portable toilets on-site, and preventive measures to avoid accidental chemical spillages. Furthermore, implications arising from the surface runoff during the operation phase would be insignificant. Adverse water quality impact would not be anticipated with the implementation of the recommended mitigation measures based on the findings of this EIA study.

6. WASTE MANAGEMENT IMPLICATION AND LAND CONTAMINATION

6.1 Introduction

6.1.1 This Chapter identifies potential environmental impact resulting from the handling, collection and disposal of the construction waste associated with the Project. It also presents an assessment of the potential for the occurrence of land contamination along the route of the Flyover.

6.1.2 The potential environmental impacts concerning their handling, collection and disposal will be assessed in accordance with the criteria and guidelines given in Annexes 7 and 15 of EIAO-TM, while the potential environmental impacts of land contamination will be assessed in accordance with the criteria and guidelines given in Sections 3.1 and 3.2 of Annex 19 of EIAO-TM.

6.1.3 Options for waste minimisation, recycling, storage, collection, and disposal of waste arising from the Project have been examined and procedures for minimising environmental impacts due to handling and disposal of waste are recommended.

6.2 Environmental Legislation and Guidelines

General Waste Management

6.2.1 The following legislations are related to the handling, treatment and disposal of waste in Hong Kong, and will be considered in the assessment of potential impacts and waste management:

- Waste Disposal Ordinance (Cap 354);
- Land (Miscellaneous Provisions) Ordinance (Cap 28); and
- Public Health and Municipal Service Ordinance (Cap 132) – Public Cleansing and Prevention of Nuisances By-laws.

6.2.2 The following subsidiary regulations of the Waste Disposal Ordinance are also related:

- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C); and
- Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap 354N).

Waste Disposal Ordinance (Cap 354)

6.2.3 The Waste Disposal Ordinance (WDO) prohibits any unauthorised disposal of wastes. Construction waste, defined under Cap. 354N of the WDO means any substance, matter or thing that is generated from construction works 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. Under WDO, waste can be disposed of only at designated waste disposal facilities licensed by the EPD.

Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C)

6.2.4 Chemical wastes include unwanted substances or chemicals causing pollution or impose a danger to health or risk of pollution to the environment. A person should not produce, or cause to be produced, any chemical wastes unless he/she is registered with the EPD. Chemical wastes must be treated using on-site plant as licensed by the EPD or with

engaging a licensed collector to transport the wastes to a licensed facility. For each consignment of wastes, the waste producer, collector and disposer must sign all relevant parts of a computerised trip ticket so as to trace wastes from production to disposal.

6.2.5 This regulation also prescribes the storage facilities to be provided on-site including the labelling and warning signs. To minimise the risks of pollution and danger to human health and life, waste producers are required to prepare and make available written emergency procedures for any spillage, leakage or accidents arising from storage of chemical wastes. The waste producers must also provide employees with training for such procedures.

Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap 354N)

6.2.6 Under the WDO and the Charging Regulation, wastes can only be disposed of at designated waste disposal facilities licensed by EPD. Schedule 5 of Regulation defines that inert construction waste includes rock, rubble, boulder, earth, soil, sand, concrete, brick, tile, masonry or used bentonite. According to Schedule 6 of the Regulation, construction waste delivered to a landfill for disposal must not contain more than 50% by weight of inert material while those to a sorting facility for disposal must contain more than 50% by weight of inert material. Whereas construction waste delivered to a public fill reception facility for disposal must consist entirely of inert material.

6.2.7 For construction work with a value of more than HK$1 million, the main contractor is required to establish a billing account at the EPD before transporting the construction waste to the designated waste disposal facilities (for example, landfill and public fill). The vessels for delivering construction waste to the public fill reception facilities require prior approval from the Public Fill Committee (PFC). Any breach of these regulations may lead to a fine and/or imprisonment.

Land (Miscellaneous Provisions) Ordinance (Cap 28)

6.2.8 The inert portion of Construction and Demolition (C&D) materials (including rocks, soil, broken concrete, building debris, etc.) may be taken to public fill reception facilities (PFRFs). PFRFs usually form part of land reclamation schemes and are operated by the Civil Engineering and Development Department (CEDD) and others. The Land (Miscellaneous Provisions) Ordinance requires individuals or companies who deliver public fill to PFRFs to obtain Dumping Licences. The licences are issued by CEDD under delegated authority from the Director of Lands.

6.2.9 Individual licences and windscreen stickers are issued for each vehicle involved. Under the licence conditions, PFRFs will only accept inert construction waste. In addition, in accordance with paragraph 12 of the Development Bureau (DevB) Technical Circular (Works) TC(W) No.6/2010, PFC will advise on the acceptance criteria. The material will, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical wastes, animal and vegetable matter and any other materials considered unsuitable by the PFRF supervisor.

Public Cleansing and Prevention of Nuisances Regulation (Cap 132)

6.2.10 This regulation provides further control on the illegal dumping of litter or waste in streets and public places (including water courses, streams, channels etc). Offence to this regulation would result in a fine and/or to imprisonment.

Other Relevant Guidelines

6.2.11 The following guidelines are also relevant to waste management in Hong Kong:

- Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), EPD ;
- Works Branch Technical Circular (WBTC) No. 32/92, The Use of Tropical Hard Wood on Construction Site;
- WBTC No. 2/93, Public Dumps;
- WBTC No. 2/93B, Public Filling Facilities;
- WBTC Nos. 25/99, 25/99A and 25/99C, Incorporation of Information on Construction and Demolition Material Management in Public Works Subcommittee Papers;
- WBTC No. 12/2000, Fill Management;
- WBTC Nos. 6/2002 and 6/2002A, Enhanced Specification for Site Cleanliness and Tidiness;
- WBTC No. 11/2002, Control of Site Crusher;
- WBTC No. 12/2002, Specification Facilitating the Use of Recycled Aggregates;
- Environment Transport and Works Bureau Technical Circular (Works) (ETWB TC(W)) No. 33/2002 Management of Construction and Demolition Material Including Rock;
- ETWB TC(W) No. 19/2005 Environmental Management on Construction Sites; and
- DevB TC(W) No. 6/2010, Trip Ticket System for Disposal of Construction & Demolition Materials, Development Bureau.

6.2.12 The ETWB TC(W) No. 19/2005 sets out the policy and procedures requiring contractors to prepare and implement an Environmental Management Plan (EMP) to abate environmental nuisances on construction site and reduce C&D material to be disposed of during construction.

Contaminated Land

6.2.13 The following legislations are related to the land contamination issues concerning handling, treatment and disposal of contaminated materials:

- Waste Disposal Ordinance (Cap 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C); and
- Dangerous Goods Ordinance (Cap 295).

6.2.14 The following EPD publications provide guidance on the land contamination assessment in this Assignment:

- Practice Guide for Investigation and Remediation of Contaminated Land (August 2011);

- Guidance Note for Contaminated Land Assessment and Remediation (December 2007); and
- Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management (August 2007).

6.3 Assessment Approach and Methodology

6.3.1 The assessment of waste management implications has been conducted in accordance with Annexes 7 and 15 of the EIAO-TM. This includes:

- Estimation of types and quantities of wastes generated;
- Assessment of potential impact caused by handling (including labelling, packaging and storage), collection, and disposal of wastes with respect to potential hazard, air and odour emission, noise, wastewater discharge and public transport; and
- Determination of practical mitigation measures for the environmental impacts.

6.4 Identification of Waste Sources

6.4.1 Construction activities will result in the generation of a variety of wastes which can be divided into distinct categories based on their constituents, as follows:

- Inert C&D material (inert portion of C&D material);
- C&D Waste (non-inert portion of C&D material);
- Marine Sediment;
- Chemical waste; and
- General refuse.

6.4.2 The operational phase of the proposed project is not expected to generate any waste.

6.5 Prediction and Evaluation of Waste Impacts

Construction Phase

6.5.1 The nature and preliminary quantities of each of these waste types arising from the construction phase of the proposed works are identified below. The detailed calculations of materials and waste arising are required to be submitted to Government under the requirements of WBTC 25/99 during the detailed design. **Table 6-1** summarises the estimated quantities of different types of waste arising from the Project.

Table 6-1 Summary of Estimated Quantities of Waste Arising from Construction Phase

Waste Type	Source	Total Quantity	Handling	Quantity to be Reused On-site	Quantity to be Disposed of Off-site
Inert C&D material	Excavation for foundation	4,730 m^3	Reuse on-site or disposed off-site to public fill reception facilities in Tuen Mun Area 38 Fill	4,810 m^3 of inert C&D material as fill material	1,140 m^3 inert C&D material [1]
	Excavation for at grade road construction	100m^3			

Waste Type	Source	Total Quantity	Handling	Quantity to be Reused On-site	Quantity to be Disposed of Off-site
	Excavation for other works (e.g. demolition works, utility diversion)	930 m^3	Bank		
C&D Waste	Cleared vegetation; wood from formwork; unusable cement mixes; and damaged or contaminated construction materials	655 m^3	Sent to WENT landfill	--	790 m^3
Marine Sediment	Excavation for piling and foundation works	400m^3	Treatment for decontamination, if necessary followed by cement stabilisation for treated and uncontaminated marine sediment	480m^3 [2] as fill material for abutment after treatment	--
Chemical Waste	Scrap batteries, spent acid/alkali, spent mineral oil/ cleaning fluid, spent solvent, engine oil and fuel from construction plants or equipment	Few hundred litres per month	Stored on-site within suitably designed containers and collected by licensed company	--	Few hundred litres per month
General Refuse	Food waste, waste paper, aluminium cans etc generated from workforce	Few hundred kilogrammes per day in the peak period	Sorted recyclables sent to recycling company, other non-recyclable refuse collected by on-site refuse collection point and transferred to landfill	--	Few hundred kilogrammes per day in the peak period

Note:

[1] A factor of 1.2 is applied in the estimate of inert C&D material and C&D waste quantity to be disposed of off-site.

[2] The volume of the marine sediment after cement stabilisation will be increased by around 20%.

Inert Construction and Demolition (C&D) Material

6.5.2 Inert C&D material would be generated during the construction of proposed bridges including the foundation, substructure and superstructure works, and the reprovisioning work of the footbridge. Types of inert C&D material include soil, rock, concrete, bituminous material etc. The total quantity of the inert C&D material generated in the Project is estimated to be approximately 5,760 m^3. Among this, about 4,810 m^3 of inert C&D material would be reused on-site as fill material. Approximately 1,140 m^3 of inert C&D material would be disposed to public fill reception facilities in Tuen Mun Area 38 Fill Bank for other beneficial uses with accounting a factor of 1.2 in the estimate of inert C&D material quantity to be disposed of off-site.

6.5.3 The site for the Public Works Regional Laboratory of Tsuen Wan (Laboratory Site), which is currently allocated to CGE/Standards & Testing of CEDD, is proposed to be the site office and stockpiling area for those inert C&D material not immediately disposed during construction phase.

C&D Waste

6.5.4 In addition to the inert C&D material that would be generated, as noted above, which are suitable for reuse on site or as public fill, some C&D waste would, also, be generated during the construction phase. These materials include:

- Any cleared vegetation;
- Wood from formwork;
- Unusable cement mixes; and
- Damaged or contaminated construction materials.

6.5.5 About 655 m^3 of C&D waste would be generated during construction phase. They will be disposed to WENT Landfill. A factor of 1.2 is applied in the estimate of C&D waste quantity to be disposed of off-site and therefore the quantity of C&D waste to be disposed off-site is 790 m^3.

Marine Sediment

6.5.6 According to the existing information from Geotechnical Investigation (GI) records, marine sediment has been identified in the reclamation area within the Project Site. It is estimated that approximately 400m^3 of marine sediment will be excavated from the reclaimed land due to the piling works for the proposed bridges in the Project. The assessed volume will be verified during detailed design stage of the Project in future.

6.5.7 A common way of handling marine sediment in local construction industry is disposing of it to marine dumping sites in accordance with ETWB TC No 34/2002 and Dumping at Sea Ordinance, Cap. 466 (DASO). However, recent public concerns are growing on the high levels of heavy metal contents found in some common seafood species due to serious sea water pollution.

6.5.8 One method to address this environmental issue is by treatment and reuse of the dredged marine sediment rather than disposing it to the sea.

6.5.9 With reference from overseas' and Hong Kong's cases, reuse of the dredged sediment on-site with treatment, if necessary, is proposed to this Project, a preliminary contamination

assessment for the site of marine sediment was conducted in accordance with the following Technical Memorandum and Guidance Notes published by the EPD:

- Practice Guide for Investigation and Remediation of Contaminated Land, August 2011 (Practice Guide);
- Guidance Note for Contamination Land Assessment and Remediation, August 2007 (Guidance Note); and
- Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management, December 2007 (Guidance Manual).

6.5.10 Possible ex-situ treatment and beneficial reuse options are identified to demonstrate that no environmentally unacceptable impact would be resulted from the excavation, treatment and reuse of marine sediment.

6.5.11 The preliminary contamination assessment and possible ex-situ treatment and beneficial reuse options for the marine sediment to be excavated in this Project is presented as follows:

Initial Contamination Evaluation of the Site for Marine Sediment

6.5.12 The history information of the site with possible excavation of marine sediment (Site with Marine Sediment) was obtained by reviewing the relevant aerial photographs. The aerial photographs are shown in **Appendix 6-2**. **Table 6-2** summarises the findings of the aerial photographs reviewed.

Table 6-2 Findings of Aerial Photographs Reviewed for the Site with Possible Excavation of Marine Sediment

Year	Notes
1963	The Site with Marine Sediment comprises natural hillside and sea where there were a lot of fishing boats around the site.
1973	Extensive reclamation has taken place at the Site with Marine Sediment.

6.5.13 As observed from the aerial photograph of 1963 in **Appendix 6-2** the Site with Marine Sediment, is located on the sea in 1963. From the aerial photograph of 1973, the site was reclaimed.

6.5.14 As the Site with Marine Sediment is located in the urban area where there was industrial development nearby from 1950s, local discharge of polluted effluent from industrial uses might impose a potential cause to contaminate the marine sediment in the sea before reclamation of the site.

6.5.15 From a conservative point of view, it is proposed to conduct a site investigation with environmental sampling and analysis during detailed design stage of this Project on the Site with Marine Sediment to identify the contamination extent of the marine sediment.

6.5.16 As the marine sediment was potentially contaminated by local discharge of polluted effluent from many unknown uses, the potential contaminants may include semi-volatile organic compounds (SVOCs), metals, polychlorinated biphenyl, petroleum carbon ranges (PCRs) and organometallics.

6.5.17 It is proposed that the samples could be collected at where the excavation of marine sediment to be conducted which are the locations for piles. Exact sampling locations and

numbers shall be identified with the updated information during detailed design stage. The proposed locations of works with possible marine sediment excavation with the past geotechnical investigation records showing the locations of samples for marine sediment are shown in **Figure 6-1**

6.5.18 Among the four different post-restoration land use categories, namely "Urban Residential", "Rural Residential", "Industrial" and "Public Parks", "Public Park" is the most relevant use to the proposed development as flyover from Kwai Tsing Interchange Upramp to Kwai Chung Road as they are both open space of good ventilation and with transient receivers. Therefore, it is suggested that the contamination extent of the marine sediment excavated should be checked against the RBRGs for soil for "Public Park" as the marine sediment is proposed to be re-used on-site.

6.5.19 Samples of marine sediment should be collected and analysed against the RBRGs for soil for Public Park. The RBRGs for soil is presented in **Appendix 6-1**.

6.5.20 A more detailed assessment and environmental investigation for marine sampling and analysis shall be carried out during the detailed design stage of this Project.

6.5.21 A Sediment Assessment Plan shall be submitted with the updated information during the detailed design stage and obtain EPD's approval before the environmental investigation. A Sediment Assessment Report / Sediment Remediation Plan should be prepared pending the result of environmental investigation for EPD's approval before treatment and reuse of marine sediment.

Possible Remediation Options

6.5.22 With reference from the consultancy study – FM01/2007 by CEDD on various management options for marine sediment in Hong Kong [1], the following presents possible remediation options for treatment of marine sediment exceeding the proposed RBRGs for this Project.

(a) Mechanical Dewatering

This technique separates water from the sediments by mechanical means such as belt filter presses and centrifuge. The advantages are high capacity, and it can be easily increased by using additional presses. Also, it requires small area for installation. Moreover, dewatering is effective and efficient. However, it requires relatively high investment and operation costs. Besides, treated sediments after dewatering may be still considered contaminated which requires further treatment.

This is applied in St. Lawrence River in Canada (EC. 1995). Shallow areas that posed a navigational hazard in the St. Lawrence River at the Port of Sorel were dredged and found to contain elevated levels of metals (EC, 1995). The project utilised a rotatory press and additives to remove water and decontaminate approximately 5,000m^3 of sediment along the river. The rotary press reduced the volume of sediments 5 to 10 times and the dryness level went from 15% to 72% of total particulate matter during dewatering.[2]

(b) Biological Remediation

This option makes use of bio-oxidation of organic matter by micro-organisms to break down Polychlorinated Biphenyls (PCBs), pesticides, and other organic constituents into less toxic compounds. It has high removal efficiency for PCRs and polycyclic aromatic hydrocarbon (PAHs) but the treatment time is relatively long. The presence of heavy

metals can inhibit microbial metabolism and thus affects the removal efficiency.

The Stauffer Management Company Superfund Site is an inactive pesticide manufacturing/distribution facility in Tampa, Florida. From 1951 to 1986, the site was used to formulate organochlorine and organophosphate pesticides. From 1953 to 1973, waste materials from the facility were disposed on site, leading to pesticide contamination in soil, surface water, sediment, and groundwater. Bioremediation was adopted from 1997 to 1998 for treatment of pesticide-contaminated surface soils and sediments at the site. Concentrations of toxaphene were reduced by more than 90% and chlordane by nearly 90%. [3]

(c) Chemical Treatment

Oxidation, reduction, hydrolysis or neutralisation are the available technologies for chemical treatment. The benefits are low energy consumption and relatively rapid process. However, as treatment methods are specific to particular contaminants or classes of compounds, selection of method and reagent is important to the success of the process.

A research on separating the Tributyltin (TBT) contaminated seawater from the dredged marine sediment was undertaken by the Kyushu University in Japan. It is reported that TBT was successfully separated from the contaminated seawater by applying coagulant called PSl-100 as well as filtering the water through fibre sheet, sand and activated carbon. Following the treatment, the concentration of TBT was reduced from 1,200-1,450ng/L to 3ng/L.

(d) Thermal Destruction / Incineration

It is the most widely operation used for destroying organic contaminants in which the organic contaminants are volatilised at temperatures greater than 1000°F in the presence of oxygen resulting in combustion and destruction of the contaminants. It is effective that incineration typically achieve greater than 99% destruction for organics. However this option is relatively expensive and not effective on heavy metals. Additional handling / treatment of by-products such as residue contaminants in ash, gaseous emissions and wastewater is required.

The Drake Chemical Superfund (DCS) Site included a chemical manufacturing facility that operated from 1951 to 1982, producing chemical intermediates used in dye, cosmetic, textile, pharmaceutical, pesticide and herbicide manufacturing. Drums of chemical waste, chemical sludge, and demolition debris were disposed on the ground surface and in the shallow subsurface at the site. Site soil and chemical sludge were contaminated with volatile organic compounds (VOCs), SVOCs and metals.

The incinerator was in full-scale operation from 1998 to 1999 as the remedial technology for addressing soil contamination at the site. All site soil was excavated down to the water table and treated. Treated soil and fly ash that met treatment standards were used as fill material at the site. [3]

(e) Sediment Washing

Sediment washing is a water-based process for mechanically scrubbing excavated sediment to remove contaminant and contaminants from sediment either by dissolving or suspending them in a wash solution. A wide variety of sediment contaminated with soluble metals, halogenated solvents, aromatics, gasoline, fuel oils, PCBs, chlorinated phenols and pesticides can be treated with this method with high removal efficiency. The treatment cost

is relatively high and this process cannot efficiently treat fine particles, low-permeability packed materials, or sediment with high humic content.

Advanced Sediment Washing Technology is marketed jointly by WESTON and BioGenesis, West Chester, PA. This technology is a multistaged sediment washing and organic oxidation process for decontaminating dredged sediments and producing a marketable fine-grained soil-like product for reuse after the addition of bulking materials. During the process, organic material is stripped from the solid particles and chemically oxidised. [4]

(f) Immobilisation / Solidification / Stabilisation

Reactive materials are mixed with the marine sediment to immobilise contaminants. Available technology in market includes microencapsulation, cement-based solidification and silicate-based solidification. It operates most successfully in wastes with inorganics and metals and is a relatively less expensive technique. The treated sediment can be reused as fill material for construction works. Nevertheless, it is not effective on volatile organics and the effectiveness on organics or other leachables is inconclusive.

Sediments at the New York/New Jersey Harbour were contaminated with organochlorine pesticide, PAHs, PCBs, dioxins and furans and metals. Immobilisation was adopted in the treatment of the contaminated sediment. The treatment of the material was done in a barge. Stabilised materials have been used as structure fill at a parking lot and capping brownfield site in New Jersey.[5]

Sediments excavated for South Island Line (East) were sampled and tested in accordance with ETWB TC(W) No. 34/2002 and were found contaminated with copper and zinc. Cement stabilisation was adopted to treat the metal contaminated sediment. The cement stabilised materials were used as fill on-site in 2014.[6]

Treatment and Outlet of Decontaminated or Uncontaminated Marine Sediment

6.5.23 The applicant shall propose in the Sediment Assessment Report / Sediment Remediation Plan the remedial measures for decontaminating marine sediment based on the results from environmental investigation and the clean-up criteria for the contaminated marine sediment for agreement with EPD.

6.5.24 It is proposed to locate the treatment facilities at the Laboratory Site or the area just near to the piling works where marine sediment is excavated, depending on where it is excavated and the area required for the treatment.

6.5.25 It is proposed to reuse the marine sediment as fill material for abutment of the proposed Bridge H. Unless solidification or stabilisation process is chosen as the remediation option for the contaminated marine sediment, to reuse the marine sediment as fill material, the decontaminated or uncontaminated marine sediment should undergo cement stabilisation process for improvement of the structural stability. After cement stabilisation process, it is expected the volume of the treated marine sediment will expand by 10-20%.

6.5.26 The cement stabilised marine sediment shall comply the criteria agreed upon with EPD, for example Universal Treatment Standards (UTS) and Unconfined Compressive Strength (UCS) standard, in accordance with the Practice Guide.

6.5.27 With identification of proper treatment methods for the excavated marine sediment pending the results of site investigation, no environmental impact is anticipated from the

excavation, treatment and reuse of the marine sediment.

Chemical Waste

6.5.28 Chemical Waste, as defined under the Waste Disposal (Chemical Waste) (General) Regulation, includes any substance being scrap material, or unwanted substances specified under Schedule 1 of the Regulation. A complete list of such substances is provided under the Regulation, however, substances likely to be generated by construction activities will, for the most part, arise from the maintenance of equipment. These may include, but not limited to, the followings:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils/cleaning fluids from mechanical machinery; and
- Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

6.5.29 It is difficult to quantify the amount of chemical waste which will arise from the construction activities as it will be highly dependent on the Contractor's on-site maintenance intention and the number of plants and vehicles utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent produced from plant maintenance will be small, (in the order of a couple of hundred litres per month) and will be readily accepted at the Chemical Waste Treatment Centre (CWTC) or other licensed waste oil recycling facilities. The actual amount of chemical wastes generated should be quantified and recorded in the Site Waste Management Plan to be prepared by the Contractor.

General Refuse

6.5.30 Construction site workers, site offices and canteens will result in the generation of a variety of general refuse requiring disposal. General refuse generated on site will mainly consist of food wastes, aluminium cans and waste paper.

6.5.31 The maximum number of workers and peak activities on-site are expected around the mid of Year 2019 to mid of Year 2020, hence the site will produce the highest volume of general refuse.

Operation Phase

6.5.32 The operational phase of the proposed Project is not expected to generate any waste and thus no significant waste implications during the operational phase are predicted.

Timing of Waste Generation

6.5.33 Based on the preliminary construction programme, the construction will be carried out from 2018 to 2021. A tentative estimated timing of waste arising is shown in **Table 6-3**.

Table 6-3 Tentative Estimated Timing of Waste Arising

Type of Waste	Months
Construction Phase	
Inert C&D Material	M1 to M37
C&D Waste	M1 to M37
Marine Sediment	M3 to M7 and M20 to M23
Chemical Waste	Entire construction phase
General Refuse	

Transportation Frequency and Route

6.5.34 The peak generation of the inert C&D material and C&D waste is expected during the foundation works of Bridge H including excavated soil and construction debris such as the used formworks at the months M22-M23 of the tentative construction programme. Among this period, all the inert C&D material and C&D waste will be transported to the stockpiling area at the Laboratory Site via Kwai Chung Road and Tsuen Wan Road, pending for sorting and backfilling or disposal. Assuming 24 working days monthly, the daily generation rate of the inert C&D material and C&D waste estimated from the tentative construction programme is 33.5m^3. Assuming a density of 2 tonnes/m^3, approximately 7 trucks (10 tonnes loading capacity per truck) per day will be used to transport this amount of the inert C&D material and C&D waste to the stockpiling area.

6.5.35 Backfilling of the inert C&D material will be carried out from M24 to M27, after which the remaining inert C&D material and the C&D waste stockpiled before this period will be disposed off site within M28 which is considered as the peak period for disposal. Based on the tentative construction programme, the estimated quantity of inert C&D material and the C&D waste for disposal within M28 is expected to be 1116m^3 and 216m^3 after applying a factor of 1.2. The inert C&D material and C&D waste for disposal would be delivered to the public fill reception facilities and the landfill respectively. Assuming 24 working days monthly, the daily disposal rate of the inert C&D material and C&D waste is 46.5m^3 and 9m^3 respectively. Assuming a density of 2 tonnes/m^3, approximately 10 trucks (10 tonnes loading capacity per truck) per day would deliver the inert C&D material to Tuen Mun Area 38 Fill Bank and approximately 2 trucks (10 tonnes loading capacity per truck) per day would deliver the C&D waste to WENT Landfill for disposal in a month. No barging point and conveyor will be used. Other inert C&D material and C&D waste will be generated and disposed at later time during off-peak period.

6.5.36 The inert C&D material for disposal will be transported to Tuen Mun Area 38 Fill Bank via Tsuen Wan Road, Tuen Mun Road, Lung Mun Road while the C&D waste will be further transported to WENT Landfill via Lung Kwa Tan Road and Nim Wan Road.

6.5.37 The marine sediment excavated will be transported to the treatment facilities at the Laboratory Site or the area just near to the piling works where marine sediment is excavated during the period for excavation from M3 to M7 and M20 to 23. As the choice of location depends on where the marine sediment is excavated and the area required for the treatment, the transportation frequency and route cannot be provided at this stage.

6.5.38 As the quantity of chemical waste and general refuse is small, the chemical waste will be collected by licensed company in a truck monthly while general refuse will be collected by licensed collector and sent to WENT Landfill daily via the same route as C&D waste.

6.6 Mitigation of Adverse Environmental Impacts

6.6.1 The Contractor is responsible for the management of materials and wastes during construction. This includes control of wastes on site, removal of the waste materials from the site and the implementation of any mitigation measures to minimise waste or redress any problems that arise from waste associated with the works.

6.6.2 This section sets out the measures to be adopted to avoid or minimise potential adverse impacts associated with waste arising from the works under the headings of each waste type. The Contractor should incorporate these recommendations into a comprehensive on-site Waste Management Plan, (WMP). If, for any reason, the recommendations cannot be implemented, full justification should be given in the WMP.

6.6.3 In accordance with ETWB TC(W) No. 19/2005 – Environmental Management on Construction Sites, the WMP should be prepared and submitted for approval by the Architect/ Engineer/ Supervising Officer prior to any construction activities. During the construction period the WMP should be used as a working document to detail the on-going management procedures and to record waste arising from construction works and import of fill throughout the Contract. The WMP shall be subject to audit under the requirements of the Environmental Monitoring and Audit (EM&A) Procedures set out in the EM&A Manual accompanying this EIA Report.

Waste Management Hierarchy

6.6.4 The WMP shall be developed and implemented according to a best-practice philosophy of waste management. There are various waste management options, which can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long-term context. The hierarchy shall be as follows:

- Avoidance and minimisation, i.e. avoiding or not generating waste through changing or improving practices and design;
- Reuse of materials, thus avoiding disposal (generally with only limited reprocessing);
- Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and
- Treatment and disposal, according to relevant laws, guidelines and good practice.

6.6.5 The suitability (or otherwise) of material for reuse on site shall be detailed in the WMP. If, for any reason, the recommendations cannot be implemented, full justification should be given in the WMP for approval by Architect/Engineer/Supervising Officer according to ETWB TC(W) No. 19/2005.

Training

6.6.6 To facilitate adoption of the best-practice philosophy, training shall be provided to all personnel working on site. The training shall promote the concept of general site cleanliness and clearly explain the appropriate waste management procedures defined in the WMP. Overall, the training should encourage all workers to reduce, reuse and recycle wastes.

Records of Waste and Management

6.6.7 During construction, the WMP should be kept up-to-date on a monthly basis with records of the actual quantities of wastes generated, recycled and disposed of off-site. Quantities shall be determined by weighing each load or other methods agreed to by the Engineer's Representative. Waste shall only be disposed of at licensed sites and the WMP should include procedures to ensure that illegal disposal of wastes does not occur. Only waste haulers authorised to collect the specific category of waste concerned should be employed and a trip ticket system shall be implemented for offsite disposal of inert C&D material and C&D waste at public fill reception facilities and landfills. Appropriate measures should be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers.

Site Planning

6.6.8 Work site(s) shall be arranged and managed to facilitate the proper management of wastes and materials. The WMP shall include plans indicating specific areas designated for the storage of particular types of waste, reusable and recyclable materials as well as areas and management proposals for any stockpiling areas. Waste storage areas should be well maintained and cleaned regularly. Specific provisions for different types of material are outlined below. In general, these areas should be designed to avoid cross contamination of materials as well as pollution of the surrounding environment.

Inert Construction and Demolition (C&D) Material / C&D Waste

6.6.9 In order to minimise the impact resulting from collection and transportation of inert C&D material for off-site disposal, it is recommended that the excavated fill material should be reused on site as backfill material as far as possible. Also, careful design, planning and good site management should be maintained in order to minimise over ordering and generation of surplus materials such as concrete, mortars and cement grouts. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse.

6.6.10 Inert C&D material should be segregated on site into different waste and material types. This will increase the feasibility of certain components of the waste stream being recycled by specialised contractors. The Contractor should clearly demonstrate in the WMP how he intends to maximise the reuse of inert C&D material on-site. Where reuse of materials on site is not feasible, the Contractor should explore opportunities for recycling materials off-site. Inert C&D material shall be reused on site as much as possible or recycled.

6.6.11 Potential opportunities for recycling and reuse of inert C&D material from the Project include:

- Milling wastes arising from regrading of the existing pavement could be recycled on site and reused as either road-base in the new carriageways or fill for new embankments;
- Existing marginal roadside barriers comprise pre-cast units, which may be possible to be reused in the following widening works; and
- Existing bridge parapets comprise aluminium post and railings, which have a recyclable value and could be sold for reconditioning or reused for scrap metal.

6.6.12 Any stockpile should be sited away from existing watercourses and suitably covered to prevent wind erosion and impacts on air and water quality. Measures for impacts on air and water quality are described in **Sections 3** and **5** in this report, respectively.

6.6.13 C&D waste which cannot be reused or recycled should be segregated and stored in different containers or skips from the inert C&D material and should be disposed of to landfill.

Marine Sediment

6.6.14 In order to minimise the exposure to contaminated materials, workers should, when necessary, wear appropriate personal protective equipment (PPE) when handling contaminated sediments. Adequate washing and cleaning facilities should also be provided on site.

6.6.15 In order to minimise any potential adverse impacts arising from the handling, treatment and reuse of the marine sediment, it should be excavated, transported and processed properly. Stockpiling of contaminated sediments should be avoided as far as possible. If temporary stockpiling of contaminated sediments is necessary, the excavated sediment should be covered by tarpaulin and the area should be placed within earth bunds or sand bags to prevent leachate from entering the ground, nearby drains and surrounding water bodies. The stockpiling areas should be completely paved or covered by linings in order to avoid contamination to underlying soil or groundwater. Separate and clearly defined areas should be provided for stockpiling of contaminated and uncontaminated materials. Leachate, if any, should be collected and discharged according to the WPCO.

6.6.16 The approved Sediment Assessment Plan and Sediment Assessment Report with Remediation Plan shall be incorporated to the WMP.

Chemical Waste

6.6.17 Chemical waste should be handled in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* as follows. Containers used for the storage of chemical wastes should:

- Be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- Have a capacity of less than 450L unless the specifications have been approved by the EPD; and
- Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the *Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C).*

6.6.18 The storage area for chemical wastes should:

- Be clearly labelled and used solely for the storage of chemical waste;
- Be enclosed on at least 3 sides;
- Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- Have adequate ventilation;

- Be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and
- Be arranged so that incompatible materials are adequately separated.

6.6.19 The Contractor shall register with EPD as a Chemical Waste Producer. Waste oils and other chemical wastes as defined in the *CAP 354C* will require disposal by appropriate means and could require pre-notification to EPD prior to disposal. Appropriate means include disposal:

- Via a licensed waste collector; and
- To a facility licensed to receive chemical waste, such as the CWTC which also offers a chemical waste collection service and can supply the necessary storage containers; or

General Refuse

6.6.20 General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

6.6.21 General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible. Therefore separate, labelled bins for their deposit should be provided if feasible.

6.6.22 Office waste can be reduced through recycling of paper if volume is large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.

6.7 Evaluation of Residual Impacts

6.7.1 The Project is likely to result in the generation of a variety of wastes and require management and disposal of inert C&D material and C&D waste, marine sediment, chemical waste and general refuse. Provided that the wastes 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 Project would be envisaged.

6.8 Environmental Monitoring and Audit Requirements

6.8.1 It is the Contractor's responsibility to ensure that all wastes produced during the construction of the Project are handled, stored, and disposed of in accordance with good waste management practices and relevant regulations and requirements. The mitigation measures recommended in **Section 6.6** should form a basis of the WMP to be developed by the Contractor in the construction phase of the Project.

6.9 Land Contamination

Methodology

6.9.1 The objective of this assessment is to identify and evaluate the potential soil contamination along the Project Site and if required, develop an assessment plan to determine the extent of any contamination present. In order to achieve this, the following has been undertaken:

- Review of the current and historical land use of the site to evaluate whether there is the potential for any soil or groundwater contamination to have occurred;
- Assess any potential environmental impacts arising as a result of land contamination or during future use of the land; and
- Site visits to confirm land uses and likely impacts of any land contamination identified.

6.9.2 Site visits were undertaken on the 7 and 28 November 2013 along the road alignment to confirm land uses and identify potential land contamination sources.

Review of Aerial Photographs and Historic Land Uses

6.9.3 The site history information of the Study Area was obtained by reviewing the relevant aerial photographs. The aerial photographs are shown in **Appendix 6-2**. **Table 6-4** summarises the findings of the aerial photographs reviewed.

Table 6-4 Findings of Aerial Photographs Reviewed for Project Site

Year	Notes
1963	The study area comprises natural hillside, anthropogenic terrace and sea.
1973	Extensive reclamation has taken place at the study area. Kwai Chung Road has been constructed
1982	Tsuen Wan Road and flyovers were constructed. The Tsuen Wan Line was constructed. The land between the elevated section of Tsuen Wan Road and the Tsuen Wan Line has been cleared.
1993	Container Port Road South was constructed. Temporary buildings were constructed in 1983 and removed in 1989 at the area between the elevated road and Tsuen Wan Line.
2003	The area between the elevated road and MTR lines was cleared in 1994 for development. A hard surface was provided in 1999. Slip roads were constructed on Kwai Chung Road (1995-1996). A Public Works Regional Laboratory of Civil Engineering and Development Department was built along the Container Port Road South.
2008	No further significant changes since 1999.

6.9.4 Various HKSAR Government Departments, listed below, were approached on the historical land use, chemical storage, and accident records for further identify the potential land contamination of the Site.

- Lands Department (LandsD) - To further understand the historical land use and retrieve the past records of land contamination issues of the Premise, information request letter was sent to LandsD on 31 October 2013. Written reply from LandsD on 3 December 2013 stated that no contamination was recorded. The letters are present in **Appendix 6-3**.
- Environmental Protection Department (EPD) - Letters were sent to EPD to identify the historical records of chemical spillage / leakage as well as the records of registered chemical waste producer, respectively, on 31 October 2013. Written reply from EPD on 22 November 2013 stated that there was no record for chemical spillage / leakage accident of the Site. There was one registered chemical waste producer near the

proposed flyover and widening in Tsuen Wan Road. The letters are present in **Appendix 6-3**. **Table 6-5** shows the list of registered chemical producer in the nearby areas.

- Fire Services Department (FSD) - To identity the registration records of Dangerous Goods and the historical records of dangerous goods spillage / leakage, letter was sent to FSD on 31 October 2013. Written reply from FSD on 15 November 2013 reported there are neither records of dangerous goods licence nor incident of spillage / leakage of dangerous goods at the Site. The letters are present in **Appendix 6-3**.

Table 6-5 List of Registered Chemical Waste Producers

Waste Producers	Address	Nature of Business	Major Chemical Waste Type
Director of Civil Engineering (Public Works Regional Laboratory of Tsuen Wan)	Container Port Road South, Kwai Chung, N.T.	Material Testing	Methylene Chloride

Description of Existing Environment

6.9.5 From the detailed walk over site survey on 7 November 2013 and from historical records, the Public Works Regional Laboratory of Tsuen Wan (Laboratory) has been identified as a chemical waste producer, which is a potential contaminated land use within the project boundary. **Figure 6-2** shows the site boundary of the Laboratory. Details are summarised in **Table 6-6**. According to **Figure 6-2**, although a part of the Laboratory Site is out of the project boundary currently, the whole Laboratory Site is considered in this review as it is possible for the whole Laboratory Site to be occupied as a single land lot during construction as works area.

6.9.6 Another site walk over the Laboratory Site was conducted on 28 November 2013.The Laboratory Site is located at Container Port Road South and under Tsuen Wan Road. There were three nos. of single storey buildings within Laboratory Site. The whole site is concrete paved. There are storage of fresh and waste Methylene Chloride in the Dangerous Goods Store and Chemical Waste Storage Room, respectively. Stain was found on the paved ground at the entrance of the Chemical Waste Storage Room. There is a transformer on the Laboratory Site but no emergency power generator was found. The Site Walkover Checklist and Photographs are shown in **Appendix 6-4**.

Table 6-6 Potentially Contaminative Land Use along the Site

No	Potentially Contaminative Land Use	Location
1	Public Works Regional Laboratory of Tsuen Wan	Container Port Road South

Implications for Road Development

6.9.7 The Laboratory Site is currently allocated to CGE/Standards & Testing, CEDD. As stated in **Section 2.9.9**, temporary occupation of the Laboratory Site is required during construction phase for this Project. The existing laboratory buildings will be demolished and the Laboratory Site will be reinstated at the expiry of the allocation. The current allocation period of the land is up to 23 June 2016 and its extension will be subjected to the commencement of the construction work for this Project. The implementation of the construction under this Project will tentatively commence in year 2017/2018. According to a memo between LandsD and the allocatee of the Laboratory Site (i.e. CGE/Standards & Testing, CEDD) dated on 7 June 2012, the allocatee shall ensure the Laboratory Site is free

from contamination and in event of land contamination found on the Laboratory Site, the allocatee will be responsible to carry out the remediation works to remove all the contaminants from the Laboratory Site at the expiry of the allocation. The memo is presented in **Appendix 6-5**.

Assessment of Land Contamination Impacts

6.9.8 The Laboratory has been identified as a chemical waste producer, which is a potential contaminated land use within the project boundary. The allocatee shall be responsible for the land contamination assessment of the Laboratory Site and ensure the Laboratory Site is free from contamination at the expiry of allocation and therefore any land contamination concern arising from past activities would have been remediated prior to the construction of the works.

6.9.9 With implementation of good site practice, land contamination at the Site arising from construction and operation phases of the Project as road upgrading works is not envisaged.

6.9.10 Thus no adverse environmental impacts on land contamination for the Project are anticipated.

6.10 Conclusion

6.10.1 The Project is likely to result in the generation of a variety of wastes and require the management and disposal of inert C&D material, C&D waste, marine sediment, chemical waste and general refuse during construction phase. It is not expected for waste generation during operation phase. Provided that the wastes are managed using approved methods described above, no unacceptable adverse environmental impacts will be envisaged.

6.10.2 The mitigation measures recommended in this Chapter should be incorporated into a WMP and applied through the contract documents to ensure that environmental nuisance does not arise.

6.10.3 The Laboratory has been identified as a chemical waste producer, which is a potential contaminated land use within the project boundary. The allocatee shall be responsible for the land contamination assessment of the Laboratory Site and ensure the Laboratory Site is free from contamination at the expiry of allocation and therefore any land contamination concern arising from past activities would have been remediated prior to the construction of the works.

6.10.4 With implementation of good site practice, land contamination at the Site arising from construction and operation phases of the Project as road upgrading works is not envisaged.

6.10.5 No adverse environmental impacts on land contamination for the Project are anticipated.

6.11 References

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7. LANDSCAPE AND VISUAL IMPACTS

7.1 Introduction

7.1.1 The aim of this Section of Report is to assess the potential landscape and visual impacts arising from the construction and operation of the Project and associated works and to propose measures to mitigate these impacts.

7.2 Environmental Legislation, Standards and Guidelines

7.2.1 The following Legislation, Standards, Guidelines and Criteria are applicable to the evaluation of landscape and visual impacts associated with the construction and operation of the project:

- Environmental Impact Assessment Ordinance (Cap. 499) and the Technical Memorandum on EIA Process (EIAO-TM), particularly Annexes 10, 11, 18, 20 and 21;
- EIAO Guidance Note 8/2010 on Preparation of Landscape and Visual Impact Assessment under the EIAO;
- ETWB TCW No. 10/2013 on Tree Preservation;
- ETWB TCW No. 2/2004 on Maintenance of Vegetation and Hard Landscape Features;
- ETWB TCW No. 29/2004 on Registration of Old and Valuable Trees, and Guidelines for their Preservation;
- Highways Department Technical Circulars, HyD TC No. 3/2008 on Independent Vetting of Tree Works under the Maintenance of Highways Department;
- Highways Department Guidelines, HQ/GN/13 on Interim Guidelines for Tree Transplanting Works under Highways Department's Vegetation Maintenance Ambit;
- Highways Department Guidelines, HQ/GN/15 – Guidelines for Greening Works along Highways;
- Requirements for Handover of Vegetation to Highways Department (2013 version);
- WBTC No. 7/2002 – Tree Planting in Public Works;
- ETWB TCW No. 02/2013 – Greening on Footbridges and Flyovers;
- GEO Publication No. 1/2011 - Technical Guidelines on Landscape Treatment for Slopes (2011);
- Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and;
- Related Statutory Plans, e.g. Outline Zoning Plans.

7.3 Assessment Methodology

Introduction

7.3.1 The Landscape and Visual Impact Assessment (LVIA) in this study follows the methodology as listed below:-

- Identification of potential impact receivers including landscape resources, landscape characters and the zones of visual influence. The sensitivity of the landscape framework and its ability to accommodate change are focused.
- Identification of probable sources of landscape and visual impacts resulting from the project including noise mitigation measures (NMM) and their "Magnitude";
- Assessment of the resulting Impact Significance Threshold of landscape and visual impacts;
- Identification of landscape and visual mitigation measures; and
- Final assessment of the significance of residual impacts.

Landscape Impact Assessment

7.3.2 Landscape and visual impacts have been assessed separately for the construction and operation phases.

7.3.3 The assessment of landscape impacts has involved the following procedures:-

(a) Identification of the baseline landscape resources and landscape character found within the assessment area – this is achieved by a combination of desktop studies and site surveys. Landscape elements that are in consideration include:-

- Local topography;
- Woodland extent and type;
- Other vegetation types;
- Built form;
- Patterns of settlement;
- Land use;
- Scenic spots;
- Details of local materials, styles, streetscapes, etc.;
- Prominent watercourses; and
- Cultural and religious identity.

(b) Assessment of the degree of sensitivity of the landscape resources – each LR and LCA is rated at a different level of sensitivity, (low, medium or high). The sensitivity depends on the following issues:

- Condition, quality and maturity of the LRs / LCAs;
- Importance and scarcity of special landscape elements (scarcity being of either local, regional, national or global importance);
- Ability of the LRs / LCAs to accommodate change; and
- Statutory or regulatory requirements relating to the LRs/ LCAs.

(c) The sensitivity of each landscape feature and character area is classified as follows:-

High: Important landscape or landscape resource of particularly distinctive character or high importance, sensitive to relatively small changes.

Medium: Landscape or landscape resource of moderately valued landscape characteristics reasonably tolerant to change.

Low: Landscape or landscape resource, the nature of which is largely tolerant to change.

(d) Identification of potential sources of landscape impacts – these are the various elements of the construction works and operational procedures that will generate landscape impacts.

(e) Identification of the magnitude of landscape impacts – the magnitude of impacts depends on a number of factors as follows:-

- Scale of the carriageway structures and associated facilities;
- Compatibility of the structures with the surrounding environment;
- Duration of impacts (temporary or permanent) under construction and during operation phases; and,
- Reversibility of change.

Large: The landscape or landscape resource will suffer from a major change.

Intermediate: The landscape or landscape resource will suffer from a moderate change.

Small: The landscape or landscape resource will suffer from slight or barely perceptible changes.

Negligible: The landscape or landscape resource will suffer from no discernible change.

(f) Identification of potential landscape mitigation measures – these may take the form of the followings measures:-

- Adopting alternative design or revisions to the basic engineering design to prevent or minimize negative impacts;
- Remedial measures include colour or textural treatment of the carriageway; and
- Compensatory measures such as implementation of landscape design measures to compensate for unavoidable negative impacts and to attempt to generate potentially positive long term impacts.

(g) Prediction of the significance of landscape impacts before and after the implementation of the mitigation measures – the significant thresholds are defined as follows:-

Substantial: Adverse / beneficial impact where the proposal will cause significant deterioration or improvement in existing landscape quality.

Moderate: Adverse / beneficial impact where the proposal will cause a noticeable deterioration or improvement in existing landscape quality.

Slight: Adverse / beneficial impact where the proposal will cause a barely perceptible deterioration or improvement in existing landscape quality.

Insubstantial: No discernible change in the existing landscape quality.

(h) Prediction of Significance Threshold – the analysis of the landscape and visual impacts during construction and operation are presented in the following form of matrix as illustrated in **Table 7-1** to ascertain the Significance Threshold. The impacts may be beneficial or adverse.

Table 7-1 Significance Thresholds

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

(i) The significances of landscape impacts before and after mitigation are recorded – this comparison helps to illustrate the benefits of the mitigation measures. This is ranked as substantial, moderate, slight or insubstantial. The impacts can be beneficial or adverse.

Substantial: Adverse / beneficial impact where the proposal will cause **significant** deterioration or improvement in existing landscape/visual quality

Moderate: Adverse / beneficial impact where the proposal will cause a **noticeable** deterioration or improvement in existing landscape/visual quality

Slight: Adverse / beneficial impact where the proposal will cause a **barely perceptible** deterioration or improvement in existing landscape/visual quality

Insubstantial: No discernible change in the existing landscape/visual quality

Tree Survey Methodology

7.3.4 In accordance with Environment, Transport and Works Bureau Technical Circular (Works) No. 10/2013, all existing trees whose trunk diameters measure 95mm or more at a height of 1.3m above ground level were identified. Every tree surveyed individually is recorded with the following information:

- Species
- Height
- Crown spread
- Trunk diameter
- Tree form amenity value
- Health condition
- Survival rate after transplanting
- Special features

Visual Impact Assessment

7.3.5 The baseline survey of all views towards the proposed new carriageway structures and associated facilities is undertaken by identifying:

- The visual envelope (VE) and zone of visual influence (ZVI) may contain areas which fall wholly, partially within views, or non-visible from the proposed development. Indirect effects such as offsite construction activities were also considered; and
- The visual sensitive receivers (VSRs) within the visual envelope whose views will be affected by the proposed development. For the purpose of this study, receivers are grouped into the following categories:

Residential:	The most sensitive of receivers due to the high potential of intrusion on the visual amenity and the quality of life.
Occupational:	Less sensitive than above due to visual amenity considered less important within the work environment.
Leisure:	Including all areas apart from the above, e.g. public parks, recreation grounds, footpaths, etc. Sensitivity of this group depends on the transitory nature of the receiver, e.g. sitting in a park. Also considered is the degree of view or glimpsed views.
Transportation:	Those people who will view the NMM's from vehicles or while walking along the road.

7.3.6 Same as the landscape impact assessment, each of the VSRs is rated in different magnitude in the categories of sensitivity to visual intrusion (low, medium or high), magnitude of change (negligible, small, intermediate or large), and significance threshold before and after mitigation (substantial, moderate, slight or insubstantial).

7.3.7 The sensitivity of each group is also influenced by its location and direction of view relative to the scheme. Typical viewpoints from each of the visually sensitive groups are identified and their views described.

7.3.8 The magnitude of changes of each VSR is affected by the following factors:

(a) Scale of the proposed road works and associated facilities;

(b) Compatibility of the project with the surrounding landscape forming the view;

(c) Extent of visibility (level of potential blockage of the view);

(d) Viewing distance;

(e) Duration of impacts under construction and operational phases;

(f) Reversibility of change; and

(g) Night glare effect.

7.3.9 The degree of visual impact is rated in a similar fashion to the landscape impacts. Impacts can be beneficial or adverse.

Review of Planning and Development Control Framework

7.3.10 The review of the relevant statutory plan has been undertaken. The planned uses shown in plans and existing conditions on site within the study area would be taken as the sensitive receivers. The assessment focuses on the areas directly affected by the proposed works. The study review covers the following information.

- Land use zonings;
- Approximate area of the land use zones to be affected by the project;
- Design and conservation intention; and
- Future outlook of the area.

Mitigation Measures

7.3.11 The identification of landscape and visual impacts assists in the recognitions of the sources of impacts. Mitigation measures should focus on the sources of impacts if possible, such as designing the proposed carriageway structures and associated facilities to blend in with the surrounding environment.

Mitigation measures may be considered under two categories:

(a) Primary mitigation measures that intrinsically comprise the identification of the location of the proposed carriageway and the design of supporting facilities through an iterative process. This form of mitigation is generally the most effective; and

(b) Secondary mitigation measures designed to specifically address the remaining (residual) adverse effects of the proposed works.

7.4 Scope and Content of the Study

7.4.1 The scope of the LVIA study shall cover the proposed road widening and associated

works. The LVIA study shall address the potential landscape and visual impacts during the construction and operation of the project.

7.4.2 The assessment shall follow the criteria and guidelines for evaluating and assessing landscape and visual impacts as stated in Annexes 10 and 18 of the TM, and the EIAO Guideline Note No. 8/2010 "Preparation of Landscape and Visual Impact Assessment under the EIAO".

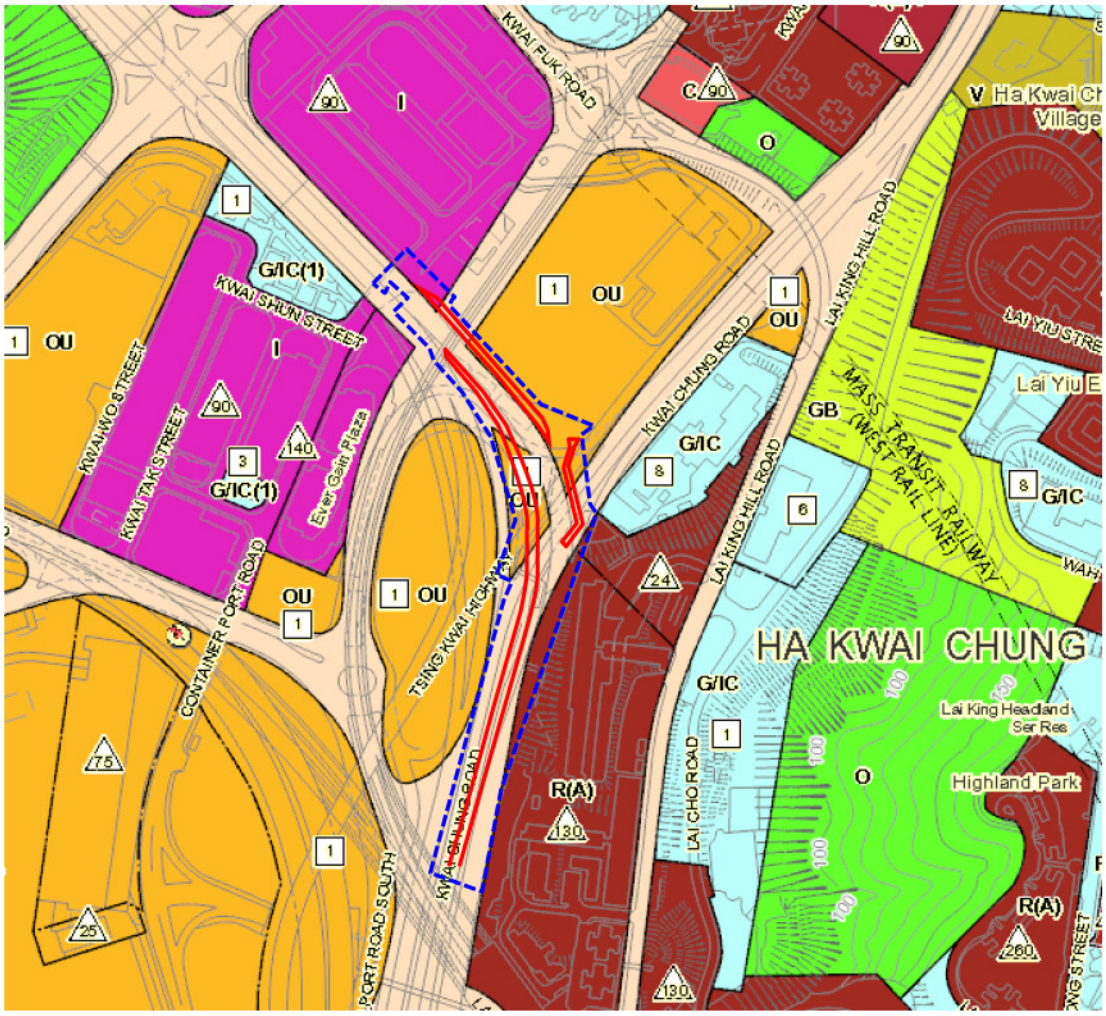
7.4.3 The study area for the landscape impact assessment shall include areas within a distance of 500 metres from the site boundary of the Project while the study area for the visual impact assessment shall be defined by the visual envelop of the project.

7.4.4 The layout plan for LVIA is shown in **Figure 7.1**.

7.5 Review of Planning and Development Control Framework

7.5.1 A review of the existing and planned development framework for the proposed works and for the surroundings is undertaken. The review of OZP includes a review of the plans, Notes and Explanatory Statements.

7.5.2 The project boundary outlined on the extracted Outline Zoning Plan (OZP) No. S/KC/28 is shown as below.



7.5.3 It is found that the project boundary falls mainly within area shown as "Road" and partly within area zoned "Industrial" ("I"), "Other Specified Uses" ("OU") annotated "Container

Related Uses", "Residential (Group A)". In accordance with the correspondence of Planning Department in Jan 2014, it is stated in the Notes of the OZP that the road works implemented by Government department is always permitted and no planning permission is required from the Town Planning Board. No existing and planned industrial or residential developments will be affected by the project. The proposed permanent works only encroach onto the area "Road" and "OU". Part of the flyover is in form of the elevated structure. The existing condition reveals that the affected "OU" areas are the planter, Public Works Laboratory and public carpark. Numerous highways structures and truck roads including Tsuen Wan Road, Kwai Chung Road, Tsing Kwai Highway, Container Port Road South and MTR viaduct – Tsuen Wan Line are surrounding the proposed flyover. Before the commencement of the construction, it is anticipated that the laboratory will be terminated; while a small portion of public carpark will be temporarily occupied as works area and permanently occupied by the proposed piers. The planter under the proposed flyover will be affected during the construction. Mitigation measures are discussed under this chapter.

7.6 Baseline Study

Identification

7.6.1 This baseline study identifies and describes the landscape resources and landscape character areas and the visual amenity within the assessment area that will be affected during the construction and operation phases of the Project.

Landscape Resources

7.6.2 Landscape resources (LRs) identified within the assessment area includes roadside planting areas with existing trees, public open spaces, and recreational grounds. The landscape resources that will be potentially affected during the construction and operation phase are described below:

(a) *LR1 – Tree Planting along Tsuen Wan Road*

(b) *LR2 – Tree Planting at Kwai Chung Road Interchange Area*

(c) *LR3 – Kwai Chung Park*

(d) *LR4 – Planting at foothills of Lai King Hill*

(e) *LR5 – Lai King Sports Centre*

(f) *LR6 – Kwai Shun Street Playground*

(g) *LR7 – Kwai Chung Sports Ground*

(h) *LR8 – Landscaped Area in Kwai Fong Core Area*

(i) *LR9 – Kwai Yi Road Playground*

(j) LR10 – Lai King Hill Road Playground

(k) LR11 – Landscape at Residential

(l) LR12 – Landscape at School, Clinic, other Public Buildings

(m) LR13 – Man-made Slope

(n) LR14 – Roadside Planting Inside Container Terminal

(o) LR15 – Planting at Highland Park

(p) LR16 – Planting at DSD Kwai Chung Industrial Wastewater Pumping Station

7.6.3 The identified landscape resources in each group are discussed in details below and presented in **Figure 7.2**, whereas photos of the key landscape resources are shown on **Figure 7.5**.

(a) *LR1 – Tree Planting along Tsuen Wan Road*

Existing trees found along the embankment between Tsuen Wan Road and the factory buildings in Kwai Chung industrial areas are mainly established *Casuarina equisetifolia, Acacia confusa, Bombax malabarium, Koelreuteria bipinnata,* and *Macaranga tanariu*s. Other tree species such as *Roystonea regia* are found on the planting islands at road junctions at Kwai Tsing Interchange. These trees are of typical urban landscaping features in Hong Kong and have medium amenity value. The sensitivity is **medium**.

(b) *LR2 –Tree Planting at Kwai Chung Road Interchange Area*

The trees are mainly located in planting areas underneath the interchange viaducts with some of the tree crowns fetching a height more than 6m above ground and protruding in between the driving lane of the flyovers. These trees are mostly *Ficus benjamina, Ficus microcarpa, Spathodea campanulata, Bauhinia purpurea,* and *Melaleuca leucadendendron*. Some smaller tree species such as *Bauhinia purpurea, Bauhinia blakeana, Plumeria ruba*, and palm species like *Caryota ochlandra* and *Livistona chinensis* are scattered in groups in various planters in the area. These trees located underneath or adjacent to the proposed road works are typical urban landscaping features in Hong Kong. The sensitivity is **medium**.

(c) *LR3 –Kwai Chung Park*

The Park, originally a restored landfill site, is a heavily wooded area with mature trees such as Acacia *confusa, Eucalyptus urophylla, Ficus microcarpa,* and *Albizia lebbeck* framing the western alignment of the Tsuen Wan Road. Although the park is now closed to the public, people still use the connecting footbridges to travel between different factory clusters. The massive tree coverage is a distinct landscape resource in the bustling city landscape of Kwai Chung area. The sensitivity is **high**.

(d) *LR4 –Planting at Foothills of Lai King Hill*

This area of heavily vegetated hill slopes forms a green backdrop to the eastern Kwai Chung District. The vegetation of the lower portion of the hill is mainly semi-indigenous woodland with *Casuarina equisetifolia, Acacia confusa, Bombax malabarium, Koelreuteria bipinnata, Macaranga tanariu*s, *Ficus microcarpa,* and *Bauhinia blakeana* while vegetations on higher elevations are natural woodland due to the topography. The lush tree covered hills is an important landscape resource in the area and sensitivity is **high**.

(e) *LR5 – Lai King Sports Centre*

This is a recreational facility consists of indoor sports facilities, a football field and associated landscape area. There are tree planting at the entrance area and at the

sitting out area towards the northern end of the facility. The trees are common species like *Casuarina equisetifolia, Delonix regia, Magnolia alba and Terminalia mantaly*. The trees are common species with medium amenity value. The sensitivity is **medium**.

(f) *LR6 – Kwai Shun Street Playground*

A tree lined small local open space which provides both active and passive recreation facilities in the area. The sitting out areas are frequently visited by the workers in nearby industrial buildings but the two skating rinks are seldomly used because of their relative obscure locations which are underneath the Tsuen Wan Road flyover. The trees are common species with medium amenity value such as *Hibuscus variegate, Hibiscus tiliaceus, Koelreuteria bipinnata and Lagerstroemia spiciosa*. The sensitivity is **medium**.

(g) *LR7 – Kwai Chung Sports Ground*

A major sports ground facilities in Kwai Chung area which not only do large sports events but becomes a popular jogging venue for local residents in the evenings. The sports ground is lined with trees on the peripheral with species such as *Juniperus chinensis,* while the interior are planted with *Casuarina equisetifolia, Bauhinia blakeana and Chrysalidocarpus lutescens*. The quality of the landscape is high and an important recreational resource in urban area. The sensitivity is **high**.

(h) *LR8 – Landscaped Area in Kwai Fong Core Area*

This area is primarily the traffic hub of Kwai Fong which includes the central planting area with the landmark clock tower in the centre, the massive tree planting at the Kwai Tsing Theatre and ornamental planting at the roundabout area. The tree planting at Kwai Tsing Theatre are especially important since it created an effective green barrier to shield off the industrial buildings beyond. Trees are common species like *Archontophoenix alexandrae, Ficus Benjamina, Ficus microcarpa, Lagerstroemia spiciosa, Terminalia catappa, Terminalia mantaly and Roystonia regia*. The amenity value of the landscape is high and sensitivity is **high**.

(i) *LR9 – Kwai Yi Road Playground*

A small local open space with tree lined sitting area and basketball courts which provides both active and passive recreation for the district. The trees are common species like *Aleurites moluccana, Callistemon viminalis, Delonix regia, Peltophorum petrocarpum and Plumeria rubra*. The quality of the landscape is medium and sensitivity is **medium**.

(j) *LR10 –Lai King Hill Road Playground*

A local open space provides both active and passives recreation facilities for the residents in Lai King Area. Trees are common species like *Aleurites moluccana, Bauhinia variegate, Ficus virens, Eucalyptus citriodora, Livistona chinensis and Melaleuca leucadendron.* The quality of landscape is medium and sensitivity is **medium.**

(k) *LR11 – Landscape at Residential*

These are mainly amenity shrubs and trees planting within the Lai King Estates, Cho Yiu Chuen and Yin Lai Court. Screen planting are also found in areas like

parking lots and roadside planting. Trees are common species like *Albizia lebbeck, Bauhinia variegate, Bombax ceiba, Delonix regia, Ficus microcarpa.* The amenity value of the landscape is medium and sensivity is **medium**.

(l) *LR12 – Landscape at School, Clinic, other Public Buildings*

This LR represent those landscape areas located at public institutions and schools scattered around lower Lai King area. The landscape treatment is mainly trees with shrubs planting that are well maintained. These plantings serve various functions such as screening and shade providing. The amenity value of the landscape is medium and sensitivity is **medium.**

(m) *LR13 –Man-made Slope Area*

This LR represents a dominant type of man-made landform as a result of site formation work for vehicular roads and human settlements for Kai King Area. Depending on the topograghy of the slope, varying slope treatments such as exposed rock surface, shotcreted, hydroseeding and regenerated woodland. The vegetation are mainly semi-indigenous woodland type with species like *Casuarina equisetifolia, Acacia confusa, Bombax malabarium, Koelreuteria bipinnata, Macaranga tanariu*s, *Ficus microcarpa,* and *Bauhinia blakeana.* The amenity value of the landscape is medium and sensitivity is **medium.**

(n) *LR14 –Roadside Planting inside Container Terminal*

These are mainly roadside tree plantings along the Container Port Road inside the container terminal. Tree species are mainly *Ficus benjamina* which provides shade and screening along the Container Port Road. These trees are typical urban landscaping features in Hong Kong. The sensitivity is **medium.**

(o) *LR15 – Planting at Highland Park*

This LR is typical landscape treatment in most residential development on Hong Kong. The trees at this locations are mainly *Ficus benjamina, Ficus microcarpa, Bauhinia species, Schefflera heptaphylla* and Archontophoenix alexandrae. The amenity of this landscape is medium and sensitivity is **medium.**

(p) *LR16 – Planting at DSD Kwai Chung Industrial Wastewater Pumping Station*

The trees in this pumping station effectively screen the facility from views on street level. The tree species are mainly *Senna siamea* and *Ficus microcarpa*. The amenity value of the landscape is medium and sensitivity is **medium.**

Impacts on Existing Trees

Existing Trees

7.6.4 A survey of existing trees within the study area identified a total number of 85 trees within the tree survey boundary. Typical roadside tree planting is common with a majority of the trees having reached a mature stature. The trees are of various sizes and species.

7.6.5 None of these are Registered Old and Valuable Trees. There are no rare and endangered species but only common species.

Recommended Treatment of Existing Trees

7.6.6 A total number of **85** trees were identified within or in close proximity to the proposed road works and are likely to be affected by the proposed works.

7.6.7 Compensatory planting / replanting according to ETWB TCW No. 10/2013 App. A: I (v)(b) states that the compensatory planting ratio shall not be less than 1:1 in terms of quantity of felled trees including dead trees and trees of undesirable species. Tree findings and recommendation of their treatment are summarized in the following table. The tree survey layout plan under the preliminary stage of design and conceptual Landscape Master Plan are shown in Figures **7.8A** and **7.8B**. Due to the limited available space for the construction of the new carriageway and associated footbridges, 59 trees will be felled and 26 trees will be transplanted to locations within Kwai Chung district under separate arrangement with LCSD. Attempts has been made to propose transplanting trees back to site but failed due to site constraints, spatial requirements for healthy tree growth, and future maintenance department requirement. Detailed tree removal application will be submitted in accordance with ETWB TCW No. 10/2013.

Table 7-2 Summaries of the Tree Survey Recommendations

Tree Recommendation Status - Existing Trees within Proposed Road Widening Works Area	**Total**
Recommended for Retaining	0
Recommended for Transplanting	26
Recommended for Felling	59
Total Trees Surveyed on Site	***85***

Landscape Character Areas

7.6.8 The landscape characters of the assessment area situated within and adjacent to the Tsuen Wan Road and Kwai Chung Road Interchange area are strongly influenced by the topography and urban development context. Eight major landscape character areas (LCAs) have been identified within the area. The following section describes those areas and their degrees of sensitivity toward the proposed changes. Landscape character plans are presented in **Figure 7.3** to read in conjunction with the text. Photographic records of LCAs are provided in **Figure 7.6**.

7.6.9 The eight major LCAs identified within the assessment area are described as below:-

(a) *LCA1 – Mixed Residential and Commercial Surrounding Kwai Fong MTR Station*

The area of high-rise residential buildings, office buildings and MTR station is the hub in Kwai Chung area. The area is characterised by a high sense of enclosure, with predominantly man-made features with busy pedestrian and vehicle traffic. The area is visited by high numbers of daily commuters and has high ability to accommodate change. The sensitivity is **low**.

(b) *LCA2 – Residential at Higher Level of Lai King Hill*

The residential area at higher level of Lai King is represented by the PSPS development the Highland Park and public housing Lai Yiu Estate. The area is buffered by a natural vegetated slope separating the lower level of Lai King Hill residential area below. This resulted in a relatively secluded residential area overlooking the bustling city activities below. The sensitivity is **medium**.

(c) *LCA3 – Residential at Lower Level of Lai King Hill*

This landscape character area is represented by the concentration of public housing estates, such as Lai King Estate and Cho Yiu Chuen; HOS housing such as Yin Lai Court and Yuet Lai Court; schools and MTR station. The area also includes a Polyclinic & Special Educational Services and is of Polyclinic & Special Educational Services. Vegetation is limited in the area and the type of landscape is common public housing setting with high ability to accommodate change. The sensitivity is **low**.

(d) *LCA4 – Industrial & Open Storage Area along Tsuen Wan Road*

Centred around the Kwai Tsing Interchange, open storage areas and industrial buildings of mixed ages form dense clusters of blocks with narrow streets serving the interior. This LCA has **low** sensitivity because of its industrial character.

(e) *LCA5 – Kwai Chung Sports Ground*

Located across Kwai Fong Road opposite to LCA1, the Kwai Chung Sports Ground is the major outdoor sports facilities in the heart of the area. The facility is well-served with pedestrian linkages and sensitivity is **high**.

(f) *LCA6 – Kwai Chung Road Interchange*

This area is characterised by the major highways with separated carriageways, MTR viaducts, footbridges, and associated uses. Between the roads are profile barriers and occasionally planting areas with trees fetch up to 10m high. This type of LCA is common to Hong Kong and is less sensitive to development. The sensitivity is **low**.

(g) *LCA7 – Kwai Chung Container Terminal*

Built in the late 60's, the container terminal continually drives the development of Kwai Chung area to a busy and vibrant suburb of Hong Kong. The area is characterised by container loading cranes, stacks of containers, go downs and lifting vehicles. This type of LCA is less sensitive to development and sensitivity is **low**.

(h) *LCA8 – Kwai Chung Park*

The Park is characterised by heavily vegetated small mount with mature trees which provides a distinctly contrasting setting to the industrial buildings and container terminal in the area. The landscape is considered as high quality and of regional significance. The sensitivity is **high**.

Potential Sources of Landscape Impacts

7.6.10 The potential sources of landscape impact during construction would include items such as site clearance including removal of existing trees for construction, setting up site hoardings and offices, establishing storage area, constructing future carriageway, noise barriers and associated footbridges structural works. Potential impacts would result from the nature of the items either temporary or permanent works during construction.

7.6.11 The potential sources of landscape impact during operation will include the permanent loss of trees, completed new carriageway, footbridges, noise barriers, new shrubs planting and streetscape enhancement.

Table 7-3 Potential Sources of Landscape Impacts during Construction Phase

LIC1 – Loss of Existing Vegetations	Removal of existing trees and shrubs for the new viaduct, footbridge and road widening works
LIC2 – Site Hoarding/Offices	Establishment of site offices and erection of hoardings
LIC3 – Dismantlement of Existing Footbridge	Dismantlement of the existing footbridge for the down ramp of the new carriageway
LIC4 – Road Widening Works	Widening section of Tsuen Wan Road
LIC5 – Construction of Noise Barriers	Construction of noise barriers along the new viaduct
LIC6 – Construction of New Footbridge	Re-provision of the footbridge north close to the Lai King Catholic Secondary School

Table 7-4 Potential Sources of Landscape Impacts during Operation Phase

LIO1 – Loss of Existing Trees	Permanent loss of existing trees
LIO2 –New Viaduct	Permanent pre-stressed concrete box girder viaduct
LIO3 –New Footbridge	Permanent footbridge structure
LIO4 –New Shrub	New shrub planting in the area
LIO 5 Streetscape Enhancement	Landscape elements such as pedestrian walkway paving enhancement, street furniture and lighting

Magnitude of Landscape Impacts

7.6.12 The magnitude of unmitigated landscape impact associated with the construction phase and operational phases of the Project are assessed and described below:

Table 7-5 Magnitude of Landscape Impacts during Construction and Operation Phases

ID No.	Landscape Resources/Landscape Character Areas	Source of Impact	Description of Impacts	Magnitude of Change (large / Intermediate / Small / Negligible)	
				Construction	Operation
LR1	*Tree Planting along Tsuen Wan Road*	Nil	Nil	Negligible	Negligible
LR2	*Tree Planting at Kwai Chung Road Interchange Area*	Dismantlement of existing footbridge, construction of the new carriageway and footbridges and associate structures and operation of the new carriageway footbridges and associate structures during operation phase	During construction phase, tree planting within the road interchange area will be removed. Approximately 85 nos. of trees are affected with 59 nos. proposed to be felled, 26 nos. proposed to be transplanted to new locations within Kwai Chung area under separate arrangement with LCSD. Tree species include Ficus benjamina, Ficus microcarpa, Spathodea campanulata, Bauhinia purpurea, and Melaleuca leucadendendron, Bauhinia purpurea, Bauhinia blakeana, Plumeria ruba.	Large	Large
LR3	*Kwai Chung Park*	Nil	Nil	Negligible	Negligible
LR4	*Planting at foothills of Lai King Hill*	Nil	Nil	Negligible	Negligible
LR5	*Lai King Sports Centre*	Nil	Nil	Negligible	Negligible
LR6	*Kwai Shun Street Playground*	Nil	Nil	Negligible	Negligible
LR7	*Kwai Chung Sports Ground*	Nil	Nil	Negligible	Negligible
LR8	*Landscaped Area in Kwai Fong Core Area*	Nil	Nil	Negligible	Negligible
LR9	*Kwai Yi Road Playground*	Nil	Nil	Negligible	Negligible
LR10	*Lai King Hill Road Playground*	Nil	Nil	Negligible	Negligible
LR11	*Landscape at Residential*	Nil	Nil	Negligible	Negligible
LR12	*Landscape at School, Clinic, other Public*	Nil	Nil	Negligible	Negligible

ID No.	Landscape Resources/Landscape Character Areas	Source of Impact	Description of Impacts	Magnitude of Change (large / Intermediate / Small / Negligible)	
				Construction	Operation
	Buildings				
LR13	*Man-made Slope*	Nil	Nil	Negligible	Negligible
LR14	*Roadside Planting Inside Container Terminal*	Nil	Nil	Negligible	Negligible
LR15	*Planting at Highland Park*	Nil	Nil	Negligible	Negligible
LR16	*Planting at DSD Kwai Chung Industrial Wastewater Pumping Station*	Nil	Nil	Negligible	Negligible
LCA1	*Mixed Residential and Commercial Surrounding Kwai Fong MTR Station*	Nil	Nil	Negligible	Negligible
LCA2	*Residential at Higher Level of Lai King Hill*	Nil	Nil	Negligible	Negligible
LCA3	*Residential at Lower Level of Lai King Hill*	Dismantlement of existing footbridge, construction of the new carriageway and footbridges and associate structures and operation of the new carriageway footbridges and associate structures during operation phase	During construction phase, there would be some change of landscape character due to the proposed demolition, construction and associated temporary works. During operation phase, the new a carriageway and footbridges will be integrated into the existing Kwai Chung Road system.	Small	Negligible
LCA4	*Industrial & Open Storage Area along Tsuen Wan Road*	Nil	Nil	Negligible	Negligible

ID No.	Landscape Resources/Landscape Character Areas	Source of Impact	Description of Impacts	Magnitude of Change (large / Intermediate / Small / Negligible)	
				Construction	Operation
LCA5	*Kwai Chung Sports Ground*	Nil	Nil	Negligible	Negligible
LCA6	*Kwai Chung Road Transportation Corridor*	Dismantlement of existing footbridge, construction of the new carriageway and footbridges and associate structures and operation of the new carriageway footbridges and associate structures during operation phase	During construction phase, the will be changes in landscape character due to proposed demolition, construction and associated construction works. The extend of works is localised at the interchange area which is the heart of the Kwai Chung Road system. During operation phase, impact will be same as the construction period. New section of carriageway, new footbridges and associated structures will become part of the Kwai Chung Road system.	Intermediate	Intermediate
LCA7	*Kwai Chung Container Terminal*	Nil	Nil	Negligible	Negligible
LCA8	*Kwai Chung Park*	Nil	Nil	Negligible	Negligible

7.6.13 The magnitude of change, before implementation of mitigation measures, in the construction and operation phases are assessed and presented in **Table 7-5**. All impacts are adverse unless otherwise stated.

7.6.14 LR2 – Tree Planting at Kwai Chung Road Interchange Area will be removed for the new carriageway and associated footbridges construction work. The tree planting area will be occupied by the flyover and bridge structure leaving insufficient room for future tree planting. The magnitude of change is expected to be large.

7.6.15 LCA3 – Residential at Lower Level of Lai King Hill will be affected by the change of landscape character due to the proposed demolition, construction and associated temporary works. The magnitude of change is considered as small. The resultant unmitigated impact is considered as moderate. There will not be any impact on this LCA during operation phase when the construction works are completed.

7.6.16 LCA6 – Kwai Chung Road Transportation Corridor will have changes in landscape character due to proposed demolition, construction and associated construction works. The extent of works is localised at the interchange area which is the heart of the Kwai Chung Road and will become an integral part of the road system when completed. The magnitude of change is intermediate.

7.6.17 There would not be any discernible landscape impact on other LRs and LCAs and their magnitude of impact is negligible.

Visually Sensitive Receivers (VSRs)

7.6.18 This baseline study identifies and describes the visual zones and visual sensitive receivers (VSRs) that will be affected during the construction and operation phases of the Project.

7.6.19 The visual envelope (VE) for the proposed road work is quite open along at the Kwai Chung Road Interchange area. It is however, the VE is confined by a combination of human infrastructure such as buildings, flyover systems and natural elements such as topography and nearby hills and vegetation. In general, viewing distances of the proposed work vary from as close as 100m for those VEs at Lai King Estate area to 500m for VEs at Kwai Fong. Within this VE, extension of the existing views is determined by factors such as the presence of intervening visual obstacles such as building structures, earth berms, and vegetations.

7.6.20 The visual amenity observed by VSRs inside ZVI is characterised by the views framed by the surrounding buildings, elevated roads along the Tsuen Wan Road, Kwai Chung Road Interchange area and natural terrain of the Lai King Hill, which are quite restricted in some sections. The proposed road widening work is proposed at the merging point of Tsuen Wan Road and Kwai Chung Road which is very visible from the local residents, vehicular travellers, school goers, visitors and workers in the area. Considering the existence of a major flyover interchange system in the area, the degrees of sensitivity of these receivers are generally from low to medium.

7.6.21 VSRs identified within the ZVI are listed below and their existing visual context is illustrated in **Figure 7.4**; photographic record of key VSRs are listed in **Figures 7.7A** to **7.7C**.

(a) ***VSR – Residential (R)***

R1 – Residents at Kwai Chung Plaza

R2 – Residents at New Kwai Fong Gardens

R3 – Residents at Kwai Fong Terrace

R4 – Residents at Lai Yiu Estate

R5 – Residents at Lai King Estate North

R5A – Residents at Lai King Estate South

R6 – Residents at Yin Lai Court

R7 – Residents at Highland Park

R8 – Residents at Yuet Lai Court

R9 – Residents at Cho Yiu Chuen

(b) ***VSR – Occupational (O)***

O1 – Workers at Metroplaza

O2 – Workers at Kwai Chung Industrial Area

O3 – Workers at Kwai Fong Ancillary Building

O4 – Staff and Visitors at Polyclinic & Special Educational Services

O5 – Staff and Students at Lai King Catholic Secondary School

O6 – Workers at Ever Gain Plaza

O7 – Staff and Workers at Container Terminals

O8 – Staff and Students at Lingnan Dr. Chung Wing Kwong Memorial Secondary School

O9 – Workers at Lai King MTR Station

O10 – Staff at Lai King Assessment Centre

O11 – Staff and Visitors at OUHK – CITA Lai King Learning Centre

O12 – Staff and Visitors to Lai King Community Hall

O13 – Staff and Students at Asbury Methodist Primary School

(c) ***VSR – Leisure (L)***

L1 – Visitors to Kwai Shun Street Playground

L2 – Visitors to Kwai Yip Road Playground

L3 – Visitors to Lai King Sports Centre

L4 – Visitors to Kwai Chung Park

L5 – Visitors to Lai King Hill Road Playground

(d) ***VSR – Transportation (T)***

T1 – Open Storage Area Car Park Users

T2 – Pedestrians travelling on Street Level under Kwai Chung Road Interchange Area

T3 – Commuters on Tsuen Wan Road/Kwai Chung Road

T4 – Commuters at Lai King Bus Terminus

T5 – Commuters on MTR

T6 – Travellers to Kwai Fong Core Area

7.6.22 The degrees of sensitivity of selected VSRs within the ZVI to accommodate changes are demonstrated in **Table 7-8**. The magnitude of changes related to the VSRs before mitigation are demonstrated in **Table 7-9**.

Potential Sources of Visual Impacts

7.6.23 The potential sources of visual impacts during construction will include items such as setting up of site hoardings, constructing site office, materials and machinery storage area, site clearance including removal of vegetations for construction. All impacts are reversible with careful design, planning and coordination during the design phase. The impacts of these items can further be reduced by choices of colour and material for the

hoardings, site offices design and lighting during night time. The removal of vegetation will cause a downgrade of visual quality in the area. Details of mitigation measures during construction phase are presented in **Table 7-10**.

7.6.24 The potential sources of visual impacts during operation will include the completed flyover systems, footbridges, noise barriers, and the loss of existing trees at the project site. The appearances of flyovers, footbridges, noise barrier structures and other associated structures can be dealt with during the design phase of the project with considerations of choices of materials and colour of the structures. It is also important to integrate all the bridge structures, noise barriers and associate structures with the existing flyover system so that they form an integral part of the mega-structure once completed. The loss of trees due to the construction work can be dealt with by a holistic planting scheme that considers using shrubs for planters at grade. Details of mitigation measures during operation phase are presented in **Table 7-11**.

Table 7-6 Potential Sources of Visual Impacts during Construction Phase

VIC1 – Loss of Existing Vegetations	Removal of existing trees and shrubs for the new viaduct, footbridge and road widening works
VIC2 – Site Hoarding/Offices	Establishment of site offices and erection of hoardings
VIC3 – Dismantlement of Existing Footbridge	Dismantlement of the existing footbridge for the down ramp of the new carriageway
VIC4 – Road Widening Works	Widening section of Tsuen Wan Road
VIC5 – Construction of Noise Barriers	Construction of noise barriers along the new viaduct
VIC6 – Construction of New Footbridge	Re-provision of the footbridge north close to the Lai King Catholic Secondary School

Table 7-7 Potential Sources of Visual Impacts during Operation Phase

VIO1 – New Viaduct	Permanent pre-stressed concrete box girder viaduct
VIO2 – Noise Barrier Structure	Permanent noise barrier associated with the new viaduct
VIO3 – New Footbridge	Permanent footbridge structure
VIO4 – New Shrub Planting	New shrub planting
VIO5 – Streetscape Enhancement	Landscape elements such as pedestrian walkway paving enhancement, street furniture and lighting

Table 7-8 Visual Sensitive Receivers (VSRs) and their Sensitivity

Type	VSRs	Population of VSRs (Few/ Small/ Intermediate/ Large)	Quality of View (Good/ Fair/ Poor)	Degree of Visibility (Full / Partial / Glimpse/Shielded)	Availability and Amenity Alternative Views	Frequency of View (Very Frequent / Frequent / Occasional / Rare / Nil)	Sensitivity (Low/ Medium/ High)
Residential							
R1	*Kwai Chung Plaza*	Intermediate	Fair	Partial	Yes / alternative surrounding views	Occasional	Medium
R2	*New Kwai Fong Gardens*	Intermediate	Fair	Partial	Yes / alternative surrounding views	Occasional	Medium
R3	*Kwai Fong Terrace*	Intermediate	Fair	Partial	Yes / alternative surrounding views	Occasional	Medium
R4	*Lai Yiu Estate*	Large	Good	Full	Yes / Panoramic surrounding views	Rare	Medium
R5	*Lai King Estate North*	Large	Fair	Full	Yes / Panoramic surrounding views	Very Frequent	High
R5A	*Lai King Estate South*	Large	Fair	Partial	Yes / Panoramic surrounding views	Occasional	High
R6	*Yin Lai Court*	Intermediate	Fair	Partial	Yes / alternative surrounding view	Occasional	Medium
R7	*Highland Park*	Large	Good	Partial	Yes / Panoramic surrounding views	Frequent	Medium
R8	*Residents at Yuet Lai Court*	Intermediate	Good	Shielded	Yes / alternative surrounding views	Nil	Medium
R9	*Residents at Cho Yiu Chuen*	Large	Good	Shielded	Yes / alternative surrounding views	Nil	Medium
Occupational							
O1	*Metroplaza*	Large	Good	Full	Yes / alternative surrounding views	Occasional	Low
O2	*Kwai Chung Industrial Area*	Large	Poor	Glimpse	Yes / Limited views in other directions	Rare	Low

Type	VSRs	Population of VSRs (Few/ Small/ Intermediate/ Large)	Quality of View (Good/ Fair/ Poor)	Degree of Visibility (Full / Partial / Glimpse/Shielded)	Availability and Amenity Alternative Views	Frequency of View (Very Frequent / Frequent / Occasional / Rare / Nil)	Sensitivity (Low/ Medium/ High)
O3	*Kwai Fong Ancillary Building*	Few	Good	Full	Yes / alternative surrounding views	Rare	Low
O4	*Polyclinic & Special Educational Services*	Intermediate	Good	Full	Yes / alternative surrounding views	Rare	Medium
O5	*Lai King Catholic Secondary School*	Intermediate	Fair	Full	Yes / alternative restricted surrounding views	Very Frequent	Medium
O6	*Ever Gain Plaza*	Large	Good	Full	Yes / alternative surrounding views	Frequent	Low
O7	*Container Terminals*	Large	Fair	Full	Yes / Panoramic surrounding views	Rare	Low
O8	*Lingnan Dr. Chung Wing Kwong Memorial Secondary School*	Intermediate	Fair	Partial	Yes / alternative surrounding views	Occasional	Medium
O9	*Lai King MTR Station*	Small	Poor	Glimpse	Yes / alternative surrounding views	Rare	Low
O10	*Lai King Assessment Centre*	Small	Fair	Partial	Yes / alternative surrounding views	Occasional	Low
O11	*OUHK – CITA Lai King Learning Centre*	Small	Fair	Shielded	Yes / limited surrounding views	Nil	Low
O12	*Lai King Community Hall*	Small	Fair	Shielded	Yes / limited surrounding views	Nil	Low
O13	*Asbury Methodist Primary School*	Intermediate	Fair	Shielded	Yes / limited surrounding views	Nil	Medium
Leisure							
L1	*Kwai Shun Street Playground*	Small	Poor	Glimpse	Yes / alternative surrounding views	Occasional	Medium
L2	*Visitors to Kwai Yip Road Playground*	Small	Fair	Shielded	Yes / alternative surrounding views	Rare	Medium

Type	VSRs	Population of VSRs (Few/ Small/ Intermediate/ Large)	Quality of View (Good/ Fair/ Poor)	Degree of Visibility (Full / Partial / Glimpse/Shielded)	Availability and Amenity Alternative Views	Frequency of View (Very Frequent / Frequent / Occasional / Rare / Nil)	Sensitivity (Low/ Medium/ High)
L3	*Visitors to Lai King Sports Centre*	Medium	Fair	Glimpse	Yes / alternative surrounding views	Rare	Medium
L4	*Visitors to Kwai Chung Park*	Medium	Fair	Glimpse	Yes / alternative surrounding views	Frequent	Medium
L5	*Visitors to Lai King Hill Road Playground*	Small	Fair	Shielded	Yes / alternative surrounding views	Rare	Medium
Transportation							
T1	*Open Storage Area Car Park Users*	Intermediate	Poor	Full	Yes / limited surrounding views	Frequent	Low
T2	*Pedestrians travelling on Street Level under Kwai Chung Interchange Area*	Small	Poor	Full	Yes / alternative surrounding views	Very Frequent	Low
T3	*Commuters on Tsuen Wan Road/Kwai Chung Road*	Large	Fair	Full	Yes / Panoramic surrounding views	Very Frequent	Low
T4	*Commuters at Lai King Bus Terminus*	Intermediate	Good	Full	Yes / Panoramic surrounding views	Occasional	Low
T5	*Commuters on MTR*	Large	Fair	Full	Yes / alternative surrounding views	Frequent	Low
T6	*Travellers to Kwai Fong Core Area*	Large	Fair	Glimpse	Yes / alternative surrounding views	Rare	Low

Table 7-9 Magnitude of Change on Visually Sensitive Receivers before Mitigation

Type	VSRs	Source of Impact	Distance to Source (m)	Compatibility with Surroundings (Good / Fair / Poor)		Scale of Development (Small / Med / Large)		Duration of Impacts (Short / Med / Long)		Reversibility of Change (Yes / No)		Potential Blockage of View (Full / Part / Nil)		Magnitude of Change (Large / Intermediate / Small / Negligible)	
				Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op
Residential															
R1	*Kwai Chung Plaza*	VIC1,2,4,5,6 VIO1,2,3	450+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
R2	*New Kwai Fong Gardens*	VIC1,2,4,5,6 VIO1,2,3	450+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
R3	*Kwai Fong Terrace*	VIC1,2,4,5,6 VIO1,2,3	300-400	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
R4	*Lai Yiu Estate*	VIC1,2,3,4,5,6 VIO1,2,3	400+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
R5	*Lai King Estate North*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	50+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Intermediate	Small
R5A	*Lai King Estate South*	VIC1,2,3,4,5 VIO1,2,3,4	250+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
R6	*Yin Lai Court*	VIC1,2,3,4,5 VIO1,2,3	200+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
R7	*Highland Park*	VIC1,2,4,5,6 VIO1,2,3	450+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
R8	*Residents at Yuet Lai Court*	--	250+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
R9	*Residents at Cho Yiu Chuen*	--	350+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
Occupational															
O1	*Metroplaza*	VIC1,2,3,4,5,6 VIO1,2,3	350+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
O2	*Kwai Chung Industrial Area*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	200+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
O3	*Kwai Fong Ancillary Building*	VIC1,2,3,4,5,6 VIO1,2,3	300	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible

Type	VSRs	Source of Impact	Distance to Source (m)	Compatibility with Surroundings (Good / Fair / Poor)		Scale of Development (Small / Med / Large)		Duration of Impacts (Short / Med / Long)		Reversibility of Change (Yes / No)		Potential Blockage of View (Full / Part / Nil)		Magnitude of Change (Large / Intermediate / Small / Negligible)	
				Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op
O4	*Polyclinic & Special Educational Services*	VIC1,2,3,4,5,6 VIO1,2,3	200+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
O5	*Lai King Catholic Secondary School*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	100+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Part	Part	Intermediate	Small
O6	*Ever Gain Plaza*	VIC1,2,3,4,5,6 VIO1,2,3	250+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Intermediate	Negligible
O7	*Container Terminals*	--	400+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
O8	*Lingnan Dr. Chung Wing Kwong Memorial Secondary School*	VIC1,2,3,4,5,6 VIO1,2,3	150+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
O9	*Lai King MTR Station*	--	150	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
O10	*Lai King Assessment Centre*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	120	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
O11	*OUHK – CITA Lai King Learning Centre*	--	300	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
O12	*Lai King Community Hall*	--	400	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
O13	*Asbury Methodist Primary School*	--	450	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
Leisure															
L1	*Kwai Shun Street Playground*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	100	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible

Type	VSRs	Source of Impact	Distance to Source (m)	Compatibility with Surroundings (Good / Fair / Poor)		Scale of Development (Small / Med / Large)		Duration of Impacts (Short / Med / Long)		Reversibility of Change (Yes / No)		Potential Blockage of View (Full / Part / Nil)		Magnitude of Change (Large / Intermediate / Small / Negligible)	
				Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op
L2	*Visitors to Kwai Yip Road Playground*	--	250+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
L3	*Visitors to Lai King Sports Centre*	--	200	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
L4	*Visitors to Kwai Chung Park*	--	250+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
L5	*Visitors to Lai King Hill Road Playground*	--	450+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible
Transportation															
T1	*Open Storage Area Car Park Users*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	50+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Intermediate	Small
T2	*Pedestrians travelling on Street Level under Kwai Chung Road Interchange Area*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	0 – 200	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Intermediate	Small
T3	*Commuters on Tsuen Wan Road/Kwai Chung Road*	VIC1,2,3,4,5,6 VIO1,2,3,4,5	0 – 300	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Part	Part	Intermediate	Small
T4	*Commuters at Lai King Bus Terminus*	VIC1,2,3,4,5,6 VIO1,2,3	100+	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
T5	*Commuters on MTR*	VIC1,2,3,4,5,6 VIO1,2,3	50 – 200	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Small	Negligible
T6	*Travellers to Kwai Fong Core Area*	--	150 – 350	Fair	Fair	Small	Small	Med	Long	Yes	Yes	Nil	Nil	Negligible	Negligible

Note: "- -" denotes no source of impact due to non-visible from the proposed works.

7.7 Landscape Impact Assessment

Evaluation of Potential Landscape Impacts without Mitigation

7.7.1 The LRs and LCAs identified earlier in this assessment report represent those resources that are situated within the study area. However, not all of these LCAs and LRs have direct impact from the proposed works as the proposed road widening works is localised only on a short section of the existing flyover system. Those LCAs and LRs that will have a potential impact due to the proposed road widening work will be discussed in the following sections and summarised in **Table 7-12** and presented in **Figures 7.10** and **7.11**. All others LRs and LCAs that show insubstantial impacts will not be included in the above tables.

Construction Phase

(a) **Substantially adverse** potential impacts will be experienced by:

- *LR2 – Tree Planting at Kwai Chung Road Interchange Area*

  The proposed road improvement works will require taking up the existing planting area for the construction of the additional carriageway. Although the work area required for the proposed work is relatively small, all existing trees will be affected. Without mitigation, the impact on this LR during construction phase is considered **substantially adverse**.

(b) **Moderately adverse** potential impacts will be experienced by:

- *LCA3 – Residential at Lower Level of Lai King Hill*

  Located in the middle of the intricate web of flyover carriage system, the proposed work will become the prominent feature in the area. Without mitigation, the impact on this LCA during construction phase is considered **moderately adverse.**

(c) **Slightly Adverse** potential impacts will be experienced by:

- *LCA6 – Kwai Chung Road Interchange*

  The proposed improvement of southbound traffic by an additional carriageway between KT I/C and Kwai Chung Road will add an additional flyover structure in the complex separated web of road interchange system. Without mitigation, the impact on this LCA during construction phase is considered **slightly adverse**.

(d) All other identified LRs and LCAs not described in the above discussions will experience **insubstantial** impacts.

Operation Phase

(a) **Substantially adverse** potential Impacts will be experienced by

- *LR2 –Tree Planting at Kwai Chung Road Interchange Area*

  The proposed new carriageway will permanently require occupying the existing tree planting area. Without mitigating for the loss of this landscape resource, the impact on this LR is considered **substantially adverse**.

(b) **Slightly adverse** potential impacts will be experienced by:

- *LCA6 –Kwai Chung Road Interchange*

  The proposed new carriageway will permanently require occupying a portion of the existing tree planting area. Without mitigating for the loss of this landscape resource, the impact on this LR is considered **slightly adverse**.

(c) All other identified LRs and LCAs not described in the above will experience **insubstantial** impacts.

7.8 Visual Impact Assessment

Evaluation of Potential Visual Impacts without Mitigation

7.8.1 The potential visual impacts on identified VSRs resulting from the proposed works during construction and operation phases of the Project are summarised in the following sections, listed in **Tables 7-6 and 7-7** and presented in **Figures 7.12** and **7.13**. The mitigated (residual) impacts are assessed during the design year which for the purpose of this study is taken as being between 10 and 15 years after the schemes opening when the proposed mitigation planting is deemed to have reached a level of maturity, which is sufficient for it to perform the design.

Construction Phase

(a) **No substantially adverse** potential impacts will be experienced by the identified VSRs.

(b) **Moderately adverse** potential impacts will be experienced by:

(i) *R5 – Residents at Lai King Estate North*

Directly overlooking onto the Kwai Chung Road Interchange, the residents of Lai King Estate North, especially for those residents residing in the low to middle floors of Fung King House and Ming King House will be exposed to the proposed road works. Without mitigation, the impact on this VSR is **moderately adverse**.

(ii) *R5A – Lai King Estate South*

The proposed road works are clearly seen by residents of On King House. Without mitigation, the impact is **moderately adverse.**

(iii) *O5 – Staff and Students at Lai King Catholic Secondary School*

Located just opposite to the proposed work site, this VSR will be exposed to the proposed work. Without mitigation, the impact on this VSR is **moderately adverse**.

(c) **Slightly adverse** potential impacts will be experienced by:

(i) *R6 – Residents at Yin Lai Court*

Shielded by the Ming King House at front, a small number of flats on the top floors of the two buildings of this VSR will have a clear view on the proposed works. The impact on this VSR is **slightly adverse**.

(ii) *R7 – Residents at Highland Park*

Overlooking the Tsuen Wan Road from the crest of Lai King Hill above, about half of the proposed road work is exposed to view. It is however, the proposed work is at a distance from this VSR resulting in a **slightly adverse** impact during construction phase without mitigation measures.

(iii) *O4 – Staff and Visitors at Polyclinic & Special Educational Services*

Situated at a higher ground behind the Lai King Estate, the proposed road work will be clearly exposed to this VSR. Without mitigation, the impact on this VSR is **slightly adverse**.

(iv) *O6 – Workers at Ever Gain Plaza*

Due to the orientation of the building, Ever Gain Plaza will be directly exposed to the proposed road work. It is however, the views to the construction works will be restricted to those VSRs on the higher floors of the building. Without mitigation, this VSR is experiencing a **slightly adverse** impact.

(v) *O8 – Staff and Students at Lingnan Dr. Chung Wing Kwong Memorial Secondary School*

Located behind another VSR-O5, this school will have a partial view on the proposed work. Without mitigation, this VSR is experiencing a **slightly adverse** impact.

(vi) *O10 – Staff at Lai King Assessment Centre*

Overlooking the Kwai Chung Road, this VSR will have a clear view on the proposed work. However the population is relatively small and is experiencing a **slightly adverse** impact during construction period without mitigation.

(vii) *L1 – Visitors to Kwai Shun Street Playground*

Located alongside the Tsuen Wan Road flyover system, the playground is mainly utilised as an outdoor sitting area for the local workers during lunch hours. The view towards the proposed road widening works is very restricted and mostly blocked by the flyover supporting columns and deck structures. This VSR is experiencing a **slightly adverse** impact during construction phase.

(viii) *T1 – Open Storage Area Car Park Users*

This group of VSR will be confronted with the construction work at ground level at close range. With the primary view is already restricted by the flyover systems overhead, this VSR is experiencing a **slightly adverse** impact during construction phase.

(ix) *T2 – Pedestrians travelling on Street Level in Tsuen Wan Road/Kwai chung Road Interchange Area*

Pedestrian currently using the footbridges and sidewalks to travel between the Lai King MTR Station and Kwai Chung Industrial Area and Container Terminal will be exposed to the proposed construction works. Without mitigation, the impact to this VSR is **slightly adverse**.

(x) *T3 – Commuters on Tsuen Wan Road/Kwai Chung Road*

A large numbers of commuters including public transit users, commuters in private vehicles and other commercial vehicles will travel in close range to the proposed road works. Without mitigation, this VSR is experiencing a **slightly adverse** impact.

(xi) *T4 – Commuters at Lai King Bus Terminus*

Overlooking the proposed works area, this VSR will be exposed to the construction works every time they commute through this bus terminus. This VSR will experience a **slightly adverse** impact without mitigation during construction phase.

(xii) *T5 – Commuters on MTR*

Travelling at a higher elevation, this VSR will have a clear view on the proposed construction work. Given the distance between the MTR tracks and the proposed work site and compound with the higher tolerance of this VSR to the potential impact on visual intrusion, this VSR will experience a **slightly adverse** impact without mitigation.

(d) **Insubstantial** potential impacts will be experienced by:

(i) *R1 – Residents at Kwai Chung Plaza*

(ii) *R2 – Residents at New Kwai Fong Gardens*

(iii) *R3 – Residents at Kwai Fong Terrace*

(iv) *R4 – Residents at Lai Yiu Estate*

(v) *R8 – Residents at Yuet Lai Court*

(vi) *R9 – Residents at Cho Yiu Chuen*

(vii) *O1 – Workers at Metroplaza*

(viii) *O2 – Workers at Kwai Chung Industrial Area*

(ix) *O3 – Workers at Kwai Fong Ancillary Building*

(x) *O7– Staff and Workers at Container Terminals*

(xi) *O9 – Staff at Lai King MTR Station*

(xii) *O11 – Staff and Visitors at OUHK – CITA Lai King Learning Centre*

(xiii) *O12 – Staff and Visitors at Lai King Community Hall*

(xiv) *O13 – Staff and Students at Asbury Methodist Primary School*

(xv) *L2 – Visitors to Kwai Yip Road Playground*

(xvi) *L3 – Visitors to Lai King Sports Centre*

(xvii) *L4 – Visitors to Kwai Chung Park*

(xviii) *L5 – Visitors to Lai King Hill Road Playground*

(xix) *T6 – Travellers to Kwai Fong Core Area*

The construction of the new carriageway will have **insubstantial** impacts for this group of VSRs as the construction work is located at a distance away or their primary views are facing away from their respective locations. It is also compounded with the existence of the complex flyover systems that the proposed work will not be easily distinguishable even without mitigation measures during construction.

Operation Phase

(a) **No substantial** potential impacts will be experienced by the identified VSRs.

(b) **No moderately adverse** potential impacts will be experienced by the identified VSRs.

(c) **Slightly adverse** potential impacts will be experienced by:

(i) *R5 – Residents at Lai King Estate North*

Although the new carriageway will blend into the existing web of flyover system upon completion, the noise barrier structures will become a visual disturbance for these residents. In addition, trees that have been removed for the construction work will be lost and result in a downgrading of visual quality. A **slightly adverse** impact is resulted.

(ii) *O5 – Staff and Students at Lai King Catholic Secondary School*

When completed, the new carriageway will blend into the existing web of flyover system and its general visual effect is minimal. However the new noise barrier structure and the loss of tree group that have been removed for the construction work will no longer exist, thus resulting a down grade of visual quality for this group of VSR and a **slightly adverse** impact.

(iii) *T1 – Open Storage Area Car Park Users*

The new carriageway will add additional structures into the already complex flyover system, and compound with the removal of trees at the concerned location. The visual quality for this VSR will be downgraded, thus resulting in a **slightly adverse impact**.

(iv) *T2 – Pedestrians travelling on Street Level under Kwai Chung Road Interchange Area*

The removal of trees for the construction of the carriageway will further deprive the already poor visual quality below the flyover system. Without mitigation, this group of VSR will experience a **slightly adverse** impact during operation period.

(v) *T3 – Commuters on Tsuen Wan Road/Kwai Chung Road*

Although the completed carriageway will blend into the existing flyover system, the introduction of noise barrier structures will create permanent visual barrier along this section of road. The loss of trees for the construction

of proposed structure will downgrade the visual quality of this group of VSR when travelling through this section of road and experience a **slightly adverse** impact.

(d) **Insubstantial** potential impacts will be experienced by:

(i) *R1 – Residents at Kwai Chung Plaza*

(ii) *R2 – Residents at New Kwai Fong Gardens*

(iii) *R3 – Residents at Kwai Fong Terrace*

(iv) *R4 – Residents at Lai Yiu Estate*

(v) *R5A – Residents at Lai King Estate South*

(vi) *R6 – Residents at Yin Lai Court*

(vii) *R7 – Residents at Highland Park*

(viii) *R8 – Residents at Yuet Lai Court*

(ix) *R9 – Residents at Cho Yiu Chuen*

(x) *O1 – Workers at Metroplaza*

(xi) *O2 – Workers at Kwai Chung Industrial Area*

(xii) *O3 – Workers at Kwai Fong Ancillary Building*

(xiii) *O4 – Staff & Visitors at Polyclinic & Special Educational Services*

(xiv) *O6 – Workers at Ever Gain Plaza*

(xv) *O7 – Staff and Workers at Container Terminals*

(xvi) *O8 – Staff and Students at Lingnan Dr. Chung Wing Kwong Memorial Secondary School*

(xvii) *O9 – Workers at Lai King MTR Station*

(xviii) *O10 – Staff at Lai King Assessment Centre*

(xix) *O11 – Staff and Visitors at OUHK – CITA Lai King Learning Centre*

(xx) *O12 – Staff and Visitors to Lai King Community Hall*

(xxi) *O13 – Staff and Students at Asbury Methodist Primary School*

(xxii) *L1 – Visitors to Kwai Shun Street Playground*

(xxiii) *L2 – Visitors to Kwai Yip Road Playground*

(xxiv) *L3 – Visitors to Lai King Sports Centre*

(xxv) *L4 – Visitors to Kwai Chung Park*

(xxvi) *L5 – Visitors to Lai King Hill Road Playground*

(xxvii) *T4 – Commuters at Lai King Bus Terminus*

(xxviii)*T5 – Commuters on MTR*

(xxix) *T6 – Travellers to Kwai Fong Core Area*

With the completion of the construction work, there will be no perceptible change of quality of view as the area will return more or less close to its current condition. All these VSRs will have **insubstantial** impacts from the proposed road works.

7.9 Landscape and Visual Mitigation Measures

7.9.1 The landscape mitigation measures described in this report are at a level which both demonstrate their ability to alleviate the potential landscape and visual impacts identified in the assessment and also allow the proposals to be carried forward during the detailed design stage. More detailed landscape proposals will be developed during the initial stages of the design and construction phase of this project following the completion of the detailed Tree Survey Report. The measures are designed to address both the construction and operation phases of the Project. The residual landscape and visual impacts and the degrees of sensitivity are presented in **Figures 7.14** to **7.17** respectively.

7.9.2 The landscape and visual mitigation measures are described both in a generic sense for measures which apply to all of the development site and in terms of the proposed landscape strategy for the amenity areas within the development. The aim of the mitigation measures is to:

- Alleviate those landscape and visual impacts which are unavoidable through the review of design of the carriageway structure;
- Establish a coherent and integrated landscape framework for the proposed works drawing together the visually disparate components of the proposed carriageway and integrating the proposals within the context of the area;
- Enhance the existing landscape and visual context of the surrounding areas by providing integration between the proposed carriageway and its context; and
- Provide a co-ordinated approach to the landscape mitigation proposals where there is an interface.

Primary Mitigation Measures

7.9.3 In accordance with the EIAO-TM, the hierarchy for landscape and visual impact mitigation is first avoidance of impact, then minimisation of impact and finally compensation of impact. The design of the proposed structures sought to address the following objectives:

- Minimisation of potential impacts on landscape resources such as intrusion into the planting area by reviewing the design requirement of the proposed carriageway structure and associate structures at the concerned location; and
- Restoration and enhancement of existing roadside landscapes through planting of shrubs following the completion of the construction phase of the Project. The selection of shrubs species shall consider the planting theme of the Greening Master Plan of Tsuen Wan Area such that the disturbed area is restored to blend in with the surrounding setting.

Secondary Mitigation Measures

7.9.4 In accordance with the EIAO-TM, mitigation measures for the construction and operation phases of the development have been designed to minimise predicted landscape and visual impacts, and to compensate for the loss of landscape resources as far as possible given the project constraints.

7.9.5 A series of mitigation measures are designed to alleviate impacts and compensate for loss of landscape resources, change of landscape character and visual amenity for VSRs resulting from the construction and operation phases of the Project. The mitigation details are presented in **Figure 7.9**.

7.9.6 The mitigation measures are summarized in **Tables 7.10** and **7.11** below:-

Table 7-10 Proposed Construction Phase Mitigation Measures

Mitigation Code	Mitigation Measures
CP1	**Development Site and Temporary Works Areas –** The construction area and contractor's temporary works area should be minimized to avoid impacts on adjacent landscape. The landscape of these works areas will be restored following the completion of the construction phase. Construction site controls shall be enforced, to ensure that the landscape and visual impacts arising from the construction phase activities are minimized including the storage of materials, the location and appearance of site accommodation and the careful design of site lighting to prevent light spillage. Screen hoarding may be a practicable for this project due to the viewing distances is short in a lot of site situation.
CP2	**Mitigation Planting –** Replanting of disturbed planting areas with shrubs planting should be undertaken at the earliest possible stage during the construction phase of the project so as to reduce the impact of the removed trees.

Table 7-11 Proposed Operation Phase Mitigation Measures

Mitigation Code	Mitigation Measure
OP1	**Design of the Proposed Carriageway Structures and Associate Facilities** – the carriageway structure will incorporate design features as part of design mitigation measures including: choices of material, colour, and shape.
OP2	**Integrated Design Approach –** the associated noise barrier should consider incorporating different means of mitigation measures including choices of material, colour and integrate, as far as technically feasible, with the carriageway as part of design mitigation measures to reduce the potential cumulative impact of the proposed works.
OP3	**Roadside and Amenity Planting –** These planting will utilize flowering and colourful foliage shrubs species to improve the road side planting in creating a more pleasant landscape network in the area. Large shrubs should also be considered to create visual buffers of the supporting.

Mitigation Code	Mitigation Measure
OP4	**Enhancement of Streetscape –** The landscape proposal should consider introducing coloured paving materials to tie with the paving theme of the Kwai Chung area.

7.9.7 The photomontages of the landscape and visual impacts of the Project with and without mitigation measures during operation from a VSR (R5 – Residents at Lai King Estate North) are illustrated at the following four stages as shown in **Figure 7.18**.

- Existing condition
- Day 1 of operation with no mitigation measures
- Day 1 of operation with mitigation measures
- Year 10 of operation with mitigation measures

A viewpoint from Fung King House, Lai King Estate North being adopted for the photomontage give a representative view of the project, which shows the major landscape and visual impacts to the most severely affected VSR due to the construction of the new viaduct and noise barriers, demolition and reprovisioning works of footbridge, and ancillary works. Having considered the close distance in between, full visibility and very frequent to the works during construction and operation phases, the direct overlooking from a low level of Fung King House is taken into consideration. Other adjacent sensitive receivers such as people at Lai King Catholic Secondary School and Ever Gain Plaza or commuters on Tsuen Wan Road and Kwai Chung Road can experience the landscape and visual impacts due to this Project; however, the sensitivity is relatively low than Lai King Estate North in view of the short duration and long distance. They are considered as the temporary visitors either for school, work or travel.

7.10 Residual Impacts

Evaluation of Residual Impacts on Landscape Resources and Landscape Character Areas with Mitigation

7.10.1 The predicted unmitigated and mitigated impacts on the existing landscape resources and existing landscape character areas resulting from the proposed works during the construction and operation phases of the Project are summarised in **Table 7-12** and presented in **Figures 7.14** and **7.15**. The mitigated impacts are assessed during the design year for the purpose of this study and are taken as between 10 and 15 years after the schemes opening when the proposed mitigation planting is deemed to have reached a level of maturity, which is sufficient for it to perform the design objectives.

Construction Phase

7.10.2 There will still be some residual negative impacts after the implementation of the proposed mitigation measures in the construction phase and is as described below.

(a) **Slightly adverse** residual impacts will be experienced by the following LRs and LCAs.

(i) *LCA3 – Residential at Lower Level of Lai King Hill*

The construction works shall require heavy machinery that create visual

disturbance to this LCA. **Slightly adverse** impact will result.

(ii) *LCA6 – Kwai Chung Road Interchange*

Although mitigation measures will be applied to the area during the construction period, the area will still suffer from physical change of loss of existing trees and visual disturbance due to operating machineries and construction work. The resulting impact will be **slightly adverse**.

(b) **Moderately adverse** landscape impacts will be experienced by:

(iii) *LR2 –Tree Planting at Kwai Chung Road Interchange Area*

The unavoidable removal of trees for the construction of the new carriageway will result in a **moderately adverse** impact to the existing LR even with mitigation measures.

(c) All other LRs and LCAs will experience **insubstantial** residual impacts.

Operation Phase

7.10.4 There will be some slightly beneficial residual landscape impacts on the LR and LCA after the implementation of the proposed mitigation measures during the operation phase. The resulting impacts improve from moderately and slightly adverse during construction to slightly beneficial after mitigation.

(a) **No substantially adverse** residual impacts will be experienced by the identified LRs and LCAs in Day 1 and Year 10 during operation.

(b) **No moderately adverse** residual impacts will be experienced by the identified LRs and LCAs in Day 1 and Year 10 during operation.

(c) **No slightly adverse** residual impacts will be experienced by the identified LCAs in Day 1 of operation.

(d) **Slightly adverse** residual impacts will be experienced by LR2 at Day 1 of operation.

(i) *LR2 –Tree Planting at Kwai Chung Road Interchange Area*

With the completion of the project, new tree plantings and associated landscape treatment will be implemented in the area. However, it takes time to allow planting to re-establish and the overall landscape appearance at Day 1 of operation will not be fully achieved. It is anticipated that the proposed planting scheme will be **slightly adverse** during the operation phase in Day 1 of operation.

(e) **Slightly beneficial** residual impacts will be experienced by the following LRs and LCAs.

(i) *LCA6 –Kwai Chung Road Interchange*

With the completion of the new carriageway and with mitigation measures in place, it is anticipated to improve the existing disorganised planting arrangement in between the flyover structures. The new planting in the area will establish through time and is expected to give a coherent and orderly

appearance in the area, and bring a **slightly beneficial** impact to this LCA by Year 10 during operation.

(f) **Insubstantial** residual impacts will be experienced by LCA6 at Day 1 of operation.

(i) *LCA6 –Kwai Chung Road Interchange*

When the new carriageway is put into operation, there will be a new noise barrier structure associated with the new carriageway, and a relocated footbridge closed to Lai King Catholic Secondary School. The overall flyover system will remain the same. The newly planted trees and other vegetation in the area will be in place that the area will return somewhat to its state before the construction, and will have **insubstantial residual impacts** to this at Day 1 of operation.

(g) All other LRs and LCAs not discussed above will be of insubstantial significance in Day 1 and by Year 10 of operation.

Table 7-12 Significance of Landscape Impacts in Construction and Operation Phases (LRs & LCAs)

Id. No.	Landscape Resource / Landscape Character Area	Source of Impact	Sensitivity (Low / Medium / High)	Magnitude of Change (Large/ Intermediate/ Small/ Negligible)		Significance Threshold (Unmitigated) (Insubstantial / Slightly / Moderately / Substantially)		Recommended Mitigation Measures	Residual Impact Significance (Mitigated) (Insubstantial / Slight / Moderate / Substantial)		
				Con.	Op.	Con.	Op.		Con.	Day 1	Year 10
LR2	*Tree Planting at Kwai Chung Road Interchange Area*	Proposed Road Works	High	Large	Large	Substantially Adverse	Substantially Adverse	CP1,2 OP3,4	Moderately Adverse	Slightly Adverse	Insubstantial
LCA3	*Residential at lower level of Lai King Hill*	Proposed Road Works	Medium	Small	Negligible	Moderately Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
LCA6	*Kwai Chung Road Interchange*	Proposed Road Works	Low	Intermediate	Intermediate	Slightly Adverse	Slightly Adverse	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Slightly Beneficial

Evaluation of Residual Visual Impacts with Mitigation

7.10.6 Proposed mitigation measures are described in **Table 7-10** and **Table 7-11**. Detailed descriptions of the effect of the mitigation measures are recorded below. The residual impacts and sensitivities in construction and operation phases are presented on **Figure 7.16** to **Figure 7.17 and Table 7-13** respectively.

Construction Phase

(a) **No substantially adverse** residual impacts will be experienced by the identified VSRs.

(b) **Moderately adverse** residual impacts will be experienced by the following identified VSRs.

(i) *R5 – Residents in Lai King Estate North*

Overlooking the construction site, the construction work is clearly visible and at close range to this group of VSR. A **moderately adverse** impact will result.

(ii) *O5 – Staff and Students at Lai King Catholic Secondary School*

Located at close range to the construction site, the construction work will be visible to this group of VSR during construction period. A **moderately adverse** impact will result.

(c) **Slightly adverse** residual impacts will be experienced by the following identified VSRs:

(i) *R5A – Residents at Lai King Estate South*

Although the new carriageway will blend into the existing web of flyover system upon completion, the noise barrier structures will become a visual disturbance for these residents. A **slightly adverse** impact is resulted.

(ii) *R6 – Residents at Yin Lai Court*

The residents on top floors of the two buildings of this VSR will have a clear view of the construction work, and experience a **slightly adverse** impact.

(iii) *R7 – Residents at Highland Park*

Although situated at a distance and at a high elevation, the proposed work is clearly visible from this VSR. It will experience a **slightly adverse** impact.

(iv) *O4 – Staff and Visitors at Polyclinic & Special Educational Services*

Although situated at about 200m away from the proposed road work site, it commands an open view towards the proposed section of the road widening work. This VSR will experience a **slightly adverse** impact during construction period.

(v) *O6 – Workers at Ever Gain Plaza*

The entire length of the proposed carriageway construction work will be exposed to this VSR and a **slightly adverse** impact will result.

(vi) *O8 – Staff and Students at Lingnan Dr. Chung Wing Kwong Memorial Secondary School*

The proposed road works and the construction of the new footbridge will be visible to this VSR during construction period and a **slightly adverse** impact will result.

(vii) *O10 – Staff at Lai King Assessment Centre*

The proposed work will be clearly visible to this VSR, and a **slightly adverse** impact will result.

(viii) *L1 – Visitors to Kwai Shun Street Playground*

The proposed construction work is visible in between the flyover columns when viewed from this playground. This VSR will experience a **slightly adverse** impact during construction.

(ix) *T1 – Open Storage Area Car Park Users*

The proposed car park is close to the proposed work site and the construction work is visible to this group of VSR. A **slightly adverse** impact is expected.

(x) *T2 – Pedestrians travelling on Street Level under Kwai Chung Road Interchange Area*

The construction site is located very close to their daily commuting route, and even with mitigation, the construction work will be clearly visible. A **slightly adverse** impact is result.

(xi) *T3 – Commuters on Tsuen Wan Road/Kwai Chung Road*

The proposed construction work is located very close to the daily commuting route for this group of VSR. Although mitigation measures will be in place during construction period, the proposed work is still clearly visible to them and a **slightly adverse** impact will result.

(xii) *T4 – Commuters at Lai King Bus Terminus*

Visual disturbance created by operating machineries and construction work is visible from this VSR and even with mitigation. The resulting impact will be **slightly adverse**.

(xiii) *T5 – Commuters on MTR*

Travelling at a higher elevation, this VSR will have a clear view on the proposed construction work. Given the distance between the MTR tracks and the proposed work site, this VSR will experience a **slightly adverse** impact.

(d) **Insubstantial** residual impacts will be experienced by:

(i) *R1 – Residents at Kwai Chung Plaza*

(ii) *R2 – Residents at New Kwai Fong Gardens*

(iii) *R3 – Residents at Kwai Fong Terrace*

(iv) *R4 – Residents at Lai Yiu Estate*

(v) *R8 – Residents at Yuet Lai Court*

(vi) *R9 – Residents at Cho Yiu Chuen*

(vii) *O1 – Workers at Metroplaza*

(viii) *O2 – Workers at Kwai Chung Industrial Area*

(ix) *O3 – Workers at Kwai Fong Ancillary Building*

(x) *O7 – Staff and Workers at Container Terminals*

(xi) *O9 – Workers at Lai King MTR Station*

(xii) *O11 – Staff and Visitors at OUHK – CITA Lai King Learning Centre*

(xiii) *O12 – Staff and Visitors to Lai King Community Hall*

(xiv) *O13 – Staff and Students at Asbury Methodist Primary School*

(xv) *L2 – Visitors to Kwai Yip Road Playground*

(xvi) *L3 – Visitors to Lai King Sports Centre*

(xvii) *L4 – Visitors to Kwai Chung Park*

(xviii) *L5 – Visitors to Lai King Hill Road Playground*

(xix) *T6 – Travellers to Kwai Fong Core Area*

The above VSRs will experience **insubstantial** residual impacts during construction phase with mitigation measures due to a number of different factors; for example, the proposed work is at a distance away from R1, R2, R3, R4, R5A, O1, O2, O3, O7, O9, and travellers T6 are exposed to the proposed work only for a short duration during each encounter. For VSRs R8, R9, O11, O12, O13 and L5, their respective views are blocked by buildings or facing away from the proposed work.

Operation Phase

(a) **No substantial adverse** residual impacts will be experienced by the identified VSRs in Day 1 and Year 10 during operation.

(b) **No moderately adverse** residual impacts will be experienced by the identified VSRs in Day 1 and Year 10 during operation.

(c) **Slightly adverse** impacts will be experienced by the identified VSRs in Day 1 during operation.

(i) R5 – Residents at Lai King Estate North

The proposed noise barrier structures associated with the proposed road widening work will become a permanent visual barrier along the entire new flyover section and will become a visual disturbance for these residents. Even with mitigation, the noise barrier structure is a clearly visible feature and **slightly adverse** impact will be experienced by this VSR in Day 1 of

operation.

(ii) O5 – Staff and Students at Lai King Catholic Secondary School

The close proximity of the new flyover, the associated noise barrier and the new footbridge structure will become a permanent visual barrier for an already restricted view of this VSR. Even with mitigation measures, the new structures are still visible to this VSR and a **slightly adverse** impact will be experienced by this VSR in Day 1of operation.

(iii) T1 – Open Storage Area Car Park Users

The new carriageway and footbridges will add additional flyover and footbridges structures into the existing expressway system, thus reducing the already restricted view of this VSR when visiting the place. The mitigation measures such as new shrubs planting require time to establish. The new structures are visible to this VSR and a **slightly adverse** impact will be experienced by this VSR in Day 1 of operation.

(iv) T2 – Pedestrians Travelling on Street Level under Kwai Chung Road Interchange Area

Like the VSR-T1, this VSR will also be confronted by the new carriageway and footbridges structures when travelling through the area. Although there are mitigation measures like new shrubs planting and streetscape enhancement, the effects require time to establish especially for planting. **Slight adverse** impact will be experienced by this VSR in day 1 of operation.

(v) T3 – Commuters on Tsuen Wan Road/Kwai Chung Road

The noise barrier structures will become a prominent feature to the receivers travelling along this road section. The open view they are currently enjoying will be restricted and blocked and a **slightly adverse** impact will be experienced in Day 1 of operation.

(d) **Insubstantial** residual impacts will be experienced by the following identified VSRs in Day 1 and Year 10 during operation:

(i) *R1 – Residents at Kwai Chung Plaza*

(ii) *R2 – Residents at New Kwai Fong Gardens*

(iii) *R3 – Residents at Kwai Fong Terrace*

(iv) *R4 – Residents at Lai Yiu Estate*

(v) *R5A – Residents at Lai King Estate South*

(vi) *R6 – Residents at Yin Lai Court*

(vii) *R7 – Residents at Highland Park*

(viii) *R8 – Residents at Yuet Lai Court*

(ix) *R9 – Residents at Cho Yiu Chuen*

(x) *O1 – Workers at Metroplaza*

(xi) *O2 – Workers at Kwai Chung Industrial Area*

(xii) *O3 – Workers at Kwai Fong Ancillary Building*

(xiii) *O4 – Staff and Visitors at Polyclinic & Special Educational Services*

(xiv) *O6 – Workers at Ever Gain Plaza*

(xv) *O7 – Staff and Workers at Container Terminals*

(xvi) *O8 – Staff and Students at Lingnan Dr. Chung Wing Kwong Memorial Secondary School*

(xvii) *O9 – Workers at Lai King MTR Station*

(xviii) *O10 – Staff at Lai King Assessment Centre*

(xix) *O11 – Staff and Visitors at OUHK – CITA Lai King Learning Centre*

(xx) *O12 – Staff and Visitors to Lai King Community Hall*

(xxi) *O13 – Staff and Students at Asbury Methodist Primary School*

(xxii) *L1 – Visitors to Kwai Shun Street Playground*

(xxiii) *L2 – Visitors to Kwai Yip Road Playground*

(xxiv) *L3 – Visitors to Lai King Sports Centre*

(xxv) *L4 – Visitors to Kwai Chung Park*

(xxvi) *L5 – Visitors to Lai King Hill Road Playground*

(xxvii) *T4 – Commuters at Lai King Bus Terminus*

(xxviii) *T5 – Commuters on MTR*

(xxix) *T6 – Travellers to Kwai Fong Core Area*

These groups of VSRs will have **insubstantial** impact on them from Day 1 of operation due to the following factors:

(i) The proposed new flyover and noise barrier structure are at a distance away from their respective locations such as R1, R2, R3, R4, R5A, R7, R8, R9, O11, O12, O13, L2, L3, L4 and L5 such that the appearance of the new structures blend into the existing web of existing flyover system.

(ii) The proposed new flyover and noise barrier structure will only be visible either through narrow viewing angles, in between building structures, or flyover columns for these groups of VSRs such as R6, O8, and L1.

(iii) The duration for which the VSRs will be exposed to the proposed new flyover and noise barrier structures is short as travel through the area within seconds or minutes and is represented by T4, T5 and T6.

(iv) Those VSRs that are Staff and workers of the offices and factories in the study area such as O1, O2, O3, O4, O6, O7, O8, O9 and O10 will be considered to have higher tolerance to visual impacts and their presence in

the study area is short in comparison to local residents.

(e) **Slightly beneficial** residual impacts will be experienced by the following identified VSRs:

Although the proposed new carriageway will be largely integrated with the existing infrastructure, and urban context, the implementation of mitigation measures in the area is expected to improve the general appearance of the streetscape with new shrubs plantings and other landscape enhancements in the area. By Year 10, after the new planted shrubs have fully established and the anticipated greening effect has taken root, the overall landscape treatment in the area as seen on ground level will be expected to be improved and **slightly beneficial** impacts after completion are expected by Year 10 of operation. This is applicable to the following VSRs.

(i) *T1 – Open Storage Area Car Park Users*

(ii) *T2 – Pedestrians travelling on Street Level under Kwai Chung Raod Interchange Area*

Table 7-13 Significance of Visual Impacts during Construction and Operation Phases (VSRs)

Id. No.	VSRs	Sensitivity (Low / Medium / High)	Source of Impact	Magnitude of Change (Large/ Intermediate/ Small/ Negligible)		Significance Threshold (Unmitigated) (Insubstantial, Slight, Moderate and Substantial)		Mitigation Measures	Significance Residual Threshold (Mitigated) (Insubstantial, Slight, Moderate and Substantial)		
				Con.	Op.	Con.	Op.		Con.	Op.	
										Day 1	Year 10
Residential											
R1	*Kwai Chung Plaza*	Medium	VIC1,2,4,5,6 VIO1,2,3	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
R2	*New Kwai Fong Gardens*	Medium	VIC1,2,4,5,6 VIO1,2,3	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
R3	*Kwai Fong Terrace*	Medium	VIC1,2,4,5,6 VIO1,2,3	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
R4	*Lai Yiu Estate*	Medium	VIC1,2,3,4,5,6 VIO1,2,3	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
R5	*Lai King Estate North*	High	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Intermediate	Small	Moderately Adverse	Slightly Adverse	CP1,2 OP1,2,3,4,	Moderately Adverse	Slightly adverse	Insubstantial
R5A	*Lai King Estate South*	High	VIC1,2,3,4,5 VIO1,2,3, 4,	Small	Negligible	Moderately Adverse	Insubstantial	CP1,2 OP1,2,	Slightly Adverse	Insubstantial	Insubstantial
R6	*Yin Lai Court*	Medium	VIC1,2,3,4,5 VIO1,2,3	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,	Slightly Adverse	Insubstantial	Insubstantial
R7	*Highland Park*	Medium	VIC1,2,4,5,6 VIO1,2,3	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2	Slightly Adverse	Insubstantial	Insubstantial
R8	*Residents at Yuet Lai Court*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
R9	*Residents at Cho Yiu Chuen*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
Occupational											
O1	*Metroplaza*	Low	VIC1,2,3,4,5,6 VIO1,2,3	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
O2	*Kwai Chung Industrial Area*	Low	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
O3	*Kwai Fong Ancillary Building*	Low	VIC1,2,3,4,5,6 VIO1,2,3	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial

Id. No.	VSRs	Sensitivity (Low / Medium / High)	Source of Impact	Magnitude of Change (Large/ Intermediate/ Small/ Negligible)		Significance Threshold (Unmitigated) (Insubstantial, Slight, Moderate and Substantial)		Mitigation Measures	Significance Residual Threshold (Mitigated) (Insubstantial, Slight, Moderate and Substantial)		
				Con.	Op.	Con.	Op.		Con.	Op.	
										Day 1	Year 10
O4	*Polyclinic & Special Educational Services*	Medium	VIC1,2,3,4,5,6 VIO1,2,3	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4,	Slightly Adverse	Insubstantial	Insubstantial
O5	*Lai King Catholic Secondary School*	Medium	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Intermediate	Small	Moderately Adverse	Slightly Adverse	CP1,2 OP1,2,3,4	Moderately Adverse	Slightly adverse	Insubstantial
O6	*Ever Gain Plaza*	Low	VIC1,2,3,4,5,6 VIO1,2,3	Intermediate	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
O7	*Container Terminals*	Low	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
O8	*Lingnan Dr. Chung Wing Kwong Memorial Secondary School*	Medium	VIC1,2,3,4,5,6 VIO1,2,3	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
O9	*Lai King MTR Station*	Low	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
O10	*Lai King Assessment Centre*	Low	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
O11	*OUHK – CITA Lai King Learning Centre*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
O12	*Lai King Community Hall*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
O13	*Asbury Methodist Primary School*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
Leisure											
L1	*Kwai Shun Street Playground*	Medium	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
L2	*Visitors to Kwai Yip Road Playground*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
L3	*Visitors to Lai King Sports Centre*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
L4	*Visitors to Kwai Chung Park*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial
L5	*Visitors to Lai King Hill Road Playground*	Medium	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial

Id. No.	VSRs	Sensitivity (Low / Medium / High)	Source of Impact	Magnitude of Change (Large/ Intermediate/ Small/ Negligible)		Significance Threshold (Unmitigated) (Insubstantial, Slight, Moderate and Substantial)		Mitigation Measures	Significance Residual Threshold (Mitigated) (Insubstantial, Slight, Moderate and Substantial)		
				Con.	Op.	Con.	Op.		Con.	Op.	
										Day 1	Year 10
Traveller											
T1	*Open Storage Area Car Park Users*	Low	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Intermediate	Small	Slightly Adverse	Slightly Adverse	CP1,2 OP1,2,3,4	Slightly Adverse	Slightly Adverse	Slightly Beneficial
T2	*Pedestrians Travelling on Street Level under Kwai Chung Road Interchange*	Low	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Intermediate	Small	Slightly Adverse	Slightly Adverse	CP1,2 OP1,2,3,4	Slightly Adverse	Slightly adverse	Slightly Beneficial
T3	*Commuters on Tsuen Wan Road/Kwai Chung Road*	Low	VIC1,2,3,4,5,6 VIO1,2,3,4,5	Intermediate	Small	Slightly Adverse	Slightly Adverse	CP1,2 OP1,2,3,4	Slightly Adverse	Slightly adverse	Insubstantial
T4	*Commuters at Lai King Bus Terminus*	Low	VIC1,2,3,4,5,6 VIO1,2,3	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
T5	*Commuters on MTR*	Low	VIC1,2,3,4,5,6 VIO1,2,3	Small	Negligible	Slightly Adverse	Insubstantial	CP1,2 OP1,2,3,4	Slightly Adverse	Insubstantial	Insubstantial
T6	*Travellers to Kwai Fong Core Area*	Low	--	Negligible	Negligible	Insubstantial	Insubstantial	--	Insubstantial	Insubstantial	Insubstantial

Note: "--" denotes no source of impact and mitigation measure due to non-visible from the proposed works.

7.11 Environmental Monitoring and Audit

7.11.1 The design, implementation and maintenance of landscape and visual mitigation measures are key aspects and should be checked to ensure that they are fully realised; thus EM&A for landscape and visual resources should be undertaken.

7.11.2 The landscape and visual mitigation measures should be incorporated in the design details. The mitigation measures for the construction phase should be adopted from the commencement of the construction work and should be in place throughout the entire construction period. While the mitigation measures for the operation phase should be adopted during the detail design stage and be implemented as part of the construction works so that they are in place on date of commissioning of the project. Also, any potential conflicts between the proposed mitigation measures and any other project works and operational requirements should be resolved early and without compromising the intention of the mitigation measures.

Audit Requirements

7.11.3 Site audit should be undertaken on a regular basis during the construction phase of the Project to ensure the proposed landscape and visual mitigation measures are properly implemented and maintained as per their intended objectives. Operation phase auditing will be restricted to the 12 months establishment works of the landscaping proposals.

7.12 Conclusion

Summary of Landscape and Visual Mitigation Measures

7.12.1 Construction phase mitigation measures will comprise the following (described in detail in **Table 7-10**):

- CP1 – The construction site is carefully designed to minimise impact.
- CP2 – Replanting will be undertaken as soon as possible during the construction phase.

7.12.2 Operation phase mitigation measures will comprise the following (described in detail in **Table 7-11**):

- OP1 – The design of the proposed carriageway structures and associated facilities will incorporate design features as part of design mitigation measures.
- OP2 – The associate noise barrier will integrate as far as technically feasible with the carriageway as part of mitigation measures to reduce potential cumulative impact.
- OP3 – Roadside and amenity planting will be utilised throughout the site.
- OP4 – New streetscape treatment on pedestrian walkway is proposed.

Summary of Predicted Landscape and Visual Impacts in the Construction Phase

(a) Landscape Resources:

- LR2 – Tree Planting at Kwai Chung Road Interchange Area will be expected to experience **moderately adverse** impacts.

(b) Landscape Character Area:

- LCA3 – Residential at Lower Level of Lai King Hill and LCA6 – Kwai Chung Road Interchange will be expected to receive **slightly adverse** impacts.

(c) Visual Sensitive Receivers:

- R5 – Lai King Estate North and O5 – Lai King Catholic Secondary School will be expected to receive **moderately adverse** impacts.

- R5A – Lai King Estate South; R6 – Yin Lai Court; R7 – Highland Park; O4 – Polyclinic & Special Educational Services; O6 – Ever Gain Plaza; O8 – Lingnan Dr. Chung Wing Kwong Memorial Secondary School; O10 – Lai King Assessment Centre; L1 – Kwai Shun Street Playground; T1 – Open Storage Area Car Park Users; T2 – Pedestrians Travelling on Street Level Under Kwai Chung Road Interchange Area; T3 – Commuters on Tsuen Wan Road/Kwai Chung Road; T4 – Commuters at Lai King Bus Terminus and T5 – Commuters on MTR will be expected to experience **slightly adverse** impacts.

7.12.3 All other LRs, LCAs and VSRs will experience **insubstantial** impacts.

Summary of Predicted Landscape and Visual Impacts in the Operation Phase

(a) Landscape Resources:

- LR2 – Tree Planting at Kwai Chung Road Interchange Area will be expected to experience a **slightly adverse** impact at Day 1 of operation.

(b) Landscape Character Area:

- LCA6 – Kwai Chung Road Interchange will be expected to experience a **slightly beneficial** impact at Year 10 of operation.

(c) Visual Sensitive Receivers:

- T1 – Open Storage Area Car Park Users; T2 Pedestrians Travelling on Street Level under Kwai Chung Road Interchange Area; will expect to receive a **slightly beneficial** impact at Year 10 of operation.

7.12.4 All other LRs, LCAs and VSRs will experience **insubstantial** impacts.

Overall

7.12.5 The project will result in some landscape and visual impacts during construction and operation phase. These impacts have been minimised through minimisation of works area, incorporation of aesthetic external design and landscape treatment of the proposed new carriageway and associated footbridges. Approximately 85 existing trees will be affected, of which 59 trees will be felled and 26 trees will be transplanted. Due to the limited available space for the construction of the new carriageway and associated footbridges, 26 trees suitable for transplanting will be transplanted to locations within Kwai Chung district under separate arrangement with LCSD. Detailed tree removal application will be submitted in accordance with ETWB TC(W)10/2013. The trees are of various sizes and species. None of these are Registered Old and Valuable Trees. There are no rare and endangered species but only common species. Although there would be insufficient room for replanting trees in

the landscape area, new flowering shrubs and shrubs with colourful foliage are proposed to be planted as an alternative to tree planting. Additional streetscape enhancement such as theme paving on the connecting pedestrian walkway is also proposed to reduce the residual impact to an acceptable level.

7.12.6 Except for the existing trees, there would be no loss of landscape resources in the area. With the implementation of landscape mitigation measures, it is considered that the residual impact on landscape resource is slight to insubstantial in Year 10 of the operation phase.

7.12.7 The proposed road work is concentrated on section of the existing flyover system. During construction phase, there would be slight residual impact with the implementation of mitigation measures to the Residential at Lower Level of Lai King Hill LCA and Kwai Chung Road Interchange LCA. However, with the completion of the proposed works, and implementation of new planting and streetscape enhancement mitigation measures, the residual landscape impact on these two LCAs would be reduced to insubstantial in Day 1 and Kwai Chung Road Interchange LCA would further improves to slightly beneficial in Year 10 when the planting works become established.

7.12.8 In terms of visual impact, there would be moderate to slightly adverse visual impacts on some residential, occupational, leisure, and traveller VSRs who has visual contact with the proposed works during the construction stage. These impacts are mostly temporary in nature and would be reduced in the operation phase of the project.

7.12.9 There would be slight residual visual impacts on VSRs include Residential VSR in Lai King Estate North, Occupational VSR in Lai King Secondary School, Traveller VSR in Open Storage Area Car Park Users, Pedestrians travelling on Street Level under Kwai Chung Road Interchange and Commuters on Tsuen Wan Road/Kwai Chung Road on Day 1 of operation. With the implementation of the mitigation measures becomes established, the residual visual impact on these VSRs would be further reduced to insubstantial and in even slightly beneficial for Traveller VSRs in Open Storage Area Car Park Users and Pedestrians travelling on Street Level under Kwai Chung Road Interchange Area in Year 10.

7.12.10 Residual impacts on other VSRs are insubstantial from Day 1 of operation phase.

7.12.11 In view of the above, it is considered that the overall landscape and visual impact in association with the construction and operation of the proposed works with the implementation of the proposed mitigation measures are acceptable.

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8. LANDFILL GAS HAZARD ASSESSMENT

8.1 Introduction

8.1.1 This section presents a landfill gas hazard assessment for the construction and operation of the Project.

8.2 Environmental Legislation, Standards and Guidelines

8.2.1 Under Annexes 7 and 19 of the *Technical Memorandum of the Environmental Impact Assessment Ordinance*, Landfill Gas (LFG) hazard assessment is required for any development or re-development within the Consultation Zone, i.e. the area surrounding the landfill boundary as defined by a line running parallel to and 250m away from the edge of the waste.

8.2.2 EPD has issued the *Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97)*, which provides a risk assessment framework for developments proposed close to landfill sites. Generally, a qualitative landfill risk assessment is required to ensure that appropriate levels of safety design features are incorporated within the development.

8.3 Evaluation of Environmental Impacts

8.3.1 Restored Gin Drinkers Bay Landfill is located at the North-west from the Project boundary. The Consultation Zone boundary was published by EPD in *Annex A of Landfill Gas Hazard Assessment Guidance Note*, which is provided in **Appendix 8.1**.

8.3.2 According to the Study Brief, if any part of a project option shall fall within 250m of Consultation Zone of the restored Gin Drinkers Bay Landfill, the potential landfill gas hazard shall be evaluated and assessed.

8.3.3 As shown in **Figure 8.1**, the proposed project does not fall within the 250m Consultation Zone of the restored Gin Drinkers Bay Landfill. Therefore, the LFG hazard assessment is considered not necessary unless there is any possible change(s) on the alignment option in the future that the project/construction boundary shows encroachment on the Consultation Zone.

8.4 Conclusion

8.4.1 The LFG hazard assessment is considered not necessary as the proposed project does not fall within the 250m Consultation Zone of the restored Gin Drinkers Bay Landfill.

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9. IMPACT ON CULTURAL HERITAGE

9.1 Introduction

9.1.1 The EIA Study Brief for the Project requires a Cultural Heritage Impact Assessment (CHIA) including a Built Heritage Impact Assessment (BHIA). This BHIA requires to identify known and unknown built heritage items within the Assessment Area that maybe affected by the Project, assess the potential direct and indirect impacts on these identified built heritage, and recommend mitigation measures where required during construction and operation phases.

9.2 Environmental Legislations and Standards

9.2.1 The following legislations and guidelines are applicable to the assessment of cultural heritage impacts in Hong Kong:

- Antiquities and Monuments Ordinance (Cap. 53)
- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499)
- Technical Memorandum on the Environmental Impact Assessment Process (EIAO-TM)
- Guidance Notes on Assessment of Impact on Site of Cultural Heritage in Environmental Impact Assessment Studies (GN-CH)
- Hong Kong Planning Standards and Guidelines (HKPSG)
- Guidelines for Cultural Heritage Impact Assessment
- Development Bureau Technical Circular (Works) No. 6/2009: Heritage Impact Assessment Mechanism for Capital Works Projects

Antiquities and Monuments Ordinance (Cap. 53)

9.2.2 The Antiquities and Monuments Ordinance (the Ordinance) provides the statutory framework to provide for the preservation of objects of historical, archaeological and paleontological interest. The Ordinance contains the statutory procedures for the Declaration of Monuments. The proposed monument can be any place, building, site or structure, which is considered to be of public interest by reason of its historical archaeological or paleontological significance.

9.2.3 Under Section 6 and subject to sub-section (4) of the Ordinance, the following acts are prohibited in relation to certain monuments, except under permit:

- To excavate, carry on building works, plant or fell trees or deposit earth or refuse on or in a proposed monument or monument; and
- To demolish, remove, obstruct, deface or interfere with a proposed monument or monument.

EIAO, EIAO-TM and GN-CH

9.2.4 The Environmental Impact Assessment Ordinance (EIAO) (Cap.499) was implemented on 1 April 1998. Its purpose is to avoid, minimise and control the adverse impact of designated projects on the environment, through the application of the EIA process and the Environmental Permit (EP) system.

9.2.5 The general criteria and guidelines for evaluating and assessing impacts to sites of cultural heritage are listed in Annexes 10 and 19 of the Technical Memorandum on Environmental

Impact Assessment Process (EIAO-TM). It is stated in Annex 10 that all adverse impacts to sites of cultural heritage should be kept to an absolute minimum and that the general presumption of impact assessment should be in favour of the protection and conservation of all sites of cultural heritage. Annex 19 provides the details of scope and methodology for undertaking Cultural Heritage Impact Assessment, including baseline study, impact assessment and mitigation measures. No quantitative standard for determining the relative importance of sites of cultural heritage, but in general, sites of unique, archaeological, historical or architectural should be considered as highly significant.

9.2.6 The Guidance Notes on Assessment of Impact on Site of Cultural Heritage in Environmental Impact Assessment Studies (GN-CH) serves as a reference to assist the understanding of the requirements set out in Section 2 of Annex 10 and Annex 19 of the EIAO-TM in assessing impact on sites of cultural heritage in EIA studies.

Hong Kong Planning Standards and Guidelines (HKPSG)

9.2.7 Chapter 10 of the HKPSG details the planning principles for conservation of natural landscape and habitats, historical buildings and archaeological sites. The document states that heritage conservation is the protection of monuments, historical, buildings, archaeological sites and other antiquities, and in a wider sense implies respect for local activities, customs and traditions. The guidelines state that the concept of conservation of heritage features, should not be restricted to individual structures, but should endeavour to embrace the setting of the feature or features in both urban and rural settings.

Guidelines for Cultural Heritage Impact Assessment

9.2.8 The Guideline is issued by the Antiquities and Monuments Office (AMO). It assists the understanding of the requirements in assessing impact on archaeological and built heritage, and outlines the specific technical requirements for conducting a built heritage impact assessments and is based upon the requirements of the EIAO-TM. The guidelines include the parameters and scope for the baseline study, specifically on desk-based research and field evaluation. There are also included guidelines encompassing reporting requirements and archive preparation and submission in the form of *Guidelines for Archaeological Reports and guidelines for the Handling of Archaeological Finds and Archives*. It is also in Appendix H-1 of the EIA Study Brief for the Project.

9.2.9 The prerequisite conditions for conducting impact assessment and mitigation measures are presented in details including the prediction and evaluation of impacts based upon five levels of significance (beneficial, acceptable, acceptable with mitigation measures, unacceptable and undetermined). The guidelines also state that preservation in totality must be taken as the first priority and if this is not feasible due to site constraints or other factors, full justification must be provided.

9.2.10 Appropriate mitigation measures will be proposed in cases with identified impacts and shall have the aim of minimising the degree of adverse impact. The responsibility for the implementation of any proposed mitigation measures must be clearly stated with details of when and where the measures will be implemented and by which party.

Development Bureau Technical Circular (Works) No. 6/2009: Heritage Impact Assessment Mechanism for Capital Works Projects

9.2.11 The Technical Circular contains the procedures and requirements for assessing heritage impact arising from the implementation of new capital works projects as defined in Section 5 of the Technical Circular. It is stated in the document that the works agent will provide a checklist to the AMO of any heritage sites (as defined in the Technical Circular) situated within or within the vicinity of the project boundary (usually to be defined as not more than

50 metres measured from the nearest point of the project boundary, including works areas).

9.2.12 The identification of the heritage sites shall be undertaken at the earliest possible stage, preferably as part of the Technical Feasibility Statement. If the works boundary cannot be defined at this stage, the checklist shall be provided as soon as the project boundary has been defined. Upon receipt of the above information from the works agent, the AMO will determine if the proposed project will affect the heritage value of any heritage site and decide the necessity of conducting a Heritage Impact Assessment (HIA) based upon the submitted information.

9.2.13 If a HIA is required, the works agent shall submit a proposal for the scope of the HIA for AMO approval. Once the scope has been approved it will be the responsibility of the works agent to conduct the HIA.

9.3 Assessment Criteria and Methodology

9.3.1 The investigation of the cultural heritage of the area follows the approach that is identified in the EIAO-TM and the Guidelines for Cultural Heritage Impact Assessment as set out in the EIA Study Brief of this Project. As stated in the Study Brief, the CHIA shall include areas within a distance of 50 meters from the site boundary of the Project, associated works, supporting facilities and essential infrastructures (hereinafter "Assessment Area"). It is also mentioned that only BHIA shall be included in this Cultural Heritage Impact Assessment.

9.3.2 In addition to the desk-based study, a field visit was carried out along the alignment and within the Assessment Area. This approach minimises the likelihood of any features of cultural heritage interest being overlooked.

9.3.3 Features which fall within the scope of built heritage resources include:

- All declared monuments;
- All proposed monuments;
- All building/structure/ sites graded or proposed to be graded by the Antiquities Advisory Board (AAB);
- Government historic sites identified by AMO;
- Buildings/structures/ sites of high architectural/historical significance and interest which are not included in items mentioned above; and
- Cultural landscapes included places associated with historic event, activity, or person or exhibiting other cultural or aesthetic values, such as sacred religious sites, battlefields, a setting for buildings or structures of architectural or archaeological importance, historic field patterns, clan graves, old tracks, fung shui woodlands and pons, and etc.

9.3.4 The definitions of gradings are adopted by the Antiquities Advisory Board and the AMO for the preservation of historic buildings. The classification has three gradings:

Grade 1: Buildings of outstanding merit, which every effort should be made to preserve if possible.

Grade 2: Buildings of special merit; efforts should be made t selectively preserve.

Grade 3: Buildings of some merit; preservation in some form would be desirable and alternative means could be considered if preservation is not practicable.

Baseline Study

Desk-Based Study

9.3.5 A desk-based study was conducted to reveal all published information available in the public domain. The information sources include the following:

- List of Proposed and Declared Monuments as issued by the AMO;
- List of Graded and Proposed Graded Historic Buildings as issued by the AMO;
- Publications on relevant historical, anthropological and other cultural studies;
- Unpublished archival, papers, records; collection and libraries of tertiary institutions;
- Cartographic and pictorial documentation;
- Relevant information from AMO's website; and
- Previous Archaeological Impact Assessment, Cultural Heritage Impact Assessment and / or Approved EIA Studies conducted within the study area.

Site Visit

9.3.6 A Site Visit along the Project alignment and within the Assessment Area was conducted to note the current condition of the previously recorded resources and also the record resources not included in the previous studies, hence, to fill the information gap in the desk-based study.

9.3.7 The scope of built heritage resources included in this Study follows the requirements of the Guidelines for Cultural Heritage Impact Assessment as issued by the AMO. These include proposed and declared monuments, proposed and graded historic buildings and government historic sites, all pre-1950 buildings and structures and selected post-1950 buildings and structures of high architectural and historical significance and interest were identified and recorded.

Impact Assessment and Mitigation Recommendations

9.3.8 Prediction and identification of both direct and indirect impacts that may affect the built heritage resources within the Assessment Area was undertaken. Preservation in-situ should always be the first priority for sites of cultural heritage. If preservation in totality is not possible, mitigation would be proposed to minimise the degree of adverse impact to the greatest possible extent. As well, any disturbance to sites of cultural heritage that may cause physical damage should be avoided wherever possible through alteration of design, construction method or protective measures as appropriate.

9.4 Results of the Desk-Based Study

9.4.1 As stated in the EIA Study Brief, the Assessment Area for the built heritage impact assessment is 50m from the Project site boundary (including works area), as shown in **Figure 9-1**. Based on the desk-based study, there are no proposed or declared monuments, government historic sites, historic building nor built heritage resources within the Assessment Area. The nearest identified built heritage resources are the Tin Hau Temple near Ha Kwai Chung Tsuen and the Tang Ancestral Hall at Ha Kwai Chung Tsuen. Both of them are nil grade and are about 400m and 600m from the Project boundary respectively as shown in **Figure 9-1**.

9.5 Impact Assessment

Level of Impact

9.5.1 According to the Guidelines for Cultural Heritage Impact Assessment, the evaluation of the impacts on heritage resources affected by the proposed development is classified into five levels of significance/level based on type and extent of the effect:

- Beneficial impact: the impact is beneficial if the project will enhance the preservation of the heritage site(s);
- Acceptable impact: if the assessment indicates that there will be no significant effects on the heritage site(s);
- Acceptable impact with mitigation measures: if there will be some adverse effects, but these can be eliminated, reduced or offset to a large extent by specific measures, such as conduct a follow-up Conservation Proposal or Conservation Management Plan for the affected heritage site(s) before commencement of work in order to avoid any inappropriate and unnecessary interventions to the buildings;
- Unacceptable impact: if the adverse effects are considered to be too excessive and are unable to mitigate practically;
- Undetermined impact: if the significant adverse effects are likely, but the extent to which they may occur or may be mitigated cannot be determined from the study. Further detailed study will be required for the specific effects in question.

9.5.2 The impacts were assessed for both the construction and operation phases with the potential sources of impacts are discussed in the following sections. A proposal with details for the mitigation measures and monitoring of impacts on built heritage shall be submitted to AMO for comments before commencement of work, if considered necessary.

Construction Phase

9.5.3 Any heritage resources, located in close proximity to the Project may be impacted through:

- Direct impact to historical (e.g. demolition) and sites of terrestrial archaeological potential (e.g. excavation);
- Indirect vibration impact on historical buildings due to drilling and piling activities during construction phase that may lead to the structural damage or interference of normal activities; and
- Indirect visual impact to historical buildings due to construction works e.g. excavation works at surface.

Operation Phase

9.5.4 Impacts on sites of cultural heritage during operation phase of the Project includes indirect visual impact associated with alteration in surrounding environment of the historical structures due to the vehicular traffic noise at the above-ground structures of the Project.

Evaluation of Potential Impacts

Construction Phase

Direct Impact

9.5.5 During construction phase, no direct impact is expected as none of the historic buildings / structures are located within the Assessment Area.

Indirect Impact

9.5.6 During construction phase, no indirect impact is expected as none of the historic buildings / structures are located within the Assessment Area.

9.5.7 Temporary visual impact would not be anticipated since no built heritage resource was identified within the Assessment Area. For the nearest built heritage resource, ie. Tin Hau Temple near Ha Kwai Chung Tsuen (nil grade) and Tang Ancestral Hall at Ha Kwai Chung Tsuen (nil grade), they are distanced away from the construction site (approx. 400m and 600m from the Project boundary respectively), and the associated views to the Project site are highly disturbed / blocked by the surrounding developments such as the existing road network (both at grade and elevated) and / or the surrounding buildings/structures/development (e.g. Kwai Chung Road and the existing Tsuen Wan Road etc.) as shown in **Figure 9-1**.

Operation Phase

9.5.8 No impact is expected as none of the historic building / structure is located within the Assessment Area.

9.5.9 Similar to the discussion in **Section 9.5.7**, no visual impact would be anticipated as the closest identified built heritages are located over 50m from the Project site and the associated views to the Project site are highly disturbed / blocked by the road networks (both at grade and elevated) and / or the surrounding building/structures/development as shown in **Figure 9-1**.

9.6 Recommended Mitigation Measures

9.6.1 No adverse built heritage impact associated with the Project during both construction and operation phases would be anticipated. Therefore, no mitigation measures for cultural heritage would be required.

9.7 Environmental Monitoring and Audit

9.7.1 No mitigation measures are recommended and, therefore, no EM&A is required. As a precautionary measure, the AMO shall be informed immediately in case of discovery of antiquities or supposed antiquities within the project boundary.

9.8 Conclusion

9.8.1 No cultural heritage resource was identified within the Assessment Area of the Project. No impacts to cultural heritage are expected to be anticipated during both construction and operational phases of the Project and no mitigation measures would be required.

10. ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

10.1 Introduction

10.1.1 Based on the assessment in previous chapters on various environmental parameters, programme and methodologies for Environmental Monitoring and Audit (EM&A) are recommended for evaluating the environmental performance and compliance or implementing the 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.

10.1.2 The EM&A programme provides systematic procedures for monitoring, auditing and minimising of the environmental impacts associated with the construction and operation of the Project. Major objectives of the EM&A includes:-

- To ensure compliance with the EIA study recommendations and regulatory requirements, standards and government policies;
- To enhance the effectiveness of recommended on-site mitigation measures through monitoring and auditing;
- To allow early warning for impact prevention or minimisation;
- To identify any further need for additional mitigation measures or remedial action to redress unacceptable or unanticipated environmental impacts;
- To determine the scope and extent of remedial action if any exceedance of environmental compliance.

10.1.3 All EM&A data, assessment and recommendations would be reported in a series of regular EM&A reports during the next phases of this Project.

10.1.4 The following sections summarise the recommended EM&A requirements for the Project. Details of specific requirements, mitigation measures, monitoring procedures and locations are presented in a stand-alone Environmental Monitoring and Audit (EM&A) Manual.

10.2 Air Quality

Construction Phase

10.2.1 Although no adverse dust impact would be anticipated at the ASRs with the implementation of sufficient dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation and good site practices, regular air quality monitoring and site environmental audits during the construction phase of the Project as specified in the EM&A Manual should be conducted to ensure the recommended dust suppression measures are implemented properly.

Operational phase

10.2.2 The results of the operational air quality impact assessment related to vehicular emissions indicated that no adverse impact would be generated during the operation phase of the project. In addition, the project will bring about improvements in terms of air quality impacts to the nearby sensitive receivers, as compared to the existing and future baseline conditions. Therefore, the EM&A works related to traffic air quality for the operational

phase is considered not necessary.

10.3 Noise

Construction Phase

10.3.1 Recommended noise mitigation measures and their detailed implementation schedules, environmental monitoring and audit measures are recommended during the construction phase of the Project. Schedule and extent of the monitoring programme is presented in the stand-alone EM&A Manual. A proactive EM&A programme is necessary to be provided by the contractor, in order to ensure that construction noise impact to the NSRs should be minimized as far as practicable. An appropriate path for noise complaints handling procedures is a key element of the EM&A programme. Detailed implementation schedules of all mitigation measures are also provided in the EM&A Manual.

Operation Phase

10.3.2 Road traffic noise monitoring is recommended at representative NSRs during the first year of the road opening.

10.3.3 Recommended noise mitigation measures and their detailed implementation schedules, as well as monitoring procedures and locations are presented in the EM&A Manual. Traffic noise impacts and effectiveness of the noise mitigation measures could be evaluated through the monitoring exercise.

10.4 Water Quality

10.4.1 With the proper implementation of recommended mitigation measures, the adverse impact during construction and operation of the Project would be insignificant and hence environmental monitoring for water quality is not considered necessary but regular site inspection should be conducted at the construction and work area in order to ensure the mitigation measures are adequately implemented.

10.5 Waste Management and Land Contamination

10.5.1 It will be Contractor's responsibility to ensure that all wastes produced during the construction of the Project are handled, stored and disposed of in accordance with the recommended good waste management practices and EPD's regulations and requirements. It is recommended that regular auditing by an Environmental Team should be carried out during the construction phase of the 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.

10.5.2 A Waste Management Plan (WMP), as part of Environmental Management Plan (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.

10.5.3 The Public Works Regional Laboratory of Tsuen Wan (Laboratory) has been identified as a chemical waste producer, which is a potential contaminated land use within the project boundary. The allocatee shall be responsible for the land contamination assessment of the

Laboratory Site and ensure the Laboratory Site is free from contamination at the expiry of allocation and therefore any land contamination concern arising from past activities would have been remediated prior to the construction of the works.

10.5.4 With implementation of good site practice and design, land contamination at the Site arising from construction and operation phases of the Project as road upgrading works is not envisaged, no EM&A for contaminated land is recommended.

10.6 Landscape and Visual

10.6.1 The design, implementation and maintenance of landscape and visual mitigation measures is a key aspect and should be checked to ensure that they are fully realised, thus EM&A for landscape and visual resources should be undertaken.

10.6.2 The landscape and visual mitigation measures should be incorporated in the design details. Where feasible, the mitigation measures for the construction phase should be adopted from the commencement of the construction work and should be in place throughout the entire construction period. While in the operation phase, the mitigation measures should be adopted during the detail design stage and be implemented as part of the construction works so that they are in place on date of commissioning of the project.

10.6.3 Also, any potential conflicts between the proposed mitigation measures and any other project works and operational requirements should be resolved early and without compromising the intention of the intention of the mitigation measures.

10.6.4 Site audit should be undertaken on a regular basis during the construction phase of the Project to ensure the proposed landscape and visual mitigation measures are properly implemented and maintained as per their intended objectives. Operational phase auditing will be restricted to the 12 months establishment works of the landscaping proposals.

10.7 Landfill Gas Hazard

10.7.1 Since the Project does not fall within the 250m Consultation Zone of the closed Gin Drinkers Bay Landfill, the Landfill Gas (LFG) hazard assessment is considered not necessary. No EM&A for LFG hazard is considered required.

10.7.2 Nevertheless, the Contractor and the ET shall be aware of any change(s) on the alignment option which would potentially alter the project/construction boundary. If such alternation results in encroachment on the Consultation Zone, the Contractor shall notify EPD and the potential landfill gas hazard shall be evaluated and assessed in accordance with Annexes 7 and 19 of the *Technical Memorandum of the Environmental Impact Assessment Ordinance* and *Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97)* published by EPD.

10.8 Impact on Cultural Heritage

10.8.1 As no cultural heritage resource was identified within the Assessment Area of the Project. No impacts to cultural heritage are expected to be anticipated during both construction and operational phases of the Project. Therefore, no EM&A for cultural heritage is anticipated.

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11. ENVIRONMENTAL OUTCOMES AND CONCLUSIONS

11.1 Introduction

11.1.1 The Project is a designated project under Item A.8 of Part I, Schedule 2 of the EIAO: "A road or railway bridge more than 100m in length between abutments".

11.1.2 This EIA Report included an assessment on the potential environmental impacts for the construction and operation of the Project based on the preliminary engineering design information available at this stage, and taken into consideration of the potential cumulative impacts from other concurrent projects. The assessment has been conducted, in accordance with the Study Brief No. ESB-242/2012 under the EIAO for the Project, covering the following environmental issues:

- Air Quality Impact
- Noise Impact
- Water Quality Impact
- Waste Management and Land Contamination Impact
- Landscape and Visual Impact
- Landfill Gas Hazard
- Impact on Cultural Heritage

11.1.3 Findings of this EIA Study have determined the likely nature and extent of environmental impacts predicted to arise from the construction and operation of the Project. During EIA process, specific environmental control and mitigation measures have been identified and incorporated into the planning and design of the Project in order to achieve compliance with environmental legislation and standards during both the construction and operation phases. An environmental monitoring and audit (EM&A) programme has also been developed. The Implementation Schedule of the recommended mitigation measures is presented in the Section 12. The key environmental outcomes arising from the EIA Study and the principal findings of the study are summarised in the following sections.

11.2 Summary of Key Environmental Outcomes

General

11.2.1 Major sensitive areas within the study area include residential buildings, clinics and institutional uses. With the implementation of the proposed mitigation measures, the Project would not generate adverse environmental impacts to the surrounding population and environmental sensitive receivers. A summary of the key environmental outcomes arising from the EIA Study and benefits of the environmental protection measures recommended are presented in the following sections.

Minimisation of Environmental Impacts by Options Considered

11.2.2 Comprising with other 6 alternatives options, Option 2A is considered the best road improvement option due to traffic, engineering, environmental considerations and implementation aspects, etc.

Environmental Designs Recommended

11.2.3 Noise mitigation measures such as noise barriers and low noise road surfacing have been recommended as required to reduce noise impact contributed by the proposed DP road section in this Project. The carriageway design and associated noise barriers will incorporate design features as part of mitigation measures including vertical green panels, choices of material, colour and shape.

11.2.4 Native tree species for roadside tree planting shall be adopted in order to create a coherent landscape network in the area.

Environmental Benefits of Projection/ Mitigation Measures Recommended

11.2.5 The proposed new flyover would divert some of the on-road traffic away from the nearby noise sensitive receivers at Lai King Estate, while noise barrier along the new flyover shall be adopted as needed for the compliance of corresponding EIAO requirements. In this connection, traffic noise impact due to TWR could be slightly relieved with this Project in place.

11.2.6 With the decrease of V/C ratio on SB TWR when this Project is in place, local traffic congestion problem could be resolved. In other words, the on road traffic speed would be resumed to the design speed limit instead of idling during rush hours. As a result, the overall vehicular emission would likely be reduced in the vicinity area in the future.

Key recommended mitigation measures and their associated benefits include:

Air Quality

- Implementing control measures as stipulated in the Air Pollution Control (Construction Dust) Regulation and good site practise to minimise dust generation.
- The on road traffic speed would be resumed to the design speed limit instead of idling during rush hours. As a result, the overall vehicular emission would likely be reduced in the vicinity area in the future.

Noise

- Recommended mitigation measures during construction phase include: adopting quiet construction plant, movable noise barriers, noise jackets, mufflers, limiting the number of plants operated concurrently as well as good site practices. As a result, the construction noise impact is controlled as minimal.
- Direct noise mitigation measure (DNMM) including vertical noise barrier, cantilevered noise barriers and low noise road surfacing were recommended.
- With the implementation of DNMM, traffic noise impact due to DP road would comply with noise criteria.

Water Quality

- Implementation of good site practices as stipulated in ProPECC Note PN 1/94 to control and minimise site runoff arising from general construction activities associated with the construction of the Project.
- Application of discharge licence for discharge of effluent from the construction site under the WPCO while discharge quality must meet the requirements specified in the discharge licence.

- Treatment of all run-off and wastewater generated from the works areas to satisfy all the standards listed in the Technical Memorandum under WPCO.
- Provision of minimum distance of 100m between the discharge points of construction site effluent and the existing seawater intakes.
- Use of treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., to minimise water consumption and reduce the effluent discharge volume.
- Provision of properly maintained and regularly cleaned surface runoff collection system to ensure good service condition.

Waste Management and Land Contamination

- With the implementation of the proposed waste reduction, management and mitigation measures and practices associated with handling, transportation and disposal of the identified wastes arising from the Project, no adverse environmental impacts would be anticipated.

Landscape and Visual

"Construction Phase"

- Replanting of disturbed planting areas with shrubs planting will be undertaken at the earliest possible stage of the construction phase.
- Night-time lighting glare will be controlled to prevent light spillage.
- Decorative screen hoarding will be erected.
- All disturbed landscape areas during construction will be restored like-to-like following the completion of the construction phase.

"Operation Phase"

- The carriageway design and associated noise barriers will incorporate design features as part of mitigation measures including choices of material, colour and shape.
- Roadside and amenity planting will utilise flowering and colourful foliage shrubs species in creating a more pleasant landscape network in the area. Large shrubs will be planted to create visual buffers of the supporting columns.
- Enhancement of streetscape using coloured paving materials to tie with the paving theme of Kwai Chung Area.

Landfill Gas

- LFG hazard assessment is considered not necessary as the proposed project does not fall within the 250m Consultation Zone of the closed restored Gin Drinkers Bay Landfill. As such, no mitigation measures have been provided for LFG issue.

Cultural Heritage

- No adverse built heritage impact associated with the Project during both construction and operation phases would be anticipated. Therefore, no mitigation measures for cultural heritage would be required.

Estimated Population Protected from Various Environmental Impacts and Environmentally Sensitive Areas Protected

11.2.7 The study area for air quality assessments is generally covering 500m from project site boundary, and within 300m for noise and water quality impact assessment. According to the data extracted from the Census and Statistics Department of Hong Kong, the size of community within the Kwai Tsing District is about 500,000, while the population size of residents identified within the 500m study area is about 50,000 according to population census data in Year 2011. Sensitive areas in the vicinity of the project including Lai King Estate, Yin Lai Court, Yuet Lai Count, Lai King Catholic Secondary School, Lingnam Dr. Chung Wing Kong Memorial Secondary School, New Kwai Fong Garden, etc.

11.2.8 With the adoption of above mentioned mitigation measures, the following conclusions have been obtained:

- Construction dust and noise impact on air and noise sensitive receivers within the assessment areas have been minimised and mitigated to acceptable levels.
- No adverse air quality impact due to the Project is anticipated during operation phase.
- Approximately 50,000 residential populations within the operational air quality assessment area will be environmental benefitted.
- About 2,900 residential, classrooms and other sensitive elements have been assessed under 300m study area if noise impact assessment. With implementation of proposed mitigation measures, no exceedance of noise criteria due to DP roads and 18 representative NSRs would be protected while 85 residential dwellings would be benefitted.
- Approximately 23,500m^2 of construction area would be protected during construction phase. About 4,200m^2 of additional road area would be protected during operation phase. In addition, one flushing water intake, two cooling water intake and one typhoon shelter within 300m from the project site would be protected during both construction and operation phases.

Key Environmental Problems Avoided

11.2.9 The optimised option has been selected for this Project and thus following environmental problems have been avoided or minimised:

- Air quality would slightly improve due to the relieving of traffic congestion on Kwai Chung Road in future.
- The proposed flyover is relatively farther away from the nearby NSRs so that noise impact to the existing NSRs would be minimised.
- The site boundary is minimised so that it would not fall into 250m consultation zone of LFG hazard assessment.
- Excavated marine sediment would be treated and reused on-site to avoid the need for off-site disposal.
- Reuse of inert C&D materials on-site as far as practicable to minimise amount of off-site disposal.
- Impacts on the adjacent landscape including LRs, LCAs and VSRs would be minimised by appropriate landscape and visual appearance designs.

11.2.10 The summary of individual technical assessments is presented as follows:

Table 11-1 Summary of Key Environmental Outcomes / Benefits

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
The Project	*Requirements:* Construction of a new flyover and relocation of a footbridge are proposed including: • Introduce an additional southbound lane (a separated viaduct) on TWR and connect to the existing lane on the west side of KCR with design speed of 70 km/hr • Associated works in the following areas have been identified: (i) Existing footbridge NF303 is to be demolished and be re-provided; (ii) Existing Public Works Regional Laboratory will be affected; (iii) Existing drainage reserve zone positioned alongside TWR will be affected; (iv) Existing bus stop outside subway NS10A is to be relocated; and (v) Minor modification to the existing Kwai Chung Road involves removal of the existing planter, breaking and reinstating Kwai Chung Road with the new road marking. *Benefits:* • A section of the SB carriageway of TWR between KT I/C and KCR predicted would be deteriorate due to congestion occurs during peak hours in the future years, a flyover is proposed to improve the road section to cope with the future traffic growth by directing traffic flow from fast lane of SB TWR to merge the fast lane of SB KCR • The proposed new flyover would divert some of the on-road traffic away from the nearby noise sensitive receivers at Lai King Estate, while noise barrier along the new flyover shall be provided as required. In this connection, traffic noise impact due to TWR could be slightly relieved with this Project in place. • With the decrease of V/C ratio on SB TWR when this Project is in place, local traffic congestion problem could be resolved. In other words, the on road traffic speed would be resumed to the design speed limit instead of idling during rush hours. As a result, the overall vehicular emission would likely be reduced in the vicinity area in the future.
Preferred Option	*Various options considered and the preferred option as the most environmentally friendly:* • Comprising with other 6 alternatives options, Option 2A is preferable based on various factors including traffic, engineering, environmental considerations and implementation aspects, etc. • For the proposed scheme, Option 2A is considered the best road improvement option based on the fact that this scheme will yield the best traffic performance upon its implementation. The additional lane in this scheme is to occupy one of the segregated lanes of KCR. From results of traffic survey, there is over one full lane of capacity to receive this additional lane. With respect to the compliance on alignment deign standard, this option is an compliance on all aspects.

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
Construction Air Quality	*Impact/Problem:* • Potential air quality impacts are dust nuisance but expected minimal. *Key environmental problem avoided:* • Implement the Air Pollution Control (Construction Dust) Regulation and good site practice. *Environmental benefits of environmental protection measures recommended:* • Construction Dust impact would be minimised.
Operational Air Quality	*Impact/Problem/Environmental Benefit:* • No exceedance of RSP, FSP as well as NO_2 hourly average concentration criterion is anticipated during operation phase. • Some ASRs would exceed annual average NO_2 concentration limit in AQOs, under both "Without Project" and "With Project" scenarios. • Exceedance of annual NO_2 was mainly resulted from the high background pollutants' concentrations in this district. Marine emission rather than vehicular emission is concluded to the be major contributor to the high background level in most areas, mainly due to the pollutants emitted from the Kwai Chung Container Terminal nearby. • Comparison study concluded that some environmental benefits would be contributed by the Project due to the improvement of traffic flow and vehicles travelling speed after the implementation of the proposed Project. As a result, no adverse air quality impacts are anticipated due to the Project.
Construction Noise	*Impact/Problem:* • Unmitigated construction noise levels: 61 to 81 dB(A). *Key environmental problem avoided:* • Recommended mitigation measures: adopting quiet construction plant, movable noise barriers, noise jackets, mufflers, limiting the number of plants operated concurrently as well as good site practices. *Environmental benefits of environmental protection measures recommended & Environmentally sensitive areas protected:* • Under the mitigated scenario, all representative NSRs would be protected to comply with the daytime construction noise standard as set out in the EIAO-TM except two NSRs would exceed noise criteria during examination period at some months. The Contractor shall liaise with the school representative(s) to obtain the examination schedule and avoid noisy construction activities during school examination period.
Road Traffic Noise	*Impact/Problem:* • Unmitigated noise levels: 55 to 84 dB(A). *Key environmental problem avoided:* • Vertical barrier and cantilevered noise barrier have been provided for the project roads as shown in **Figure 4.4A**. *Environmental benefits of environmental protection measures recommended & Environmentally sensitive areas protected:*

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	• Most representative NSRs cannot comply with the noise limit of 70 dB(A) for residual use, 65 dB(A) for institutional uses and 55 dB(A) for clinic due to high volume flow of existing road networks. • For the affected NSRs with residual impact, the noise contributions from the DP road to the overall noise levels would be less than 1.0 dB(A) and the DP road noise level would be below the relevant noise criteria, although the overall noise level would still exceed the relevant noise criteria. • Eligibility test shows that all the NSRs are not eligible for provision of noise insulation works. No further noise mitigation measurement is required
Construction Water Quality	*Impact/Problem:* • General construction activities associated with the construction of the Project could lead to site runoff. *Key environmental problem avoided:* • All of the recommended mitigation measures are implemented and all construction site / work area discharges comply with the TM-DSS standards. • Treated effluent would be used for other on-site activities such as dust suppression, wheel washing and general cleaning etc., *Environmental benefits of environmental protection measures recommended:* • The beneficial uses of the treated effluent would minimise water consumption and reduce the effluent discharge volume. • No unacceptable residual water quality impacts are expected during the construction of the proposed works.
Operational Water Quality	*Impact/Problem:* • Adverse water quality impacts associated with the operation of the Project are not expected at the water sensitive receivers within the study area with properly designed and maintained surface runoff collection system including silt traps and road gullies along the road alignment. Thus, there will be no residual impact associated with the operation of the Project.
Waste Management and Land Contamination	*Impact/Problem:* • The Project is likely to result in the generation of a variety of wastes and require the management and disposal of C&D material, C&D waste, marine sediment, chemical waste and general refuse. • The Public Works Regional Laboratory of Tsuen Wan (Laboratory) has been identified as a chemical waste producer, which is a potential contaminated land use within the project boundary. The allocatee shall be responsible for the land contamination assessment of the Laboratory Site and ensure the Laboratory Site is free from contamination at the expiry of allocation and therefore any land contamination concern arising from past activities would have been remediated prior to the construction of the works. *Environmental benefits of environmental protection measures*

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	recommended: • With the implementation of the proposed waste reduction, management and mitigation measures and practices associated with handling, transportation and disposal of the identified wastes arising from the Project, no adverse environmental impacts would be anticipated.
Landscape and Visual (Construction Phase)	*Impact/Problem:* • Landscape Resources: - LR2 Tree Planting at Kwai Chung Road Interchange Area would expect to experience **moderately adverse** impacts • Landscape Character Area: - LCA 3 Residential at Lower level of Lai King Hill and LCA6 Kwai Chung Road Interchange would expect to receive **slightly adverse** impact. • Visual Sensitive Receivers: - R5 Lai King Estate North; O5 Lai King Catholic Secondary School would expect to receive **moderately adverse** impact. - R5A Lai King Estate South; R6 Yin Lai Court; R7 Highland Park; O4 Polyclinic & Special Educational Services; O6 Ever Gain Plaza; O8 Lingnan Dr. Chung Wing Kwong Memorial Secondary School; O10 Lai King Assessment Centre; L1 Kwai Shun Street playground; T1 Open Storage Area Car Park Users; T2 Pedestrians Travelling on Street Level Under Kwai Chung Road Interchange; T3 Commuters on Tsuen Wan Road/Kwai Chung Road, T4 Commuters at Lai King Bus Terminus and T5 Commuters on MTR would expect to receive **slightly adverse** impacts. • All other LRs, LCAs and VSRs would experience **insubstantial** impacts. *Key environmental problem avoided:* • CP1 – The construction site is carefully designed to minimise impact on adjacent landscape. • CP2 – Replanting of disturbed planting areas with shrubs planting would be undertaken as earliest possible during the construction phase.
Landscape and Visual (Operation Phase – By Year 10)	*Key environmental problem avoided:* • OP1 – The proposed carriageway structures will incorporate design features as part of mitigation measures. • OP2 – The associated noise barrier should incorporate different means of mitigation measures for the associated noise barrier structures to reduce potential impacts. • OP3 – Roadside and amenity planting will be utilised throughout the site. • OP4 – The landscape proposal should consider introducing coloured paved materials to tie with the paving theme of Kwai Chung area. *Environmental benefits of environmental protection measures recommended:* • Landscape Character Area:

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	- LCA6 Kwai Chung Road Interchange would expect to receive **slightly beneficial** impact. • Visual Sensitive Receivers: - T1 Open Storage Area Car Park Users; T2 Pedestrians Travelling on Street Level under Kwai Chung Road Interchange; would expect to receive **slightly beneficial** impact. • All other LRs, LCAs and VSRs would experience **insubstantial** impacts.
Landfill Gas Hazard	*Impact/Problem:* • As the work area of the Project does not fall within 250m consultation zone of the restored Gin Drinkers Bay Landfill, LFG hazard assessment is considered not necessary. No LFG hazard impact is anticipated.
Cultural Heritage	*Impact/Problem:* • As no cultural heritage resource was identified within the Assessment Area of the Project, no impacts to cultural heritage are expected to be anticipated during both construction and operational phases of the Project.

11.3 Principal Findings of the EIA Study

Air

Construction Phase

11.3.1 Potential air quality impacts arising from the construction of the Project would mainly be related to dust nuisance from excavation, material handling and wind erosion of the site. As no massive earthworks and excavation works are required during the construction of the Project, and dust suppression measures as stipulated under the Air Pollution Control (Construction Dust) Regulation, and good site practices should be implemented to further minimise the construction dust generated, significant adverse air quality impact arising from the fugitive dust is not anticipated.

Operation Phase

11.3.2 Potential impacts arising from the background pollutant levels within and adjacent to the Project area, vehicle emissions from open road networks and chimney emissions from the nearby factories have been assessed. Results of the operational air quality impact assessment related to vehicular emissions indicated that no exceedance of RSP, FSP as well as NO_2 hourly average concentration criterion is anticipated. Annual average NO_2 concentration limit in AQOs at some of the ASRs would be exceeded, under both "Without Project" and "With Project" scenarios, which was mainly resulted from the high background pollutants' concentrations in this district. Marine emission rather than vehicular emission is concluded to be the major contributor to the high background level in most areas, mainly due to the pollutants emitted from the Kwai Chung Container Terminal nearby.

11.3.3 Comparison study between the two scenarios has been conducted. Results concluded that some environmental benefits would be contributed by the Project to the existing environment, which is mainly due to the improvement of traffic flow and vehicles travelling speed after the implementation of the proposed Project. As a result, the project is not anticipated in causing any adverse air quality impact and in fact will bring about improvements in terms of air quality impacts to the nearby sensitive receivers, as compared to the existing and future baseline conditions.

Noise

Construction Phase

11.3.4 This assessment has predicted the construction noise impacts of the Project during normal daytime working hours. With the adoption of quiet PME, movable noise barriers, noise jackets, mufflers, limiting the number of plants operated concurrently as well as good site practices, the noise levels at all representative NSRs would comply with the construction noise standard except two NSRs would exceed noise criteria during examination period at some months. The Contractor shall liaise with the school representative(s) to obtain the examination schedule and avoid noisy construction activities during school examination period to further minimize the construction noise impact to those NSRs.

11.3.5 A construction noise EM&A programme is recommended to check the compliance of the noise criteria during normal daytime working hours.

Operation Phase

11.3.6 The potential road traffic noise impacts have been assessed based on the worst case traffic flows in 2036. Without the noise mitigation measures in place, the predicted noise levels at

the identified NSRs would range from 55 to 84 dB(A) L10 (1-hour). As a result, direct mitigation measures have been proposed to mitigate the noise impacts at the NSRs where DP road noise levels exceed the noise criteria or/and DP road noise contributions to the overall noise levels are more than 1.0 dB(A).

11.3.7 For those affected NSRs with residual impact, the DP road noise contributions to the overall noise levels would be less than 1.0 dB(A) and the DP road noise levels would all be below the relevant noise criteria, although the overall noise levels would still exceed the relevant noise criteria. However, it should be noted that such noise exceedances at the representative NSRs are due to the existing roads.

11.3.8 Monitoring of road traffic noise is recommended to verify the effectiveness of the mitigation scheme during the first year after road opening.

Water

Construction Phase

11.3.9 Potential water pollution sources have been identified as construction site run-off, sewage from workforce, and potential risk of chemical spillage. Adverse residual impacts would not be anticipated with the implementation of adequate mitigation measures including the of the construction site practices in accordance with the EPD's ProPECC PN 1/94 Construction Site Drainage, provision and management of portable toilets on-site, and preventive measures to avoid accidental chemical spillages.

Operation Phase

11.3.10 Implications arising from the surface runoff during the operation phase would be insignificant. Adverse water quality impact would not be anticipated with the implementation of the recommended mitigation measures based on the findings of this EIA study.

Waste Management and Land Contamination

11.3.11 The Project is likely to result in the generation of a variety of wastes and require the management and disposal of C&D material, C&D waste, marine sediment, chemical waste and general refuse. Provided that the wastes are managed using approved methods described above, no unacceptable adverse environmental impacts will be envisaged.

11.3.12 The Public Works Regional Laboratory of Tsuen Wan (Laboratory) has been identified as a chemical waste producer, which is a potential contaminated land use within the project boundary. The allocatee shall be responsible for the land contamination assessment of the Laboratory Site and ensure the Laboratory Site is free from contamination at the expiry of allocation and therefore any land contamination concern arising from past activities would have been remediated prior to the construction of the works.

11.3.13 With implementation of good site practice, land contamination at the Site arising from construction and operation phases of the Project as road upgrading works is not envisaged.

11.3.14 No adverse environmental impacts on land contamination for the Project are anticipated.

Landscape and Visual Impact

11.3.15 Visual effects are particularly prominently along western fringe of Lai King Estate where the proposed road widening works is overlooked by a number of residential units. The widened road also located close to a school and passing through the surrounding footpath

system causing slight to moderate adverse landscape and visual impacts

11.3.16 With the implementation of the proposed mitigation measures during construction and operation phases of the project, the effects of these identified impacts will gradually reduce to an acceptable level and in some cases slight beneficial by Year 10 of operation.

Landfill Gas Hazard

11.3.17 As the work area of the Project does not fall within 250m consultation zone of the restored Gin Drinkers Bay Landfill, LFG hazard assessment is considered not necessary. No LFG hazard impact is anticipated.

Cultural Heritage

11.3.18 As no cultural heritage resource was identified within the Assessment Area of the Project, no impacts to cultural heritage are expected to be anticipated during both construction and operational phases of the Project.

11.4 Environmental Monitoring and Audit

11.4.1 Environmental monitoring and audit (EM&A) is recommended for construction and operational noise. Regular site inspection/audit is also recommended for: i) dust, water quality, waste management and landscape and visual during construction phase; and ii) implementation of landscaping measures during operation phase. Details of recommended mitigation measures, monitoring procedures and locations are included in a stand-alone EM&A Manual. This will enable the Contractor to obtain early warning on potential adverse impacts from the works and take necessary action to reduce impacts in specific areas if the monitoring results are found to be close to the criteria. All the recommended mitigation measures should be incorporated into the EM&A programme for implementation.

11.5 Overall Conclusion

11.5.1 The EIA has been conducted based on the latest and best available information. The findings of this EIA have provided information on the nature and extent of environmental impacts arising from construction and operation of the Project. The EIA has, where appropriate, identified mitigation measures to ensure compliance with environmental legislation and standards.

11.5.2 In conclusion, the Project would comply with the environmental standards and legislation with the implementation of the proposed mitigation measures during the construction and operation phases. The EIA has demonstrated that the Project will not result in any adverse environmental impacts and in fact will bring about improvements in terms of air quality impacts to the nearby sensitive receivers, as compared to the existing and future baseline conditions. Environmental monitoring and audit mechanisms have been recommended for the construction and operation of the Project, where necessary, to verify the effectiveness of the recommended mitigation measures.

12. IMPLEMENTATION SCHEDULE AND RECOMMENDED MITIGATION MEASURES

Table 12-1 Implementation Schedule for Air Quality Control

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
Construction Phase						
S3.5.8	• Dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation and good site practices: • Every temporary access road shall be paved with concrete, bituminous materials, hardcores or metal plates, and kept clear of dusty materials; or sprayed with water or a dust suppression chemical. • Any stockpile of dusty materials shall be covered entirely by impervious sheeting, placed in an area sheltered on the top and the 3 sides, or sprayed with water or a dust suppression chemical. • All dusty materials shall be sprayed with water or a dust suppression chemical immediately prior to any loading, unloading or transfer operation. • Vehicles used for transporting dusty materials should be covered with tarpaulin. • Vehicle wheel washing facilities should be provided at each construction site exit. • Where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting.	To minimise dust impacts	Contractor and Sub-contractors	All works sites	Construction Phase	Air Pollution Control (Construction Dust) Regulation

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	• The speed of vehicles on unpaved road within the site should be controlled to about 10 km/hr. • Routing of vehicles and positioning of construction plants should be arranged at maximum possible distances from the sensitive receivers. • Every stock of more than 20 bags of cement and dry pulverized fuel ash (PFA) shall be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3 sides. • 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 any vent or exhaust should be fitted with the an effective fabric filter or equivalent air pollution control system. • Exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shotcrete or other suitable surface stabilizer within 6 months after the last construction activity on the construction site or part of the construction site where the exposed earth lies.					

Table 12-2 Implementation Schedule for Noise Control

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
Construction Phase						
S4.8.1	• Selection and optimisation of construction programmes, avoidance of parallel operation of noisy PME, and/or reduction in the proportion of usage of PME during noise sensitive periods such as school examination period; • Use of "quiet" PME and working methods; • Use of temporary at-source noise mitigation measures such as noise barriers, acoustic fabric, noise enclosures, noise jacket and mufflers; and • Use of good site practice to limit noise emission from construction site.	To reduce potential construction noise impact	Contractor	All works sites	Construction Phase	EIAO-TM, NCO
S4.8.2	Selection and Programming of Construction Processes • 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 parallel operation of noisy PME in order to minimize the total noise generated during construction periods. • Limiting the quantity of PME to be operated concurrently and also their proportion of usage were recommended in the Project and incorporated in this assessment.	To reduce potential construction noise impact	Contractor	All works sites	Construction Phase	EIAO-TM, NCO

<table>
<tr><th>EIA Ref.</th><th>Recommended Mitigation Measures</th><th>Objectives of the Recommended Measures & Main Concern to Address</th><th>Who to implement the measures?</th><th>Location of the measure</th><th>When to implement the measures?</th><th>What requirements or standards for the measure to achieve</th></tr>
<tr><td></td><td>• In the case during school examination when 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.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>S4.8.3 – 4.8.5</td><td>Use of “Quiet” Alternative Plant and Working Methods
• The use of particular plant with equipment noise levels quieter than those specified in the GW-TM can result in reduction of noise levels generated by the plant. The level of noise reduction achieved is dependent on the Contractor’s chosen methods of working. It is possible for the Contractor to achieve noise reductions from the adopted working methodologies by specifying maximum limits of sound power level for specific plant.
Examples of “quiet” PME and alternative PME:
<table>
<tr><th>ID Code in GW-TM</th><th>Descriptions of PME</th><th>“Quiet” PME example on QPME list [1]</th><th>SWL of “Quiet” PME, dB(A)</th></tr>
<tr><td>CNP 004</td><td>Asphalt Paver</td><td>EPD-01226 (VOLVO ABG5770)</td><td>104</td></tr>
<tr><td>CNP 081</td><td>Excavator, Wheeled/ Tracked</td><td>EPD-01896 (HYUNDAI R80CR-9)</td><td>98</td></tr>
</table></td><td>To reduce potential construction noise impact</td><td>Contractor</td><td>All works sites</td><td>Construction Phase</td><td>EIAO-TM, NCO</td></tr>
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<tr><th>EIA Ref.</th><th>Recommended Mitigation Measures</th><th>Objectives of the Recommended Measures & Main Concern to Address</th><th>Who to implement the measures?</th><th>Location of the measure</th><th>When to implement the measures?</th><th>What requirements or standards for the measure to achieve</th></tr>
<tr><td></td><td>
<table>
<tr><th>ID Code in GW-TM</th><th>Descriptions of PME</th><th>“Quiet” PME example on QPME list [1]</th><th>SWL of “Quiet” PME, dB(A)</th></tr>
<tr><td>CNP 048</td><td>Mobile Crane</td><td>EPD-01516 (KOBELCO CKS900)</td><td>101</td></tr>
<tr><td>CNP 170</td><td>Poker, vibratory, hand held</td><td>Poker, vibratory, hand held (electric)</td><td>102</td></tr>
<tr><td>CNP 185</td><td>Road Roller</td><td>EPD-01806 (KANTO-TK KV25DS)</td><td>95</td></tr>
</table>
Note: [1] QPME list available on the EPD website</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>S4.8.6 – S4.8.9</td><td>Temporary Noise Barrier:

Use of Temporary Noise Barrier/ Acoustic Fabric for breaker, mini-robot mounted; excavator/loader, wheeled/tracked; lorry; lorry with crane/grab; mobile crane; poker vibratory, hand-held (electric); road roller; hand-held chain saw; concrete pump, lorry mounted; asphalt paver; air compressor. The minimum surface density of the movable noise barrier is 10kg/m^2.

A not less than 8m high movable barrier with skid footing and a small cantilevered upper portion to be</td><td>To reduce potential construction noise impact</td><td>Contractor</td><td>All works sites</td><td>Construction Phase</td><td>EIAO-TM, NCO</td></tr>
</table>

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	located within a few metres of the grab and chisel piling plants. When temporary noise barriers are not practicable or noise reduction achieved is insufficient, noise jacket/muffler can be applied to cover the noisy part of the engine or at the engine exhaust of particular mobile plants respectively.					
S4.8.10	Good Site Practice: • Use of well-maintained and regularly-serviced plant during the works; • Plant operating on intermittent basis should be turned off or throttled down when not in active use; • Plant that is 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 maintained adequately 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.	To reduce potential construction noise impact	Contractor	All works sites	Construction Phase	EIAO-TM, NCO

<table>
<tr><th>EIA Ref.</th><th>Recommended Mitigation Measures</th><th>Objectives of the Recommended Measures & Main Concern to Address</th><th>Who to implement the measures?</th><th>Location of the measure</th><th>When to implement the measures?</th><th>What requirements or standards for the measure to achieve</th></tr>
<tr><td colspan="7">Operation Phase (Road Traffic Nosie)</td></tr>
<tr><td>S4.8.18</td><td>Direct mitigation measures for existing NSRs:
<table>
<tr><th>ID</th><th>Description</th><th>Length (m)</th><th>Location</th></tr>
<tr><td>A</td><td>5.5m high with 2.5m cantilevered barrier at 45°</td><td>85</td><td>Bridge H Southbound</td></tr>
<tr><td>B</td><td>5.5m vertical barrier</td><td>20</td><td>Bridge H Southbound</td></tr>
<tr><td>C</td><td>5.5m high with 2.5m cantilevered barrier at 45°</td><td>230</td><td>Bridge H Southbound</td></tr>
<tr><td>D</td><td>5.5m high with 3.5m cantilevered barrier at 45°</td><td>45</td><td>Bridge H Southbound</td></tr>
<tr><td>-</td><td>Low Noise Road Surfacing [1]</td><td>-</td><td>Bridge G&H (i.e. All Project Roads)</td></tr>
</table>
Notes:
[1] Low noise road surfacing is applied on highways with speed 70kph or above in general. Such mitigation measure has been included in both unmitigated scenario and mitigated scenario in road traffic noise impact analysis.

It should be noted that the exact length of the mitigation measures would be subject to minor refinement during the detail design stage.</td><td>To reduce traffic noise impact at nearby NSRs</td><td>Project Proponent/ Contractor</td><td>Project Roads</td><td>Design and construction phases prior to the operation of the Project</td><td>EIAO-TM</td></tr>
</table>

Table 12-3 Implementation Schedule for Water Quality Control

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
S5.9.2	In accordance with ProPECC PN 1/94, construction phase mitigation measures with good management practices should include the following: • At the establishment of works site, perimeter 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; • 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	To control water quality impact from construction site runoff	Contractor and Sub-contractors	All work sites	Construction Phase	Water Pollution Control Ordinance, ProPECC PN 1/94

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	time for silt / sand traps should be 5 minutes under maximum flow conditions. A sedimentation basin would be required when necessary. The detailed design of the silt / sand traps 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 the earthworks have been completed. 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					

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	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 material) 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					

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	paid to the control of silty surface run-off during storm events; • All vehicles and plant should be cleaned before leaving the Site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing facilities / bay should be provided at the exit of the 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; • The construction solid waste, debris and rubbish on-site should be collected, handled and disposed of properly to avoid causing any water quality impacts; and					

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	• All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds with adequate storage capacity to prevent spilled fuel oils.					
S5.9.5	Control of effluent discharge • A discharge licence for discharge of effluent from the construction site under the WPCO shall be applied to the EPD for. The discharge quality must meet the requirements 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 100m should be maintained between the discharge points of construction site effluent and the existing seawater intakes. • 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.	To control the effluent discharge from the Site	Contractor and Sub-contractors	All work sites	Construction Phase	Water Pollution Control Ordinance
S5.9.6	Sewage from Workforce • Portable chemical toilets and sewage holding tanks	To control Sewage generated from on-site construction	Contractor and Sub-	All work sites	Construction	Water Pollution Control Ordinance and

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	are recommended for the handling of the construction sewage generated by the workforce. • A licensed Contractor should be employed to provide appropriate and adequate portable toilets and be responsible for appropriate disposal and maintenance.	workers	contractors			Waste Disposal Ordinance
S5.9.7 – S5.9.8	Accidental Spillage of Chemicals • The Contractor must register as a chemical waste producer if chemical wastes would be produced from the construction activities. • 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 only be undertaken within the areas appropriately equipped to control these discharges.	To control accidental spillage of chemicals	Contractor and Sub-contractors	All work sites	Construction Phase	EIAO-TM, Water Pollution Control Ordinance and Waste Disposal (Chemical Waste) (General) Regulation
S5.9.9	Provision of surface runoff collection system • All surface runoff on the road shall be direct to the system. • The capacity of the system should be properly designed to cater for all surface water.	To control road surface runoff	Contractor and Sub-contractors	Along Road Alignment	Design and Construction Phases	Water Pollution Control Ordinance
	• The system should be properly maintained and cleaned regularly to ensure good service condition.		Highway Department		Operation Phase	

Table 12-4 Implementation Schedule of Waste Management and Land Contamination

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
Waste Management Plan (WMP)						
S6.6.3	WMP should be prepared and submitted for approval by the Engineer prior to any construction activities. During the construction period the WMP should be used as a working document to detail the on-going management procedures and to record waste arising from construction works and import of fill throughout the Contract. The WMP shall be subject to audit under the requirements of the Environmental Monitoring and Audit (EM&A) Procedures set out in the EM&A Manual accompanying this EIA Report.	Preparation and approval of WMP	Contractor	All works sites	Design and Construction Phases	ETWB TC(W) No. 19/2005
S6.6.4 and S6.6.5	The WMP shall be developed and implemented according to a best-practice philosophy of waste management. There are various waste management options, which can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long-term context. The hierarchy is as follows: • Avoidance and minimisation, i.e. avoiding or not generating waste through changing or improving practices and design; • Reuse of materials, thus avoiding disposal (generally with only limited reprocessing); • Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and	To minimise waste generation	Contractor	All works sites	Design and Construction Phases	ETWB TC(W) No. 19/2005

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	• Treatment and disposal, according to relevant laws, guidelines and good practice. • The suitability (or otherwise) of material for reuse on site shall be detailed in the WMP. If, for any reason, the recommendations cannot be implemented, full justification should be given in the WMP for approval by the Engineer.					
S6.6.6	To facilitate adoption of the best-practice philosophy, training shall be provided to all personnel working on site. The training shall promote the concept of general site cleanliness and clearly explain the appropriate waste management procedures defined in the WMP.	To encourage all workers to reduce, reuse and recycle wastes.	Contractor	All works sites	Construction Phase	EIAO-TM
S6.6.7	a. During construction, the WMP should be kept up-to-date on a monthly basis with records of the actual quantities of wastes generated, recycled and disposed of off-site. b. Quantities shall be determined by weighing each load or other methods agreed to by the Engineer's Representative. Waste shall only be disposed of at licensed sites and the WMP should include procedures to ensure that illegal disposal of wastes does not occur. c. Only waste haulers authorised to collect the specific category of waste concerned should be employed and a trip ticket system shall be implemented for offsite disposal of inert C&D material and C&D waste at public fill reception facilities and landfills.	To keep trace of waste generation, minimisation, reuse and disposal	Contractor	All works sites	Construction Phase	ETWB TC(W) No. 19/2005

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	d. Appropriate measures should be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers.					
S6.6.8	The WMP shall include plans indicating specific areas designated for the storage of particular types of waste, reusable and recyclable materials as well as areas and management proposals for any stockpiling areas. Generally, waste storage areas should be well maintained and cleaned regularly.	Work site(s):- a. Arrange and manage to facilitate the proper management of wastes and materials. b. Design to avoid cross contamination of materials and pollution of the surrounding environment.	Contractor	All works sites	Design and Construction Phases	ETWB TC(W) No. 19/2005
Inert Construction and Demolition Material (Inert C&D Materials)						
S6.6.9	The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse.	To maximise reuse of inert C&D Materials	Contractor	All works sites	Design and Construction Phases	ETWB TC(W) No. 19/2005

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
S6.6.10 and S6.6.11	a. Inert C&D materials should be segregated on site into different waste and material types. Where materials cannot be reused on site, opportunities for recycling materials off-site shall be explored. b. Potential opportunities for recycling and reuse of inert C&D materials from the Project include: • Milling wastes arising from regrading of the existing pavement could be recycled on site and reused as either road-base in the new carriageways or fill for new embankments; • Existing marginal roadside barriers comprise pre-cast units, it may be possible to re-use these following widening works; and • Existing bridge parapets comprise aluminium post and railings, these have a recyclable value and could be sold on for reconditioning or reused for scrap metal.	To maximise reuse and facilitate recycling by segregating inert C&D Materials	Contractor	All works sites	Design and Construction Phases	ETWB TC(W) No. 19/2005
S6.6.12	Any stockpile should be sited away from existing watercourses and suitably covered.	To prevent wind erosion and impacts on air and water quality	Contractor	All works sites	Design and Construction Phases	ETWB TC(W) No. 19/2005
S6.6.13	C&D waste which cannot be reused or recycled should be segregated and stored in different containers or skips from the inert C&D material and should be disposed of to landfill.	To facilitate disposal of C&D waste	Contractor	All works sites	Construction Phase	ETWB TC(W) No. 19/2005

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
Marine Sediment						
S6.6.14	Workers should, when necessary, wear appropriate personal protective equipment (PPE) when handling contaminated sediments. Adequate washing and cleaning facilities should also be provided on site.	To minimise the exposure to contaminated materials	Contactor	All works sites when necessary	Construction Phase	Practice Guide, Guidance Note, Guidance Manual
S6.6.15 and S6.6.16	a. The marine sediment should be excavated, transported and processed properly. b. Stockpiling of contaminated sediments should be avoided as far as possible. c. If temporary stockpiling of contaminated sediments is necessary, the excavated sediment should be covered by tarpaulin and the area should be placed within earth bunds or sand bags to prevent leachate from entering the ground, nearby drains and surrounding water bodies. The stockpiling areas should be completely paved or covered by linings in order to avoid contamination to underlying soil or groundwater. Separate and clearly defined areas should be provided for stockpiling of contaminated and uncontaminated materials. d. Leachate, if any, should be collected and discharged according to the WPCO. e. The approved Sediment Assessment Plan and Sediment Assessment Report with Remediation Plan shall be incorporated to the WMP.	To minimise any potential adverse impacts arising from the handling, treatment and reuse of the marine sediment	Contractor	All works sites	Design and Construction Phases	Practice Guide, Guidance Note, Guidance Manual

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
Chemical Waste						
S6.6.17	Chemical waste should be handled in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes as follows. Containers used for the storage of chemical wastes should: • Be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed; • Have a capacity of less than 450L unless the specifications have been approved by the EPD; and • Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.	To reduce environmental impacts in packaging, handling and storage of chemical wastes	Contractor	All works sites	Construction Phase	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S6.6.18	The storage area for chemical wastes should: • Be clearly labelled and used solely for the storage of chemical waste; • Be enclosed on at least 3 sides; • Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest; • Have adequate ventilation • Be covered to prevent rainfall entering (water collected	To reduce environmental impacts by managing storage area for chemical wastes	Contractor	All works sites	Construction Phase	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	within the bund must be tested and disposed as chemical waste if necessary); and • Be arranged so that incompatible materials are adequately separated.					
S6.6.19	The Contractor shall register with EPD as a Chemical Waste Producer. Waste oils and other chemical wastes as defined in the Waste Disposal (Chemical Waste) (General) Regulation will require disposal by appropriate means and could require pre-notification to EPD prior to disposal. Appropriate means include disposal: • Be via a licensed waste collector; and • Be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers	To reduce environmental impacts in disposing chemical wastes.	Contractor	All works sites	Design and Construction Phases	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
General Refuse						
S6.6.20 and S6.6.21	a. General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is	To reduce environmental impacts in handling general refuse.	Contractor	All works sites	Construction Phase	Waste Disposal Ordinance (Cap 354)

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
	prohibited by law. b. General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminum cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible. Therefore separate, labelled bins for their deposit should be provided if feasible.					
S6.6.22	Office waste can be reduced through recycling of paper if volumes are large enough to warrant collection. Opportunities for participation in a local collection scheme should be investigated.	To reduce office waste	Contractor	All works sites	Construction Phase	Waste Disposal Ordinance (Cap 354)

Table 12-5 Implementation Schedule for Landscape and Visual Impact

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
Landscape and Visual Impact						
S7.9.6	**For Impacts during Construction Phase:**					
	Mitigation Planting • Replanting of disturbed vegetation should be undertaken at the earliest possible stage of the construction phase of the project and this should use the recommended transplant trees identified in the Tree Removal Recommendation.	To avoid potential damage to these identified transplant trees	Contractor	Identified locations for tree planting	Construction Phase	Follow the relevant guidelines in the ETWB TC(W) 10/2013; ETWB TC(W)2/2004; ETWB TC(W)29/2004; ETWB TC(W)7/2002; *Tree Planting and Maintenance in HK, HKSAR 1991* Relevant sections of the latest version of General Specifications for Civil Engineering Works, HKSAR

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
S7.9.6	Development Site and Temporary Works Area					
	• The construction area and Contractor's temporary works area should be minimized to avoid impacts on adjacent landscape	To minimize potential impacts on adjacent landscape and VSRs	Contractor	The project area where appropriate	Construction Phase	N/A
	• The landscape of these works areas will be restored following the completion of the construction phase	To minimize potential impacts on the landscape	Contractor	The project area where appropriate	Construction Phase	
	• Construction site controls shall be enforced, where possible, to ensure that the landscape and visual impacts arising from the construction phase activities are minimized including the storage of materials	To minimize potential visual impacts on identified VSRs	Contractor	The project area where appropriate	Construction Phase	
	• The location and appearance of site accommodation and the careful design of site lighting to prevent light spillage	To minimize potential impacts on identified VSRs	Contractor	The project area where appropriate	Construction Phase	
	• Screen hoarding may be a practicable for this project due to the viewing distances is short in a lot of site situation	To minimize potential impacts on identified VSRs	Contractor	The project area where appropriate	Construction Phase	

EIA Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measure	When to implement the measures?	What requirements or standards for the measure to achieve
S7.9.6	**For Impacts during Operation Phase**					
	Roadside and Amenity Planting	These planting will utilize native tree species as far as possible to improve the road side planting in creating a more coherent landscape network in the area.	Designer and contractor to implement	The project area where appropriate	Design and construction phases	The latest version of General Specifications for Civil Engineering Works, HKSAR
	Enhancement of Streetscape	The landscape proposal should consider introducing coloured paved materials to tie with the paving theme of the Kwai Chung area.	Designer	The project area where appropriate	Design and construction phases	DEVB, LCSD and HyD's Guidelines
S7.9.6	**Visual Impact during Operation**					
	Design of the Proposed Carriageway Structures and Associate Facilities – the carriageway structure will incorporate design features as part of design mitigation measures including choices of material, colour, and shape.	To minimise potential long term visual impact to the surrounding VSRs	Designer to implement during design	The new carriageway and associate structures	Design phase	Structural Design Manual for Highways and Railway, HyD
	Integrated Design Approach - other associated structures such as noise barrier should integrate, as far as technically feasible, with the carriageway as part of design mitigation measures to reduce the potential cumulative impact of the proposed works.	To minimize potential long term visual impact to the surrounding VSRs	Designer to implement during design	The new carriageway and associate structures	Design phase	DEVB and HyD's Guidelines on greening and design of noise barriers