TABLE OF CONTENTS

Page

List of Tables

List of Figures

LIST OF ABBREVIATIONS

The following table lists out the abbreviated titles of government bureaux, departments, offices, statutory bodies and public organizations mentioned in this Report:

Abbreviation	Full title
ACABAS	The Advisory Committee on the Appearance of Bridges and Associated Structures
AFCD	Agriculture, Fisheries and Conservation Department
AMO	Antiquities and Monuments Office
CEDD	Civil Engineering and Development Department
CLP	China Light and Power Company Limited
DC	District Council
DEVB	Development Bureau
DSD	Drainage Services Department
ENB	Environment Bureau
EPD	Environmental Protection Department
ETWB	The Environment, Transport and Works Bureau
FSD	Fire Services Department
GEO	Geotechnical Engineering Office of the Civil Engineering and Development Department
HKPF	Hong Kong Police Force
HKSAR	Hong Kong Special Administrative Region
HyD	Highways Department
LandsD	Lands Department
LCSD	Leisure and Cultural Services Department
LegCo	Legislative Council
MTRCL	MTR Corporation Limited
PFC	Public Fill Committee
PlanD	Planning Department
STDC	Sha Tin District Council
T&TC	Traffic and Transport Committee
TD	Transport Department
WSD	Water Supplies Department

The following table lists out the meaning of abbreviation for expressions adopted in this report:

Abbreviation	Full Expression
AAA	Alert, Alarm and Action
ADB	Administration Building
AFA	Automatic Fire Alarm
AFCD NCPN	Agriculture, Fisheries and Conservation Department Nature Conservation Practice Note
ANPR	Automatic Number Plate Recognition
AOI	Area of Influence
API	Aerial Photograph Interpretation
APS	Air Purifier System
AQO	Air Quality Objectives
ASRs	Air Sensitive Receivers
AVI	Automatic Vehicle Identification
BIM	Building Information Modeling
BS	Backend System

Abbreviation	Full Expression
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
CASET	Computer-Aided Sustainability Evaluation Tool
CMCS	Central Monitoring and Control System
COCs	Chemicals of Concerns
CoP	Code of Practice
CRTN	UK Department of Transport Calculation of Road Traffic Noise
CV	Curriculum Vitae
CZ	Consultation Zone
C&D	Construction and Demolition
C&DMMP	Construction and Demolition Material Management Plan
DEP	Director of Environmental Protection
DEVB TC(W)	Development Bureau Technical Circular (Works)
DFC	Design Flow to Capacity
DI	Departmental Instruction
DIA	Drainage Impact Assessment
DLOs	District Lands Offices
DMP	Drainage Master Plan
DR	Director's Representative
E/B	eastbound
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EIAO-TM	Technical Memorandum on Environmental Impact Assessment Process
ELS	Excavation and Lateral Support
EM&A	Environmental Monitoring and Audit
EP	Environmental Permit
ERA	Estimating Method Using Risk Analysis
ETWB TC(W)	Environment, Transport and Works Bureau Technical Circular (Works)
FFTS	Free-Flow Tolling System
FS	Front-End System
FSI	Fire Service Installation
FSP	Fine Suspended Particulates
GA	Geotechnical Assessment
GEO TGN	Technical Guidance Notes issued by GEO
GI	Ground Investigation
HA	Hazard Assessment
HDC	Horizontal Directional Coring
HLC	Historical landslide catchments
HKPSG	Hong Kong Planning Standards and Guidelines
ICM	Integrated Catchment Modeling
ISO	International Organization for Standardization
IVU	In-Vehicle Unit

Abbreviation	Full Expression
LAOI	Lands Administration Office Instruction
LED	Light-Emitting Diode
LPG	Liquefied Petroleum Gas
LRCP	Lion Rock Country Park
LRT	Lion Rock Tunnel
LRTR	Lion Rock Tunnel Road
LT	Laboratory Testing
LVIA	Landscape and Visual Impact Assessment
MoA	Means of Access
MoE	Means of Escape
N/B	northbound
NCO	Noise Control Ordinance
NEC	New Engineering Contract
NO2	Nitrogen Dioxide
NOX	Nitrogen Oxides
NTH	Natural Terrain Hazard
NSRs	Noise Sensitive Receivers
OH	Open Hillside
OHVD	Overhead Ventilation Ducts
OSCG	On-site Chlorine Generation
OVT	Old and Valuable Tree
PDS	Project Definition Statement
PFRFs	Public Fill Reception Facilities
PME	Powered Mechanical Equipment
PoC	Proof of Concept
PR	Public Relations
ProPECC PN	Professional Persons Environmental Consultative Committee Practice Note
RAP	Remediation Action Plan
RC	Reserve Capacity
RFID	Radio Frequency Identification
RPZ	Railway Protection Zone
RR	Remediation Report
RSP	Respirable Suspended Particulates
SA	Sustainability Assessment
SAI	Sites of Archaeological Interest
S/B	southbound
SCAS	Shui Chuen Au Street
SCL	Shatin to Central Link
SDM	Stormwater Drainage Manual
SDMHR	Structures Design Manual for Highways and Railways
SoA	Schedule of Accommodation
SI	Site Investigation

Abbreviation	Full Expression
SMTR	Shing Mun Tunnel Road
SSSI	Site of Special Scientific Interest
STR	Sha Tin Road
T4	Revised Trunk Road T4 and Associated Improvement Works in Sha Tin
T&C	Testing and Commissioning
TBM	Tunnel Boring Machine
TC	Technical Circular
TCH	Tate's Cairn Highway
TCSS	Traffic Control and Surveillance Systems
TFS	Technical Feasibility Statement
TSP	Total Suspended Particulates
The Assignment	Improvement of Lion Rock Tunnel
The Project	Improvement of Lion Rock Tunnel Project
TIA	Traffic Impact Assessment
TPDM	Transport Planning and Design Manual
TSH	Tsing Sha Highway
TTMS	Temporary Traffic Management Scheme
TTU	Tsang Tai Uk
TX	Transformer
UPS	Uninterrupted Power Supply
VB	Ventilation Building
VM	Value Management
VOCs	Volatile Organic Compounds
VR	Virtual Reality
VSRs	Visually sensitive receivers
WBTC	Technical circulars issued by the Works Bureau, the then Works Branch, the then Lands & Works Branch or the then Public Works Department
WTW	Water Treatment Works

1 INTRODUCTION

1.1 Project Background

1.1.1 The existing Lion Rock Tunnel (LRT) is a trunk road linking traffic between Shatin and Kowloon. It consists of two tunnel tubes each with two traffic lanes. The Kowloon bound and Shatin bound tunnel tubes have been put in use for over 50 years and 40 years respectively. Signs of deterioration of tunnel structures have become apparent. Due to heavy traffic demand on daytime, closure of tunnel for rehabilitation is not possible, however, the time slots of only a few hours during night time for tunnel closure cannot allow comprehensive repair and strengthening works to be undertaken.

1.1.2 In 2019, Highways Department has commissioned AECOM Asia Company Ltd to undertake the investigation study of "Improvement of Lion Rock Tunnel" (the Project) for the rehabilitation of LRT in order to meet with current standard, cater for the traffic demand and extend its serviceable years.

1.1.3 The Project is a Designated Project (DP) under the Environmental Impact Assessment Ordinance (EIAO). A Project Profile (No. PP-589/2019) was submitted to the Environmental Protection Department (EPD) on 24 September 2019 under Environmental Impact Assessment Ordinance (EIAO) and the EIA Study Brief (No. ESB-323/2019) for the Project was issued on 6 November 2019 under the EIAO.

1.1.4 The purpose of the EIA Study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project and associated works that will take place concurrently. This information will contribute to decisions on:

- the overall acceptability of any 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 wherever practicable; and
- the acceptability of residual impacts after the proposed mitigation measures are implemented.

1.2 Designated Projects under EIAO

1.2.1 The Project covers the following DP elements of Schedule 2, Part I under the EIAO (Cap.499).

Table 1.1 Schedule 2 Designated Projects in this Project

Schedule 2 Designated Project		**Designated Project Element under the Project**
Item A.1, Part I	A road which is an expressway, trunk road, primary distributor road or district distributor road including new roads, and major extensions or improvements to existing roads.	The road sections under the Project comprises of: (i) construction of a new vehicular bridge next to existing K7A Vehicular Bridge. The new vehicular bridge will connect existing Waterloo Road northbound (N/B) to Lion Rock Tunnel Road N/B which are "trunk road" under TD's classification, therefore, this new vehicular bridge is classified as "trunk road". (ii) widening/re-alignment the existing roads including Lion Rock Tunnel Road which is considered as

Schedule 2 Designated Project		**Designated Project Element under the Project**
		major extensions or improvement to existing roads.
Item A.7, Part I	A road or railway tunnel more than 800 m in length between portals.	(i) The proposed new tunnel is more than 800m in length between portals. (ii) Enlargement of the existing Kowloon bound tunnel, which is more than 800m in length between portals (an exempted DP).
Item Q.1, Part I	All projects including new access roads, railways, sewers, sewage treatment facilities, earthworks, dredging works and other building works partly or wholly in an existing country park.	The proposed re-aligned southbound LRT Road at Shatin area partly in existing Lion Rock Country Park.

1.3 Purpose of the Executive Summary

1.3.1 This Executive Summary (ES) summarizes the findings, recommendations and conclusions of the EIA Report for the Project. The ES contains the following information.

- Section 2 presents purpose and nature of the Project, consideration of alternative options and construction methods for the Project;
- Section 3 presents the key findings of the environmental impact assessment;
- Section 4 describes the proposed environmental monitoring and audit for the Project; and
- Section 5 presents the conclusions.

2 PROJECT DESCRIPTION

2.1 Objective and Scope of the Project

2.1.1 The objective of the Project is to rehabilitate and improve the existing tunnel tubes of the Lion Rock Tunnel (LRT) and to take this opportunity to enhance the capacity of the tunnel and the connecting roads as far as possible, with a view to extending the service life of the LRT and help alleviating the traffic congestion at the LRT during peak hours and the traffic impact during maintenance.

2.1.2 Smoother traffic flows enhanced by the proposed improvement works would alleviate the air quality and noise impacts associated with traffic congestion during peak hours. Although the noise sources at certain locations may be nearer to local sensitive receivers due to the road widening/re-alignment works, noise mitigation measures such as noise barriers and noise enclosures will be constructed under the Project. These works could also help reduce the existing noise impact on the adjacent noise sensitive receivers.

2.1.3 The location of the Project is shown in **Figure 2.1 – 2.5**. The study covers the LRT, Lion Rock Tunnel Road (both Kowloon and Sha Tin sides), a section of Hung Mui Kuk Road near World-wide Garden, a short section of Waterloo Road adjoining Lion Rock Tunnel Road, and a short section of Lung Cheung Road eastbound (E/B).

2.1.4 The scope of the Project comprises the construction of the new tunnel tube to facilitate the subsequent rehabilitation of two existing tunnel tubes, widening/re-alignment of the connecting roads and the associated works. The details are as follows:-

(a) Construction of a three-lane road tunnel of approximately 1.4 km long between the two existing tunnel tubes of the LRT;

(b) Enlargement of the existing Kowloon bound tunnel tube to a three-lane road tunnel, together with the construction of cross passages linking the new Kowloon bound tunnel tube with the new tunnel;

(c) Carry out refurbishment works on the existing Shatin bound tunnel tube and replacement/rehabilitation of the existing fire services provisions;

(d) Provision of equipment including Traffic Control and Surveillance Systems (TCSS) for operation of the tunnels;

(e) Demolish the existing toll plaza together and provision of equipment and facilities for free-flow tolling;

(f) Re-provision of tunnel buildings including tunnel administration building (ADB), ventilation buildings (VBs) etc., construction of a vehicular crossover bridge to support tunnel operations, and construction of footbridges and any other tunnel support facilities;

(g) Widening of LRT Road at Kowloon side to dual three-lane from slip roads of Lung Cheung Road interchange to LRT Kowloon portal and construct a single lane vehicular bridge crossing over Lung Cheung Road for the Shatin bound direction;

(h) Widening of the slip road from Lion Rock Tunnel Road southbound (S/B) to Lung Cheung Road E/B to two lanes, and realigning the slip road from Lung Cheung Road E/B to Lion Rock Tunnel Road N/B;

(i) Widening of LRT Road at Sha Tin side to dual three-lane between the existing tunnel portal to Fung Shing Court (except a section of the northbound carriageway between the slip roads to and from Hung Mui Kuk Road which would remain two lanes);

(j) Reprovisioning of Footbridge NF74 near Fung Shing Court;

(k) Provision of noise barriers / enclosures to mitigate the road traffic noise impact on noise sensitive receivers; and

(l) Ancillary works including slope works, water mains diversion, road lighting, drainage, landscaping works, etc.

2.2 The Need for the Project

2.2.1 The Lion Rock Tunnel (LRT) is a trunk road linking traffic between Shatin and Kowloon. It consists of two tunnel tubes each with two traffic lanes. The Kowloon bound and Shatin bound tunnel tubes have been put in use for over 50 years and 40 years respectively. Signs of deterioration of tunnel structures have become apparent. Furthermore, being an old design, the LRT does not meet the current standards in various aspects including waterproofing, dimensions (e.g. headroom and width), smoke extraction, evacuation, durability, Traffic Control and Surveillance System (TCSS), etc.

2.2.2 The LRT is a major strategic corridor connecting the traffic between Shatin and Kowloon and it is one of the most heavily used road tunnels in Hong Kong. Due to the heavy traffic demand, the time slots of only a few hours during nighttime for tunnel closure cannot allow comprehensive improvements works to be undertaken. Hence, there is a need for the Project to bring the LRT up to current standards and extend its serviceable years; thereby enhancing the tunnel environment and road safety level.

2.2.3 In addition, the capacity of the LRT cannot cope with the traffic demand during peak hours now, long traffic queues appear at the connecting roads including the LRT Road on Shatin side, as well as the Lung Cheung Road and the Waterloo Road on Kowloon side. Hence, there is a need to enhance the capacity of the LRT and the connecting roads as far as possible to improve the traffic flow and alleviate traffic congestion at this critical link between Shatin and Kowloon during peak hours.

2.3 Consideration of Alternative Options

Need for a New Tunnel

2.3.1 Assessments have been carried out to ensure that the Project will yield the most environmental benefits. In order to carry out the improvement works, the need for a new third tunnel was explored. If the new tunnel is not constructed, the one-tube-two-way traffic arrangement (i.e. similar to the existing arrangement during routine tunnel maintenance after midnight) will have to be implemented full-time while works are in progress in one of the existing tunnel tubes to ensure safety to the tunnel users. This will reduce the traffic capacity of the LRT, and traffic queues and congestions are expected along the tunnel connecting roads (e.g. Lion Rock Tunnel Road, Waterloo Road, Lung Cheung Road etc.) which in turn will lead to increase in air quality and noise impact during construction phase. Hence a new third tunnel is needed to facilitate uninterrupted traffic during construction. Consideration has also been given for an adoption of tunnelling works instead of traditional open-cut method for the provision of additional carriageways so as to avoid direct impacts on aboveground habitats within LRCP.

Alignment of the New Tunnel

2.3.2 Three alignment options for the new tunnel, to the west, east or in between the existing LRT tubes (namely the West Option, East Option and Middle Option respectively) were studied. The Middle Option is selected as the preferred option. The Middle Option has the shortest tunnel length and therefore will generate the least Construction and Demolition (C&D) materials. In addition, this option will have the lowest construction cost, shortest construction time and hence the least number of construction vehicles needed (i.e. least impacts to noise and air quality sensitive receivers). The Middle Option is also expected to have the least visual, landscape and ecological impacts among the three tunnel alignment options as it does not involve surface excavation within the Lion Rock Country Park (LRCP), hence least impact to the hillside vegetation (i.e. least impacts to valuable visual and landscape resources and natural habitat). Direct loss of LRCP and natural habitats are anticipated to be smaller, hence adverse ecological impacts on LRCP and natural habitats would be comparatively smaller if the middle option is adopted.

2.3.3 The West Option will comprise a much longer tunnel length than the Middle Option and the portal at Kowloon for this tunnel alignment will be directly adjacent to Vista Panorama thereby increasing air quality and noise impacts to the sensitive receivers along Waterloo Road. The East Option will, on the other hand, require extensive surface excavation within the Lion Rock Country Park at Shatin side for the construction of the tunnel portal and connecting roads. This will lead to much more woodland loss and tree felling relative to the Middle Option.

Tunnel Ancillary Facilities

2.3.4 The tunnel ancillary facilities such as the tunnel administration buildings (including on-site sewage treatment facility), ventilation buildings, depot, workshops, car parking facilities etc. will have to be located near the tunnel portals. In order to facilitate future tunnel operations, a crossover bridge is proposed near the existing toll plaza. Avoidance of Lion Rock Country Park (LRCP) was explored. However, a minor portion of the tunnel ancillary facilities (e.g. car parking facilities) would unavoidably be located at the developed area and an engineered slope at the fringe of the LRCP south of the existing toll plaza. Alternative locations outside LRCP (i.e. the downslope area at feature no. 7SW-D/FR33, Tei Lung Hau and agricultural land adjacent to the Shatin South Fresh Water Service Reservoir) were also considered and discussed in Chapter 2 of the EIA Report, it is concluded that those alternative locations do not fulfil the operational need of the LRT while the current adopted layout at Shatin has avoided an encroachment into woodland. Furthermore, more site formation works (with respect to within LRCP) will be required if the tunnel facilities are proposed at these alternative locations. Aside from the increased construction cost and time, such large-scale construction on steep hilly terrains will pose much greater construction difficulties and also safety hazards to both workers (e.g. falling from height) and the public (e.g. falling objects to Ka Tin Court downslope). In addition, the extent of woodland and green area losses are also envisaged to be greater at these alternative locations. The new ventilation buildings are proposed to be located outside the boundary of the Lion Rock Country Park.

Alignment of the Road Widening Works

2.3.5 The road widening works at Shatin side are proposed to be carried out at the downhill side of Lion Rock Tunnel Road (i.e. the downhill option). This will avoid and minimise encroaching on Lion Rock Country Park to the maximum possible extent. Considerations were previously given to locate the road widening works at the uphill section within the Lion Rock Country Park (i.e. the uphill option). Nevertheless, the woodland loss and number of trees felled of the downhill option are envisaged to be much lower than the uphill option. The downhill option will also generate much less C&D materials than the uphill option, and the associated filling works could facilitate the reuse of excavated materials (say from tunnel portal excavation). In addition, unlike the downhill option where access to the road widening site / works area could be via the downhill local roads, access to the road widening site / works area for the uphill option could only be accessed via the busy Lion Rock Tunnel Road. Furthermore, the excavation works uphill will require the partial closure of the nearside traffic lane of the southbound carriageway which could lead to congestion and in turn could increase air quality and noise impacts along Lion Rock Tunnel Road. In addition, the vegetation along the hillside of the Lion Rock Country Park are valuable landscape and visual resources. The uphill option will inevitably destroy a much larger extent of it than the downhill option.

2.3.6 Nevertheless, the widened road of the downhill option will be nearer to the developments located downhill of Lion Rock Tunnel Road at Shatin side. Noise mitigation measures such as noise barriers and noise enclosures will be provided but such measures will pose visual impacts to the nearby visually sensitive receivers. Appropriate aesthetic pleasing design shall be applied to mitigate the impact.

2.4 Construction Methodologies

Tunnelling Method

2.4.1 Based on the available geological profile, it is envisaged that tunnel excavation will be mostly carried out in good quality granite rock masses. They are typically excavated by either drill &

blast or by tunnel boring machine (TBM) or other mechanical excavation methods such as drill and break. The preferred method of tunnel construction is greatly influenced by the local constraints and nearby sensitive receivers. For this Project, the new middle tunnel is proposed to be constructed using the TBM and the enlarged Kowloon bound tunnel is proposed to be enlarged by drill and break method. This is because the tunnelling works will have to be carried out in close proximity to the existing LRT tunnel tubes. The vibrations generated due to blasting for the new middle tunnel may likely have detrimental impacts to the existing tunnel structures. The daily transport and handling of explosives necessary for the drill and blast method will also have adverse impacts on hazards to life. It is also likely that the LRT has to be closed to traffic during blasting and also after each blast to check for misfires. This is highly undesirable from a traffic point of view considering that the LRT has one of the highest usages in Hong Kong. Though not peak periods, traffic queues and congestions are also expected at connecting roads on both sides of LRT, thereby increasing the air quality and noise impacts. Hence the drill and blast method is not used in this Project.

2.4.2 In general, ground-borne noise impacts from TBM or drill and break tunnelling can be more easily controlled than that of drill and blast. The advance rate of the TBM could be altered, and the choice of plants and equipment used for drill and break tunnelling could be modified to cater for different site conditions and constraints. Despite the potential environmental benefits of using TBM, it would generate more C&D materials than the drill and blast method. This is because the TBM is circular in this case whereas tunnel cross section of the drill and blast method is horseshoe shaped. Furthermore, given the large TBM size, the extent of site formation works at the Shatin Portal (and therefore impacts to the existing woodland) may be larger than the drill and blast method.

Area for Stockpiling

2.4.3 The stockpiling area is proposed to be located at the north of the existing toll plaza near downhill side within the footprint of the permanent works and outside of Lion Rock Country Park. It is envisaged that there is no additional loss of woodland area and ecological impacts due to the stockpiling area. Consideration was previously given to locate the stockpiling area at Tei Lung Hau and the area immediate next to the existing toll plaza at uphill side. Nevertheless, the area at Tei Lung Hau is a woodland area and there is a nullah/watercourse runs through this area. As no permanent works are proposed for this area, locating the temporary stockpiling area at this location will incur additional woodland loss and ecological impacts. Furthermore, the vegetation at the hillside of Tei Lung Hau is also deemed to be a visual resource. Hence relocating the stockpiling area away from Tei Lung Hau will also minimize the visual impacts of the Project. On the other hand, portion of the area next to the existing toll plaza at uphill side is located within the existing woodland and Lion Rock Country Park, locating the stockpiling area at this location will incur additional ecological impacts within Lion Rock Country Park. Conveyor belts are also proposed during TBM tunnelling to minimize the number of dump trucks for transporting tunnel spoil, which could result in a decrease in air quality and noise impacts.

Construction of administration building/ ventilation buildings and tunnel associated structures

2.4.4 The ventilation buildings and administration building will be constructed by typical reinforced concrete construction method. Superstructures will adopt bottom-up construction. Construct ground floor slabs, beams, columns and walls to the lowest level and process upwards to roof level. No percussive piling is envisaged under the construction scheme. Other tunnel associated structures, such as depots, car parking facilities etc. will be constructed by method similar to casting-in-situ.

Construction of the road widening works along LRT Road

2.4.5 Road widening works along LRT Road would mainly comprise construction of slopes and retaining walls. The construction of the road widening works mainly in the downhill area significantly replaced the need for massive equipment for bored piling works uphill to relatively much smaller filling and retaining structures (e.g. L-shaped walls) downhill that require simpler and more environmentally friendly equipment. To avoid excessive cumulative environmental impacts, the proposed widening works along LRT Road are divided into various work zones,

and with major site formation and foundations works of adjacent work zones sequenced to be constructed at different phases under the construction programme.

Sequence of Works

2.4.6 The proposed 6.5m wide single lane elevated vehicular bridge to add an additional traffic lane along the Lion Rock Tunnel Road N/B across Lung Cheung Road at Kowloon side shall comprise upstand beams which shall be precast offsite, delivered and erected by mobile crane onsite. The slab shall be constructed using the cast in-situ method to avoid prolonged traffic diversion/congestion during erection which could ultimately cause air quality and noise impacts. No percussive piling is envisaged under the construction scheme. Environmental friendly construction equipment such as installing sheet piles using the press-in method in-lieu of vibratory methods should be utilized as far as possible, such as during construction of the pile caps of the proposed viaduct and during site formation works for road widening.

2.4.7 In addition, the programme and sequence of works of this Project were planned in consideration of other nearby concurrent projects and therefore to minimize the cumulative environmental impacts during the construction stage of this Project. With regards to the road works along Lion Rock Tunnel Road, "Revised Trunk Road T4" project by Civil Engineering and Development Department (CEDD) and the "Reprovisioning of Sha Tin Water Treatment Works – South Works" project by Water Supplies Department (WSD) were considered having the highest possibility to impose cumulative environmental impacts to the nearby sensitive receivers.

2.4.8 The tentative construction works of "Revised Trunk Road T4" project would be completed in September 2028, while the start of the construction works under this Project at the work zone 1 near Sun Tin Wai Estate / Fung Shing Court which is overlapped with 300m assessment area with "Revised Trunk Road T4" project is programmed to start in December 2028, thereby avoiding the cumulative environmental impacts, including but not limited to noise and air impacts, that may impose to the nearby sensitive receivers during the construction of the Project. Considered the habitat loss of woodland and mixed woodland within LRCP under "Revised Trunk Road T4" Projects is relatively small in size and already subject to disturbance, no unacceptable cumulative impact of habitat loss to LRCP is anticipated under the Project. Also, given potentially impacted habitats were mainly urbanized (i.e. along existing traffic road), already highly disturbed, no unacceptable cumulative indirect ecological impacts are anticipated during operation phase.

2.4.9 Considering "In-situ Reprovisioning of Sha Tin Water Treatment Works – South Works" project by WSD, the tentative construction programme for their substantial civil works would be completed by January 2025. To minimize the cumulative impact with the said project, the substantial civil works at the Work Zone 5 at Sha Tin Portal under this Project is scheduled to commence in May 2025.

2.5 Project Programme

2.5.1 The Project construction works are anticipated to commence in Q1 2025. The tentative completion year for the Project is 2034. The tentative phasing of major construction works are outlined in below.

Table 2.1 Tentative Phasing of Major Construction Works

Major Works	Tentative Schedules
Construction of tunnel ancillary facilities and other misc. works such as watermain diversion at Shatin Portal (including testing and commissioning)	Shatin Portal: Q1 2025 to Q2 2031
Construction of tunnel ancillary facilities at Kowloon Portal (including testing and commissioning)	Kowloon Portal: Q3 2025 to Q4 2030

Major Works	Tentative Schedules
Tunnelling works (including testing and commissioning): ▪ Construction of new middle third tunnel tube by TBM ▪ Enlargement of existing Kowloon bound tunnel tube by drill & break method ▪ Refurbishment of the existing Shatin bound tunnel tube	New middle third tunnel tube: Q1 2025 to Q1 2029 (Construction) Q4 2032 to Q4 2033 (Closed for demolition of partition wall) Kowloon bound tunnel tube: Q2 2029 to Q4 2032 Existing Shatin bound tunnel tube: Q1 2034 to Q4 2034
Road widening works and road widening associated works at Shatin and Kowloon:	Q1 2025 to Q4 2034

2.6 Concurrent Project

2.6.1 Key concurrent projects in the vicinity of the Project are identified and summarised in **Table 2.2**. Potential cumulative impacts from these concurrent projects (if any) have been considered in this EIA Study.

2.6.2 "Relocation of Diamond Hill Fresh Water and Salt Water Service Reservoirs to Cavern" project site would be located within the air quality and noise impact assessment area of the Project. Hence, its cumulative construction phase impacts have been considered in the assessment under this EIA Study. Due to the nature of service reservoirs, no operation phase cumulative impact would be anticipated.

2.6.3 "Revised Trunk Road T4" project site is located within assessment area of the Project. Construction works of "Revised Trunk Road T4" project would be completed by September 2028, while the construction works of widening of Lion Rock Tunnel Road (except tunnel portal area) at Shatin near T4 under the Project would commence in December 2028. Hence, no construction phase cumulative impact would be anticipated. The cumulative operational phase air quality, road traffic noise, ecology, landscape and visual impacts from the Project and the "Revised Trunk Road T4" project have been addressed in the EIA Study.

2.6.4 The major construction works of "In-situ Reprovisioning of Sha Tin Water Treatment Works – South Works" project would be completed by January 2025, before the commencement of the Project. Hence, no cumulative construction phase impact would be anticipated. Due to the nature of water treatment works, no operation phase cumulative impact would be anticipated.

2.6.5 "Proposed Drainage Improvement Works at Chui Tin Street and Chui Tin Street Soccer Pitch" project would involve only small-scale construction works, which are located more than 200m from the Project. Hence, no significant cumulative impact would be anticipated. Due to the nature of drainage improvement works, no operation phase cumulative impact would be anticipated.

Table 2.2 Summary of Concurrent Projects

Project Name	Target Works Commencement Dates	Target Work Completion Dates	Cumulative Impact Considered / Addressed
Relocation of Diamond Hill Fresh Water and Salt Water Service Reservoirs to Cavern (WSD)	2022	2027	Construction Phase: Air Quality, Noise, Ecology, Visual and Landscape Operational Phase: Nil
Revised Trunk Road T4 (CEDD)	2023	September 2028	Construction Phase: Ecology and Landscape and Visual Operational Phase: Air Quality, Noise, Ecology and Landscape and Visual
In-situ Reprovisioning of Sha Tin Water Treatment Works – South Works (WSD)	2020	2027 (Major works completed by Jan 2025)	Construction Phase: Nil Operational Phase: Nil
Proposed Drainage Improvement Works at Chui Tin Street and Chui Tin Street Soccer Pitch (Drainage Services Department (DSD))	2023	2031	Construction Phase: Nil Operational Phase: Nil

2.7 Public Concerns

2.7.1 Consultation activity for the Project has been carried out during the application of EIA Study Brief under EIAO. The Project Profile was exhibited for public inspection between 25 September 2019 to 8 October 2019. Furthermore, consultation with Kowloon City District Council and Wong Tai Sin District Council was conducted on 16 June 2022 and 21 June 2022 respectively, while consultation with Sha Tin District Council was scheduled to conduct in August 2022. The key environmental comments received and follow-up actions to be taken are summarised in **Table 2.3**.

Table 2.3 Summary of Concerns and Follow Up Actions

Concerns / Issues	Follow Up Actions to be Taken
▪ Road traffic noise impact due to the additional traffic generated from the Project	▪ Noise mitigation measures including noise barriers and noise-enclosure are proposed along Lion Rock Tunnel Road. As such, the predicted noise levels at nearby NSRs will comply with the road traffic noise criteria. Please refer to **Section 3.2** for road traffic noise impact assessment.
▪ Adverse water quality of watercourses	▪ Proper site management practices and

Concerns / Issues	Follow Up Actions to be Taken
near project area due to construction activities from the Project	the mitigation measures as recommended in the EIA would be implemented. As such, no adverse water quality impact would be anticipated during construction phase. Please refer to **Table 5.1** for mitigation measures for minimizing water quality impact.
▪ Loss of surrounding natural habitat due to encroachment of project into LRCP	▪ Middle Option for alignment of new tunnel and downhill road widening at LRTR was adopted to reduce encroachment into LRCP and reduce loss of habitat to a minimum extent. ▪ Woodland compensatory planting is provided near Project Boundary for any unavoidable woodland loss within LRCP would be compensated off-site. Please refer to **Table 5.1** for mitigation measures for minimizing ecology impact.
▪ Increased air pollutant concentration due to construction activities and additional traffic generated from the Project	▪ Construction and operation phase air quality impact assessment was conducted in compliance with the requirements set out in the EIAO-TM. Suitable mitigation measures will be implemented during construction stages as recommended in the EIA. Please refer to **Section 3.1** for air quality impact assessment.
▪ Adverse impact to cultural heritage site (Tsang Tai Uk) from construction activities	▪ Project road alignment is revised. Tsang Tai Uk is now located at substantial distance from Project Site. No adverse impact is anticipated during construction phase. Please refer to **Section 3.7** for details of Cultural Heritage Impact Assessment.
▪ Removal of trees within LRCP and surrounding areas due to the Project	▪ Middle Option for alignment of new tunnel and downhill road widening at LRTR was adopted to reduce encroachment into LRCP and minimize removal of trees within LRCP. ▪ Compensatory tree planting is proposed for trees affected in LRCP near the tunnel portal area and toll plaza administration area. Off-site woodland compensatory planting is also provided. Please refer to **Table 5.1** for details of landscape and visual mitigation measures.

Concerns / Issues	Follow Up Actions to be Taken
▪ Potential hydrological impacts on natural watercourses arising from construction activities	▪ Appropriate water control strategies should be implemented to minimize the groundwater infiltration during the tunnel construction. Please refer to **Table 5.1** for details of mitigation measures for minimizing groundwater infiltration. ▪ Surface water level monitoring of natural watercourses in the vicinity of the underground tunnel improvement works area should be conducted during the construction and operation stages. Please refer to **Section 3.6** for the details of monitoring on surface water level of natural watercourses.

3 KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

3.1 Air Quality Impact

3.1.1 Potential air quality impacts associated with the construction and operational phases of the Project have been assessed in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.4 and Appendices B and B-1 of the EIA Study Brief, as well as Annexes 4 and 12 of Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). The assessment area for air quality impact assessment is within 500m from the boundary of the Project Site.

3.1.2 Potential air quality impact from the construction works of the Project would mainly be related to construction dust from site clearance, excavation, tunnel construction, slope works, road works construction and wind erosion. Quantitative fugitive dust assessments have been conducted, taking into account the cumulative impact caused by nearby concurrent sources within 500m from the boundary of the Project Site. The prediction results concluded that cumulative Total Suspended Particulates (TSP), Respirable Suspended Particulates (RSP) and Fine Suspended Particulates (FSP) concentrations at all Air Sensitive Receivers (ASRs) would comply with the criteria stipulated in EIAO-TM and Air Quality Objectives (AQOs) with the implementation of mitigation measures specified in the Air Pollution Control (Construction Dust) Regulation together with the recommended dust suppression measures including watering once every two hours on heavy construction works areas, sealed door and dust collector with at least 80% dust removal efficiency for the tunnel minded by drill and break, and adopting good site practices, no adverse dust impact at air sensitive receivers would be anticipated due to the construction activities of the Project. Dust monitoring and regular site inspection have been proposed for the EM&A during construction phase to ensure these proposed measures properly implemented.

3.1.3 Cumulative air quality impact during operational phase arising from the operation of new tunnel tube, refurbished existing tunnels, associated portal and ventilation building and widened roads, and other existing sources such as vehicular emission from open roads and nearby chimneys within 500m study area has been assessed for the operation phase of the Project at the worst year 2034, which has the highest vehicular RSP, FSP and Nitrogen Oxides (NOx) emission burden within 15 years after commencement of the Project. The results concluded that the predicted cumulative Nitrogen Dioxide (NO_2), RSP and FSP concentration at all ASRs would comply with AQO. No adverse air quality impact is anticipated arising from the operation of the Project.

3.2 Noise Impact

3.2.1 Potential noise impacts associated with the construction and operational phases of the project have been assessed in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.5 and Appendix C of the EIA Study Brief, Annexes 5 and 13 of EIAO-TM, as well as EIAO Guidance Note GN 12/2010. The assessment area for noise impact assessment is within 300m from the boundary of the Project site.

Construction Phase

3.2.2 Potential noise impact arising from the construction works of the Project would mainly be related to the use of powered mechanical equipment (PME) for various construction activities. The key construction works include construction of the new road tunnel, rehabilitation/reconstruction of the existing tunnel tubes of the LRT, reprovision of administration building and ventilation buildings, widening of Lion Rock Tunnel Road at Sha Tin side and a section of Lion Rock Tunnel Road at Kowloon side, provision of noise barriers/enclosures, and ancillary works such as slope works, drainage and landscaping works.

3.2.3 The assessment results indicated that the predicted maximum unmitigated construction noise levels at the representative noise sensitive receivers (NSRs) in the vicinity of the Project work sites would be 63 – 86 dB(A) for Kowloon side and 62 – 91 dB(A) for Shatin side. With the implementation of mitigation measures including the use of quieter powered mechanical equipment, deployment of construction noise barriers, sequencing operation of construction

activates at critical work area, reduction of PME at critical works area and avoiding to carry out particularly noisy construction activities during examination periods , the mitigated noise levels at NSRs in the vicinity of Project work sites at Kowloon side and Shatin side would be 52 – 75 dB(A) and 46 – 75 dB(A), respectively, which comply with the noise criteria set out in the EIAO-TM. Adverse noise impact during construction phase of the Project is not anticipated.

3.2.4 Potential ground-borne noise impact arising from tunnelling, rock breaking/drilling associated with the operation of TBM and concerned PME (such as hydraulic breaker, drill rig, and hand-held breaker) during construction phase of the Project was also assessed. The predicted construction ground-borne noise level at the nearest NSR would be 49 – 58 dB(A), were found to comply with the noise criteria. No adverse construction ground-borne noise impact was anticipated.

Operation Phase

3.2.5 The noise impacts associated with the operation of the Project including road traffic noise impact and fixed noise sources impact were assessed.

3.2.6 In accordance with HyD Guidance Notes on Road Surface Requirements for Expressways and High Speed Road (RD/GN/032), polymer modified friction course (PMFC) (i.e. a type of low noise road surfacing) would be adopted as standard surfacing material on the proposed road sections under the Project in both Kowloon and Shatin side.

3.2.7 With the operation of the Project, exceedance to road traffic noise criteria would be found on most NSRs in the unmitigated scenario during year 2041, which is with the maximum traffic projections within 15 years upon operation of the Project. The predicted unmitigated overall noise levels of NSRs at Kowloon side and Shatin side would be 58 – 86 dB(A) and 52 – 83 dB(A), respectively.

3.2.8 At Kowloon side, the exceedance would be solely due to the traffic noise from other existing road. The predicted Project Road noise levels at NSRs of Kowloon side would comply with the respective criteria and the predicted Project Road contribution to the overall noise level would be less than 1.0 dB(A), indicating the Project Road noise contribution is insignificant under the unmitigated scenario. Therefore, no further mitigation measures would be required.

3.2.9 At Shatin side, various types of noise mitigation measures including vertical barrier, cantilever barriers and semi-enclosures have been proposed. With the mitigation measures in place, the predicted noise levels at most of the NSRs at Shatin side would comply with the noise criteria except some NSRs at Fung Shing Court, Golden Lion Garden, Julimount Garden, King Tin Court, Shatin Government Primary School and World-Wide Garden. However, the major noise source contribution to the noise exceedance at these representative NSRs would be due to the other existing roads, such as non-Project Road section of Lion Rock Tunnel Road, Hung Mui Kuk Road and Sha Tin Road. The predicted traffic noise levels due to Project Road would comply with the noise criteria and the predicted Project Road contribution to the overall noise levels would be less than 1.0 dB(A), indicating the Project Road noise contribution is insignificant under the mitigated scenario. Therefore, no further mitigation measures would be required.

3.2.10 No NSR has been identified within 300m of the Shatin Portal. Therefore, no adverse tunnel portal noise impact would be anticipated from the Shatin Portal. On the other hand, one NSR was identified within 300m of the Kowloon Portal. Since the NSR is not directly facing the tunnel portal and the highly directional nature of tunnel portal noise, the associated portal noise impact is expected to be insignificant. No mitigation measures would be required.

3.2.11 Quantitative operation phase fixed noise sources assessment on vent shaft of the ventilation buildings has been conducted. The predicted noise level at the representative NSR at Kowloon side of Project Area would meet the relevant criteria. On the other hand, no NSR was identified within 300m assessment boundary of Shatin ventilation building. Therefore, no adverse fixed noise sources impact would be anticipated for both Kowloon side and Shatin side ventilation buildings, and no mitigation measures would be required.

3.3 Water Quality Impact

3.3.1 The water quality impact assessment was conducted in accordance with the requirements in Annexes 6 and 14 of the EIAO-TM and the requirements in Section 3.4.6 and Appendix D of the EIA Study Brief.

3.3.2 The potential water quality impacts from the construction works are associated with the general construction activities, construction site run-off, groundwater infiltration arising from tunnel boring, groundwater from contaminated areas and contaminated site runoff, construction in close proximity of inland watercourses, water pollution from culvert modification works, accidental spillage of chemicals and sewage effluent from construction workforce. Provided that proper site management practices and the mitigation measures including adequate construction site drainage, provision of sediment removal facilities, practical groundwater control measures and chemical toilets would be implemented, no adverse water quality impact during construction phase would be anticipated. Water quality monitoring and regular site inspection will be implemented for the construction works to ensure that the recommended mitigation measures are properly implemented.

3.3.3 The key potential sources of water quality impacts during operation phase would be related to non-point source stormwater runoff, sewage from the new administration building and ventilation buildings, wastewater from washing and maintenance operation, and tunnel run-off and drainage. Adequate drainage system with silt traps and oil interceptors should be provided to collect the stormwater runoff. All sewage and wastewater generated from the New Administration Building, Car Parking Area and Ventilation Buildings would be treated by on-site STP (nearby/adjoining new administration building) and septic tank with soakaway systems (nearby/adjoining new ventilation buildings). With proper design of drainage and sewerage systems and implementation of the recommended mitigation measures, no adverse water quality impact during operation phase would be anticipated.

3.4 Waste Management Implication

3.4.1 The waste management implication assessment was conducted in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.7 and Appendix E of the EIA Study Brief, as well as Annexes 7 and 15 of the EIAO-TM.

3.4.2 C&D materials (mainly from site formation works for tunnelling works, excavation, construction of adits, tunnel associated buildings and structures (e.g. ventilation buildings and new administration building etc.), demolition of existing buildings, slope formation works, retaining works and road widening/ reconfiguration works), general refuse (from workforce) and chemical waste (from maintenance of equipment and potential asbestos waste from building demolition) would be generated during the construction phase. Provided that these wastes are handled, transported and re-use/disposed of in a proper manner and that the recommended good site practices are strictly followed, adverse environmental impacts in relation to hazard, air and odour emissions, noise, wastewater discharge and public transport would not be expected.

3.4.3 Reduction measures have been recommended to minimise the amount of materials generated in the Project. Approximately 1,338,050 m^3 of inert materials and 107,044 m^3 of non-inert materials would be generated during the construction phase of the Project. 53,800 m^3 of inert material would be reused on site while the remaining 1,284,250 m^3 of surplus C&D inert material would be recycled or transported to Public Fill Reception Facilities (PFRFs) for beneficial reuse in other projects. Non-inert waste will be recycled as far as possible before disposed of to landfill. Opportunities in minimisation of generation and maximisation of reuse would be continually investigated during the detailed design and construction phases. The other materials that cannot be reused or recycled would be disposed of to designated outlets.

3.4.4 The main waste types generated during the operation of the Project would be screening, grits, sludge (from the operation of on-site Sewage Treatment Plant (STP)), general refuse (from staff and office activities) and chemical waste (from maintenance activities). Adverse impacts would not be anticipated if these wastes are handled, transported and disposed of in proper manner.

3.5 Land Contamination

3.5.1 The land contamination assessment has been conducted in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.8 and Appendix F of the EIA Study Brief, as well as Section 3.1 and 3.2 of Annex 19 of the EIAO-TM.

3.5.2 Based on the site appraisal, a total of 11 facilities / areas were identified with potential land contamination concerns at the tunnel portal areas within the Project Area.

3.5.3 A sampling and testing programme, targeting the concerned facilities / areas identified within the Project Area, had been proposed. A total of 35 sampling locations were proposed for soil and groundwater sample collection. The collected samples will be tested for the chemicals of concerns (COCs) (i.e. metals, VOCs, SVOCs, PCRs and PCBs).

3.5.4 As the concerned facilities are still in operation and the demolition and construction works will not commence until 2026-2027, there could be change in site activities and land uses within the Project Area prior to development which may cause further contamination issues. Site re-appraisal should be carried out for the whole Project Area at a later stage of the Project in order to address any new contamination issues caused by the (i) changes in operation of the identified potentially contaminated site and (ii) changes in land use within the Project Area. The submission of supplementary Contamination Assessment Plan(s) (CAP(s)), associated site investigation (SI) works and any necessary remediation should be carried out at the concerned facilities and any new contaminated area identified in the site re-appraisal, prior to the commencement of construction at the potentially contaminated area(s). The recommended further assessment and remediation works, including the submission of supplementary CAP(s), Contamination Assessment Report(s) (CAR(s)), Remediation Action Plan(s) (RAP(s)) and Remediation Report(s) (RR(s)) would follow EPD's prevailing guidelines.

3.5.5 With the implementation of the recommended further works for the Project as detailed in **Section 3.5.4**, any soil/groundwater contamination would be identified and properly treated prior to the construction works at concerned areas. No insurmountable land contamination impacts to the Project are therefore anticipated.

3.6 Ecological Impact (Terrestrial)

3.6.1 Ecological assessment has been conducted in accordance with the criteria and guidelines as stipulated in Annexes 8 and 16 of the EIAO-TM, as well as Section 3.4.10 and Appendix H of the EIA Study Brief, together with EIAO Guidance Notes Nos. 3/2010, 6/2010, 7/2010 and 10/2010.

3.6.2 Literature review and ecological field surveys have been conducted. Eleven habitat types, including woodland, mixed woodland, plantation, shrubland, village/orchard, active agricultural land, abandoned agricultural land, pond, natural watercourse, modified watercourse and developed areas were identified within the 500 m ecological assessment area.

3.6.3 Direct impacts arising from the proposed aboveground works include permanent loss (14.80 ha) and temporary loss (2.75 ha) of habitats. Direct impacts on recognized sites of conservation importance (e.g. Beacon Hill Site of Special Scientific Interest (SSSI) and LRCP) are largely avoided. Over 69% permanent habitat loss would be largely located at Shatin side and along the existing Lion Rock Tunnel Road. About 0.16 ha woodland, 0.17 ha plantation, <0.01 ha modified watercourse and 0.81 ha developed area at the LRCP would be permanently affected. About 0.09 ha woodland, 0.16 ha plantation and 0.33 ha developed area also at LRCP would be temporarily affected. To address the permanent (0.16 ha) and temporary (0.09 ha) impacts on woodlands within LRCP, provision of compensatory woodland (at least 0.25 ha) near the Project footprint in accordance with the Final Woodland Compensation Plan is recommended as mitigation and enhancement measures. Temporarily affected area within the Project footprint, including those within LRCP, would be reinstated by woodland mix planting according to the Final Reinstatement Plan.

3.6.4 To avoid and protect the five flora species of conservation importance recorded in close proximity to the footprint of NTHMMs (including one seedling of Incense Tree, one individual

of Ailanthus and three clumps of Luofushan Joint-fir near the rigid barriers within LRCP; and four individuals of Butulang Canthium, one individual of Hong Kong Pavetta and three individuals of Ailanthus near the proposed flexible barriers outside LRCP) during the construction of the NTHMMs, all the identified flora species of conservation importance above shall be preserved on site with provision of plant protection zones with sturdy fencing during the construction phase. In case in-situ preservation is found to be impractical during the later design phase, appropriate alternative mitigation measures (e.g. transplantation / compensatory planting) should be considered and addressed in the Final PPTP, where necessary.

3.6.5 A total of four flora species of conservation importance (including one individual of Incense Tree, nine individuals of Butulang Canthium, 19 individuals of Ailanthus along LRTR and nine individuals Rhodoleia near Lung Cheung Road Park) were recorded within Project footprint. To mitigate potential impacts on these flora species, a detailed vegetation survey would be conducted and a Final Plant Preservation and Transplantation Proposal should be prepared by a qualified ecologist / botanist with at least 10 years relevant experience accordingly prior to the commencement of construction activities to identify potentially affected flora species of conservation importance and recommend appropriate mitigation measures to be implemented under the Project.

3.6.6 The section of natural watercourse S7 outside the Project footprint was likely to be a potential breeding/nursery ground of Small Clubtail (nymph) and Lesser Spiny Frog (tadpoles). Another reptile species of conservation importance (Tokay Gecko) was recorded at developed area near LRT portals at Shatin outside the Project footprint. No direct impact on these species is anticipated as no construction activities would be carried out at their recorded habitats. Precautionary measure such as a pre-construction survey in natural habitats within and in the surrounding of the Project footprint is recommended (e.g. woodland, mixed woodlands and natural watercourse within and near the Project footprint) to verify the findings of ecological field surveys prior to the commencement of construction activities. In case any fauna species of conservation importance recorded would be directly impacted, a Protection and Translocation Proposal should be prepared by a qualified ecologist with at least 10 years relevant experience to recommend suitable mitigation measures.

3.6.7 Other potential direct impacts may include direct harm / mortality to wildlife and bird collision, while potential indirect impacts may include dust, noise, site runoff, groundwater infiltration and glare to natural habitats and wildlife in the vicinity. Given the Project footprint mainly involves habitats of limited ecological values (e.g. developed area, plantation) and other areas located at and along existing LRTR currently exposed to heavy disturbance, thus the indirect impacts are anticipated to be minor/minor to moderate. Implementation of good site practices (e.g. provision of screening, control of glare / lighting, groundwater infiltration minimization measures, water quality impact control measures, etc.) would minimize the potential indirect impacts. Carefully design noise barriers (e.g. location, use of tinted materials and superimposing dark patterns or strips) would minimize the potential impact of bird collision.

3.6.8 Site audit and inspection for the implementation of the mitigation measures for minimization of indirect impact (e.g. glare, air quality, noise) should be carried out at least once per week throughout the construction phase by ET. Regular site inspections covering the Project boundary within LRCP and the ecological compensatory plantings should be conducted as early as possible once the Project commences to ensure that all construction activities are confined to the Project footprint and that the proposed mitigation measures are implemented appropriately and effectively.

3.6.9 Upon completion of the woodland compensatory planting works, a maintenance and monitoring programme should be undertaken during the planting and establishment period which normally takes at least 9 years. The Contractor should regularly maintain the planted individuals, including watering, weeding, pest control and replanting works, where necessary. A monitoring programme would be conducted by a qualified ecologist / arborist with at least 10 years relevant experience to monitor the health condition and survival of the woodland compensatory planting. The management and maintenance of the established woodland compensation area will be regulated by the *DEVB TCW No. 6/2015*, and should be continued until the plantings are fully established (which normally takes at least 9 years) and before hand

over of the established woodland to the long-term maintenance party identified and agreed in accordance with the *DEVB TCW No. 6/2015* after the establishment period for maintenance.

3.6.10 Appropriate groundwater control measures and associated monitoring/site inspections would be implemented to minimize the groundwater infiltration during the tunnel construction and no adverse residual impacts on water quality impact are anticipated. As an additional precautionary measure, surface water level monitoring of natural watercourse in the vicinity of the underground tunnel improvement works area should be conducted during the construction stage. Post-construction monitoring of surface water level of natural watercourse in the vicinity of the underground tunnel improvement works area, including those within the LRCP and Beacon Hill SSSI, for one year should also be carried out. Monthly monitoring should be conducted at watercourses S6 to S8 to monitor parameters (including water depth and water velocity) and remedial measures should be recommended, where necessary, if any abnormal significant decrease of the water level is arising from the Project.

3.6.11 With the implementation of the recommended mitigation measures along with EM&A activities, no unacceptable adverse residual impacts would be expected during construction or operation phases.

3.6.12 Four projects, including "Revised Trunk Road T4 in Sha Tin", "Relocation of Diamond Hill Fresh Water and Salt Water Service Reservoirs to Cavern", "In-situ Reprovisioning of Sha Tin Water Treatment Works – South Works" and "The Proposed Drainage Improvement Works at Chui Tin Street and Chui Tin Street Soccer Pitch" are likely to be constructed/operated concurrently with the LRT Project. Given the scale of impacts on natural habitats under the concurrent projects are minor and a majority of the project sites are urbanised and relatively disturbed, with the implementation of the proposed mitigation measures (e.g. staggered construction works period, adoption of good site practices, transplantation of flora species of conservation importance, etc.) under the projects, no unacceptable adverse cumulative impacts are anticipated.

3.7 Cultural Heritage Impact

3.7.1 The cultural heritage impact assessment was conducted following the criteria and guidelines as stated in the requirements given in Annexes 10 and 19 of the EIAO-TM as well as Section 3.4.12 and Appendix J of the EIA Study Brief.

3.7.2 Ex Kowloon Canton Railway Beacon Hill Tunnel (Government Historic Site) is located approximately at 90m from the Project Boundary. Direct impact would not be anticipated but indirect impacts including ground-borne vibration, tilting and settlement, would be anticipated. Pre and post condition survey of Ex Beacon Hill Tunnel should be conducted by professional qualified building surveyor or engineer. Monitoring of vibration, settlement and tilting incorporated with a set of Alert, Alarm and Action (AAA) system shall be employed for the Ex Beacon Hill Tunnel during the construction phase, measuring inside the tunnel tube at locations closest to the proposed construction works. A monitoring proposal should be submitted to Antiquities and Monuments Office (AMO) for agreement before the commencement of works.

3.7.3 Other identified historic buildings in the vicinity include Lau Ancestral Hall (Sha Tin Tau) (Grade 3), Tsang Tai Uk (Grade 1) and High Rock Christian Camp (Grade 2) which are located at approximately 160m to 280m from the Project Boundary. No adverse impact would be anticipated on these historic buildings during the construction phase.

3.7.4 As the first Lion Rock Tunnel would be expanded, destruction of the portals would be imminent. The second Lion Rock Tunnel will undergo refurbishment. It is suggested that fonts on both sides of the portals of the two tunnels should be kept or replicated and placed on similar position as the current setting. The colour scheme of the associated buildings is suggested to be adopted to the new administrative buildings in order to maintain the original sentiment. Moreover, the two commemorative plaques marking the opening ceremony of the tunnel should be kept at prominent position at the new administrative buildings visible to all guests. Detailed photographic recording on the Lion Rock Tunnel and its associated buildings (both exterior and interior) should be conducted before any works to commence. A copy of the photographic documentation should be provided to AMO for record.

3.7.5 No Sites of Archaeological Interest (SAIs) are identified within the assessment area. Any potential archaeological resources might have been disturbed by the urban developments. The archaeological potential in the assessment area is negligible. No archaeological impact would be anticipated during the construction phase of the Project. As a precautionary measure, AMO should be informed immediately in case of discovery of antiquities or supposed antiquities in the course of works, so that appropriate mitigation measures, if needed, can be timely formulated and implemented in agreement with AMO.

3.7.6 No adverse impact would be anticipated on both built heritages and archaeology during the operational phase of the Project.

3.8 Landscape and Visual Impact

3.8.1 Landscape and visual impacts assessment has been assessed in accordance with the criteria and guidelines as stated in Annexes 10 and 18 of the EIAO-TM and the Environmental Impact Assessment Ordinance (EIAO) Guidance Note No. 8/2010, as well as Section 3.4.11 and Appendix I of the EIA study brief.

3.8.2 The Project will inevitably result in some landscape and visual impacts during construction and operation phases. These impacts have been minimized through careful consideration of alternatives to minimize direct conflict with LRCP, minimization of works areas, and incorporation of aesthetic external designs and appropriate landscape and visual treatments along the LRT Road.

Landscape Impacts

3.8.3 Within the assessment area, 17 Landscape Resources (LRs) and 11 Landscape Character Areas (LCAs) are identified.

3.8.4 Based on a broad brush tree estimate among the approximate 5,018 existing trees including 26 individual trees surveyed, approximate 2,925 existing trees (including 2,910 nos. of existing trees in tree groups, 14 nos. of trees of particular interest and 1 no. of potential tree of particular interest) will be unavoidably affected by the Project in which approximate 300 nos. of affected trees are within Lion Rock Country Park. None of them are Old and Valuable Trees (OVTs). The major affected tree species include *Acacia confusa, Casuarina equisetifolia, Eucalyptus robusta, Eucalyptus tereticornis, Lophostemon confertus, Schima superba* and *Sterculia lanceolata*. Among the 26 individual trees surveyed, 14 nos. of *Ailanthus fordii* with conservation importance located on the slopes along the LRT Road and 1 no. of potential tree of particular interest *Ficus elastica* located on the slope in Lung Cheung Road Park are in direct conflict with the construction of road improvement works. All of the 15 affected individual trees are outside Country Park boundary.

3.8.5 Within the Project Boundary, a minimum of 145 heavy standard trees will be proposed at roadside flat areas mainly near the tunnel portal area and toll plaza administration area in Tai Wai and road verge area in Kowloon side, and total area of approximate 7,720m.sq. will be proposed as compensatory woodland tree mix planting of about 2,070 tree whips within site. In addition, approximately 0.3ha off-site woodland compensation area with approximately 1,200 nos. of native seedlings/whip trees is proposed. Mix of native tree species will be proposed in reference to Guiding Principles on Use of Native Plant Species in Public Works Projects promulgated by DEVB to improve the vegetation diversity, enhance ecological value and re-creation of vegetation habitat particular for areas adjoining the Lion Rock Country Park.

Visual Impacts

3.8.6 There are four types of Key Visually Sensitive Receiver (VSR) Types identified in the Visual Envelopes of the Project, which are Residential VSRs, Institutional VSR, Recreational VSR and Travelling VSR.

3.8.7 Appropriate landscape and visual mitigation measures are proposed during construction phase, including preservation of existing vegetation, control of night-time lighting glare, erection of decorative screen hoarding, management of construction activities and facilities, reinstatement of temporarily disturbed landscape areas and minimize the direct conflict with

Lion Rock Country Park, and during operation phase, including compensatory tree planting for loss of existing trees, compensatory woodland mix planting on soil slopes, aesthetically pleasing design of aboveground structures, aesthetically pleasing design of highways structures and slope associated structures, aesthetically pleasing design of footbridges, noise barriers and noise enclosures, provision of green roof, provision of buffer planting / roadside planting and greening works on slopes and associated structures, to alleviate the potential impacts. Regarding mitigated visual impact, it is predicted that there would be insubstantial to moderate residual impact on most of the VSRs during construction, and would be insubstantial to moderate on day 1 of operation and be further reduced to insubstantial when the proposed tree planting becomes mature in year 10 of operation. The residual impact on several VSRs R-04 (residents in high-rise residential developments along LRT Road in Sha Tin Tau), R-07 (Residents in village residential developments along LRT Road in Sha Tin Tau), O-04 (Recreational Users along Hung Mui Kuk Nature Trail), I-01 (Occupants in Union Hospital) and T-02 (Travellers along LRT Road) with overview on the proposed noise semi-enclosure would maintain as moderate in year 10 of operation while residual impact on VSRs R-02 (Residents in high-rise residential developments near Tei Lung Hau) and O-03 (Hikers along Wilson Trail (Stage 5) and Amah Rock) would maintain as slight in year 10 of operation. There would be insubstantial residual impact on other VSRs within the visual envelope during the construction and operation of the Project.

3.8.8 As a whole, the residual landscape and visual impacts of the proposed Project is considered acceptable with the proposed mitigation measures implemented during construction and operation phases.

3.9 Hazard to Life

3.9.1 There is a Potentially Hazardous Installation (Sha Tin Water Treatment Works) and the Liquefied Petroleum Gas (LPG) storage installation at Worldwide Gardens located within the assessment area of the Project.

3.9.2 According to the latest information provided by the WSD, it is understood that the upgrading works of the disinfection facilities in Sha Tin Water Treatment Works (Sha Tin WTW) will be completed in Year 2022, and all chlorine drums in Sha Tin WTW would be removed by Q4 2022 after the on-site chlorine generation (OSCG) plant is put into operation. Based on the tentative construction programme of this Project, the construction works for this Project will be commenced in Year 2025, at which time the upgrading works of the Sha Tin WTW would already been completed. As such, risk impact due to storage of liquid chlorine in Sha Tin WTW would not be expected during the construction and operation phases of this Project, and thus no hazard to life assessment for the Sha Tin WTW is required.

3.9.3 A hazard to life assessment was conducted in accordance with the criteria as stated in the requirements given in Annex 4 of the EIAO-TM as well as Section 3.4.9 and Appendix G of the EIA Study Brief to evaluate the risks associated with the LPG storage installation at Worldwide Gardens during both construction and operation phases of the Project.

3.9.4 The maximum individual risk contour of 1×10^{-6} per year contour extends approximately 60m from the LPG Compound. Given there is no offsite risk with frequency greater than 1×10^{-5} per year, individual risk is considered acceptable and in compliance with the Hong Kong Risk Guidelines. For societal risk, part of the FN curve (i.e. between 3 and 6 fatalities) falls within the “ALARP” region and this trend is applicable for all assessed scenarios (i.e. Year 2033 – Base Case, Year 2033 – Construction Phase and Year 2041 – Operation Phase). The total PLLs for all assessed scenarios were found to be about 3.84×10^{-5} per year and the proposed project works area accounts for 2.87×10^{-8} per year (0.07% of total PLL) during construction phase. Thus, the PLL contribution to the proposed Project works area as compared with the overall risk level was considered negligible. Although there are no practicable risk mitigation measures identified to further reduce the risk level at the project works area, good safety practices are recommended to further manage and minimize the potential risks during construction phase of the Project.

4 ENVIRONMENTAL MONITOIRNG AND AUDIT (EM&A)

4.1.1 Environmental Monitoring and Audit (EM&A) requirements and regular site inspection and audits for air quality, noise, water quality, waste management, land contamination, terrestrial ecological, cultural heritage, landscape and visual impacts and hazard to life have been recommended during construction phase whilst EM&A requirements for traffic noise impact, ecology aspects and landscape and visual aspects and commissioning test for fixed noise sources impact have been recommended during operation phase to ensure that the recommended mitigation measures are properly implemented. The EM&A requirements under construction and operation phases are specified and detailed in the EM&A Manual.

5 CONCLUSION

5.1.1 The findings of the EIA provided information on the nature and extent of the environmental impacts likely to arise from the construction and operation of the Project. The EIA has, where appropriate, identified mitigation measures to ensure compliance with environmental legislation and standards. The summary of the environmental impacts arising from the Project is presented in **Table 5.1**.

5.1.2 Overall, the EIA concluded that the Project would comply with the requirements of the EIA Study Brief and EIAO-TM with the implementation of the proposed mitigation measures during construction and operational phases of the Project. The schedule of implementation of the proposed mitigation measures has been provided in the EIA Report. An EM&A programme has also been recommended to check the effectiveness of the proposed mitigation measures.

Table 5.1 Summary of Environmental Impacts

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
Air Quality Impact					
Construction Impact					
Representative existing residential, commercial developments and government uses within 500m from the boundary of the Project Site	TSP • The highest 1-hr average conc.: 135 – 1165 µg/m^3 RSP • 10th highest 24-hr average conc: 62 – 128 µg/m^3 • Annual average: 26 – 53 µg/m^3 FSP • 19th highest 24-hr average conc: 30 – 44 µg/m^3 • Annual average: 14 – 19 µg/m^3	• Annexes 4 and 12 of the EIAO-TM TSP 1-hr average conc.: 500 µg/m^3 • Air Quality Objectives (AQO) RSP • 24-hr average conc.: 100 µg/m^3 (Number of exceedances allowed: 9) • Annual average conc.: 50 µg/m^3 FSP • 24-hr average conc.: 50 µg/m^3	TSP • The highest 1-hr average conc.: Exceedances of EIAO-TM TSP criterion up to 665 µg/m^3 RSP • 10th highest 24-hr average conc: Exceedances of AQO up to 28 µg/m^3 • Annual average: Exceedances of AQO up to 3 µg/m^3 FSP • 19th highest 24-hr average conc: No exceedance was predicted • Annual average: No exceedance was predicted	Watering once every 2 hours on work areas, exposed surface and unpaved road to reduce dust emission. Provide sealed door and dust collector with dust removal efficiency of at least 80% at the opening of tunnel mined by drill and break. Dust suppression measures and good site practices • Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather. • Use of frequent watering for particularly dusty construction areas and areas close to ASRs. • Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering shall be applied to aggregate fines. • Open stockpiles shall be avoided or covered. Where possible, prevent	• No adverse residual impacts anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
		(Number of exceedances allowed: 18) • Annual average conc.: 25 µg/m^3		placing dusty material storage piles near ASRs. • Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations. • Establishment and use of vehicle wheel and body washing facilities at the exit points of the site. • Provision of wind shield and dust extraction units or similar dust mitigation measures at the loading area of barging point, and use of water sprinklers at the loading area where dust generation is likely during the loading process of loose material, particularly in dry seasons/ periods. • Provision of not less than 2.4m high hoarding from ground level along site boundary where adjoins a road, streets or other accessible to the public except for a site entrance or exit. • Imposition of speed controls for vehicles on site haul roads. • Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs. • Implementation of an environmental monitoring and auditing program to monitor the construction process in order to enforce controls and modify	

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
				method of work if dusty conditions arise.	
Operation Impact					
Existing and planned residential, commercial developments and government uses within 500m from the boundary of the Project Site	NO_2 • 19th highest 1-hr average conc.: 91–135 µg/m3 • Annual average conc.: 16– 34 µg/m3 RSP • 10th highest 24-hr average conc: 61 – 64 µg/m3 • Annual average: 26 – 27 µg/m3 FSP • 19th highest 24-hr average conc: 30 – 33 µg/m3 • Annual average: 14 – 15 µg/m3	• AQO NO_2 • 1-hr average conc.: 200 µg/m3 (Number of exceedances allowed: 18) • Annual average conc.: 40 µg/m3 RSP • 24-hr average conc.: 100 µg/m3 (Number of exceedances allowed: 9) • Annual average conc.: 50 µg/m3 FSP • 24-hr average conc.: 50	NO_2, RSP and FSP • No exceedance was predicted	• No mitigation measure is required.	• No adverse residual impacts anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
		µg/m^3 (Number of exceedances allowed: 18) • Annual average conc.: 25 µg/m^3			
Noise Impact					
Construction Airborne Noise Impact					
Representative residential developments and education institution within 300m from the boundary of the Project Site	• 62 – 91 dB(A)	• Annexes 5 and 13 of the EIAO-TM • $Leq_{(30\ min)}$ 75dB(A) at 1m from the façade of residential dwellings • $Leq_{(30\ min)}$ 70dB(A) at 1m from the façade of Educational Institutions and 65 dB(A) during examinations	• Exceedance of the noise criteria by up to 16 dB(A)	• Use of Quality Powered Mechanical Equipment • Use of Movable Noise Barrier, Purpose-built Noise Barrier, Noise Insulating Fabric and Noise Enclosure • Sequencing Operation of Construction Activates at critical works area • Reduction of PME at critical works area • Avoid to carry out particularly noisy construction activities during examination periods • Good site practices - Only well-maintained plant should be operated on site and plant should be serviced regularly. - Silencers or mufflers on construction plant should be utilized and should be properly maintained.	• No adverse residual impacts anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
				- Mobile plant should be sited as far away from sensitive uses as possible. - Machines and plant that may be in intermittent use should be shut down between works periods or should be throttled down to a minimum. - Plant known to emit noise strongly in one direction should, where possible, be orientated so that noise is directed away from the nearby sensitive uses. - Material stockpiles and other structures should be effectively utilized to screen noise from on-site construction activities.	
Construction Ground-borne Noise Impact					
Representative residential developments within 300m from the boundary of the Project Site	• 49 – 58 dB(A)	• $Leq_{(30\ min)}$ 65dB(A)	• No exceedance predicted	• No mitigation measure required	• No adverse residual impacts anticipated.
Operation Impact					
Representative existing and planned residential developments within 300m from the	<u>Road Traffic Noise Impact</u> • Predicted overall noise levels: 52 – 86 dB(A) • Predicted road traffic noise levels of the Project roads: <10 – 83 dB(A)	<u>Road Traffic Noise</u> • Annexes 5 and 13 of the EIAO-TM • EIAO-GN	<u>Road Traffic Noise</u> • Exceedance of the noise criteria by up to 16 dB(A) • The exceedances are	<u>Road Traffic Noise</u> • Provision of polymer modified friction course (PMFC) (i.e. a type of low noise road surfacing) as standard surfacing material	• No adverse residual impacts anticipated.

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
boundary of the Project Site	• Maximum contribution from Project roads (when the overall noise level exceeds respective criterion): 23.3 dB(A) <u>Fixed Noise Sources Impact</u> • Predicted noise level: 55 dB(A)	12/2010 • $L_{10(1\ hour)}$ 70dB(A) at 1m from the façade of residential dwellings • $L_{10(1\ hour)}$ 65dB(A) at 1m from the façade of educational institute and place of worship <u>Fixed Noise Sources Impact</u> • Annexes 5 and 13 of the EIAO-TM • IND-TM under Noise Control Ordinance • $L_{eq\ (30\text{-}min)}$ 65 dB(A) during day and evening time • $L_{eq\ (30\text{-}min)}$ 55 dB(A) during night-time	dominantly contributed by the other existing roads. <u>Fixed Noise Sources Impact</u> • No exceedance predicted.	• Provision of a total of 170m long vertical barrier, 240m long cantilever noise barriers, and 1300m long semi-enclosure on Project Road sections. <u>Fixed Noise Sources Impact</u> • No mitigation measure required.	
Water Quality Impact					
Construction Impact					

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
Representative water sensitive receivers in the vicinity of the Project and within 500m from the boundary of the Project, covers the Tolo Harbour and Channel WCZ as well as the Victoria Harbour WCZ as designated under the WPCO	The potential sources of water quality impact associated with the construction works would include: • Wastewater from general construction activities; • Construction site run-off; • Sewage from construction workforce; • Accidental spillage of chemicals; • Groundwater infiltration arising from tunnel boring; • Water pollution from culvert modification works; • Construction works in close proximity of inland watercourses; and • Groundwater from Contaminated Areas and Contaminated Site Runoff.	• Annexes 6 and 14 of the EIAO-TM • Water Quality Objectives for the Victoria Harbour (Phase Two) Water Control Zone (WCZ), Tolo Harbour and Channel WCZ and Tolo Harbour Supplementary WCZ • Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS) • Practical Note for Professional Persons (ProPECC) PN 1/94 and 5/93 • Hong Kong	• N/A	• Mitigation measures and good site practices in ProPECC PN 1/94 "Construction Site Drainage" • Waste Disposal Ordinance • Provision of temporary sanitary facilities, such as chemical toilets, for construction workforce • Precaution measures in ETWB Technical Circular (Works) No. 5/2005 • Groundwater infiltration minimisation strategies and post-grouting • Proper interception and treatment of contaminated site runoff and wastewater from land decontamination in compliance with the TM-DSS • Proper treatment or recharge of contaminated groundwater in compliance with the TM-DSS	• No adverse residual impacts anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
		Planning Standards and Guidelines • Environmental, Transport and Works Bureau (ETWB) Technical Circular (Works) No. 5/2005			
Operation Impact					
• Representative water sensitive receivers in the vicinity of the Project and within 500m from the boundary of the Project, covers the Tolo Harbour and Channel WCZ as well as the Victoria Harbour WCZ as designated under the WPCO	Potential water quality impacts associated with the operation phase include: • Non-point source surface run-off from road/bridge/viaduct; • Sewage effluent from the new administration building and ventilation buildings; • Wastewater generated from washing and maintenance operation; and • Tunnel run-off and drainage	• Annexes 6 and 14 of the EIAO-TM • Water Quality Objectives for the Victoria Harbour (Phase Two) WCZ, Tolo Harbour and Channel WCZ and Tolo Harbour Supplementary WCZ • Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland	• N/A	• Adequate design in on-site STP adopted MBR with UV disinfection, an emergency storage tank with 2 hours of ADWF capacity and grease trap for sewage and wastewater generated from administration building which designed with reference to EPD's "Guidelines for the Design of Small Sewage Treatment Plant" • Provision of dual or standby power supply, standby sewage treatment units, flow sensors and alarm systems for the on-site STP. • Provision of spare parts such as electrical and mechanical components of the on-site STP in case of break down / emergency. • Adequate design in septic tank with soakaway system and active carbon filter for sewage and wastewater generated from ventilation buildings	• No adverse residual impacts anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
		and Coastal Waters (TM-DSS) • ProPECC PN 5/93 • Guidelines for the Design of Small Sewage Treatment Plant		which take into account the guidelines in ProPECC PN 5/93. • Adequate design in on-site STP, petrol interceptor and sedimentation tank for wastewater generated from washing and maintenance operation. • Regular test, maintenances and replacement of membranes or equipment to maintain a good operation condition. • Regular maintenance to all wastewater treatment system, including the on-site STP, septic tank with soakaway system, grease traps, active carbon filter system, petrol interceptor, sedimentation tank, etc.	
Waste Management Implications					
Construction Impact					
C&D materials, chemical wastes and general refuse	• Around 107,044 m^3 of non-inert C&D materials and 1,338,050 m^3 of inert C&D materials will be generated from tunnelling works, excavation, site formation works, construction of adits, ventilation/shafts buildings and new administration building and demolition of the existing administration building. • Small quantity of chemical wastes in the order of a few cubic metres per month will be generated from plant operations and maintenance, maintenance of mechanical equipment and potential asbestos	• Annexes 7 and 15 of the EIAO-TM • Waste Disposal Ordinance (Cap. 354) • Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C) • Waste Disposal	• N/A	• Implementation of good site practices, waste reduction measures and proper storage, collection and transport of waste	• No adverse residual impact anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
	waste from demolition of existing administration building. • Around 325 kg per day of general refuse will be generated from construction works and on-site staff and workers	(Charges for Disposal of Construction Waste) Regulation (Cap. 354N) • Land (Miscellaneous Provisions) Ordinance (Cap. 28) • Public Health and Municipal Services Ordinance (Cap. 132BK) – Public Cleansing and Prevention of Nuisances Regulation • Air Pollution Control Ordinance (APCO)			
Operation Impact					
Screening & grits, sludge, chemical wastes and general refuse	• Small quantity of chemical wastes in the order of a few cubic metres per month will be generated from maintenance of facilities and equipment • Around 97.5 kg per day of general refuse will be generated from on-site	• Annexes 7 and 15 of the EIAO-TM • Waste Disposal Ordinance (Cap. 354) • Waste Disposal	• N/A	• Implementation of waste reduction measures and proper storage, collection and transport of waste	• No adverse residual impact anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
	staff and office activities • The total quantity of screening and grits generated from the on-site STP is expected to be less than 0.01 m^3/day • About 1m^3/day of sewage sludge will be generated from the on-site STP	(Chemical Waste) (General) Regulation (Cap. 354C) Public Health and Municipal Services Ordinance (Cap. 132BK) – Public Cleansing and Prevention of Nuisances Regulation			
Land Contamination					
Onsite construction workers and future occupants	• A total of 11 facilities / areas were identified with potential land contamination concerns at the tunnel portal areas within the Project Area.	• Annex 19 of the EIAO-TM • Guidance Note for Contaminated Land Assessment and Remediation (EPD, 2007) • Practice Guide for Investigation and Remediation of Contaminated Land (EPD, 2011) • Guidance	• N/A	• A sampling and testing programme, targeting the potential hotspots identified within the Project Area, had been proposed. • Site re-appraisal should be carried out for the whole Project Area at a later stage of the Project in order to address any new contamination issues caused by the (i) changes in operation of the identified potentially contaminated site and (ii) changes in land use within the Project Area. The submission of supplementary CAP(s), associated SI works and any necessary remediation should be carried out at the concerned facilities and any new contaminated area identified in the site re-appraisal, prior	• No adverse residual impact anticipated.

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
		Manual for Use of Risk-based Remediation Goals for Contaminated Land Management (EPD, 2007)		to the commencement of construction at the potentially contaminated area(s). The further assessment and remediation works would follow EPD's prevailing guidelines. • Any soil / groundwater contamination would be identified and properly treated prior to the construction works.	
Ecological Impact (Terrestrial)					
Construction Impact					
Natural/Semi-natural habitats including woodland, mixed woodland, shrubland and the associated wildlife (including species of conservation importance)	• Permanent loss (14.80 ha) and temporary loss (2.75 ha) of habitats • Affect about 0.16 ha woodland, 0.17 ha plantation, less than 0.01 ha modified watercourse and 0.81 ha developed area located at the LRCP permanently • Potential impact to four flora species of conservation importance (including one individual of Incense Tree, nine individuals of Butulang Canthium, 19 individuals of Ailanthus and nine individuals Rhodoleia) recorded within the Project footprint • Potential direct injury/mortality to wildlife and bird collision • Indirect disturbance impact (e.g. dust, noise, glare, site runoff, groundwater infiltration) on natural habitats and associated wildlife in the vicinity	• Annexes 8 and 16 of the EIAO-TM • EIAO Guidance Notes Nos. 3/2010, 6/2010, 7/2010 and 10/2010	• N/A	• Avoidance of encroachment on recognised sites of conservation importance (i.e. LRCP (about 197 ha) and Beacon Hill SSSI (about 34 ha)) within the assessment area as far as possible • Carefully design the detailed layout of the construction works to avoid/minimise direct impact on flora species of conservation importance recorded in the project footprint. If direct impact is unavoidable, mitigation measures to (e.g. transplant, compensate) the flora species of conservation importance should be conducted, where possible, according to Final Plant Preservation and Transplantation Proposal to be submitted at later stage	• No adverse residual impact anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
				• Reinstatement of temporarily affected area within the Project footprint (about 1.48 ha), including those within LRCP (about 0.25 ha), by woodland mix planting according to the Final Reinstatement Plan to be submitted at later stage • Direct impact on fauna species of conservation importance and their key habitats are avoided. Precautionary measure such as a pre-construction survey in natural habitats within and in the surrounding of the Project footprint is recommended (e.g. woodland, mixed woodlands and natural watercourse within and near the Project footprint) prior to the commencement of construction activities. In case any fauna species of conservation importance recorded would be directly impacted, a Protection and Translocation Proposal should be prepared to recommend suitable mitigation measures at later stage. • Compensate the unavoidable loss of woodland within Lion Rock Country Park (LRCP) (0.25 ha) by provision of compensation woodland in a ratio not less than 1:1 in terms of area (at least 0.25 ha) in accordance with the Final	

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
				Woodland Compensation Plan to be submitted at later stage • Implementation of good site practices (e.g. provision of screening, control of glare / lighting, groundwater infiltration minimization measures, etc), regular site inspection and monitoring requirement • Implementation of groundwater infiltration minimization measures (e.g. groundwater control strategies, post-grouting) as stated in the Water Quality Section above • Adoption of NTHMMs with smaller footprint (rigid barriers and flexible barriers) to avoid and minimize the potential impacts to LRCP, natural habitats and associated vegetation	
Operation Impact					
Natural/Semi-natural habitats including woodland, mixed woodland, shrubland and the associated wildlife (including species of conservation importance)	• Disturbance impacts (e.g. dust, noise, glare) to the natural/semi-natural habitats and the associated wildlife (including species of conservation importance) in the vicinity of Project site • Direct mortality (e.g. road kill) and bird collision	• Same as construction phase	• N/A	• Implementation of mitigation measures (e.g. planting of peripheral screening plants/vertical green, control of glare / lighting) measures • Carefully design the noise barrier (e.g. location, use of tinted materials and superimposing dark patterns or strips on the noise barrier)	• No adverse residual impact anticipated
Cultural Heritage Impact					
Construction Impact					

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
Cultural heritage resources, Site of Archaeological Interest	• Indirect impacts of ground-borne vibration, settlement and tilting would be anticipated on the Ex Beacon Hill Tunnel (Government Historic Site) • Direct impact would be anticipated to the two Lion Rock tunnels and associated buildings	• EIAO-TM Annexes 10 and 19 • Guidelines for Cultural Heritage Impact Assessment • Antiquities and Monuments Ordinance (A&MO) (Cap.53)	• N/A	• As a precautionary measure, AMO should be informed immediately in case of discovery of antiquities or supposed antiquities in the course of works, so that appropriate mitigation measures, if needed, can be timely formulated and implemented in agreement with AMO <u>Monitoring of vibration, settlement and tilting</u> • Monitoring of vibration, settlement and tilting incorporated with a set of Alert, Alarm and Action (AAA) system shall be employed for Ex Beacon Hill Tunnel during the construction phase, measuring inside the tunnel tube at locations closest to the proposed construction works. • Monitoring proposal should be submitted to AMO for agreement before commencement of works. • Records of monitoring should be submitted regularly to AMO. • AMO should be alerted in case any irregularities are observed. <u>Pre and post condition survey</u> • Pre and post condition survey of Ex Beacon Hill Tunnel (Government Historic Site) should be conducted by professional qualified building surveyor or engineer.	• No adverse residual impact anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
				• Survey results shall be submitted to AMO for record. <u>Adopt similar fonts of the name of the tunnel and colour scheme of associated buildings</u> • Fonts on both sides of the portals of the two tunnels should be kept or replicated and placed on similar position as the current setting • The colour scheme of associated buildings could be adopted to the new administrative buildings in order to maintain the original sentiment. • The two commemorative plaques marking the opening ceremony of the tunnel should be kept at prominent position at the new administrative buildings visible to all guests. <u>Conduct detailed photographic recording</u> • Detailed photographic recording on the Lion Rock Tunnel and its associated buildings (both exterior and interior) should be conducted before any works to commence. A copy of the photographic documentation should be provided to AMO for record.	
Operation Impact					
Cultural heritage resources, Site of Archaeological Interest	• No adverse impact would be anticipated on both built heritages and archaeology during the operational phase.	• EIAO-TM Annexes 10 and 19 • Guidelines for Cultural	• N/A	• No mitigation measure would be required	• No adverse residual impact anticipated

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
		Heritage Impact Assessment			
Landscape and Visual Impacts					
Construction Impact					
Landscape Resources (LRs)	• Substantial landscape impact on LR-3.2 (Vegetation on Roadside Engineered Slopes from Tai Wai to Sha Tin Tau) • Moderate landscape impact on LR-1.1 (Vegetation on Natural Terrain), LR-1.2 (Vegetation in Village Areas near Kak Tin), LR-3.1 (Vegetation on Roadside Engineered Slopes in Kowloon Tong), LR-3.3 (Vegetation in Other Roadside Areas) and LR-4.2 (Lung Cheung Road Park) • Slight landscape impact on LR-6.1 (Vegetated Areas in Service Reservoirs and Associated Landscape Areas in Kowloon Side) and LR-6.3 (Vegetated Areas in Fenced-off Area (e.g. vacant land, construction site)) • No discernible change in other LRs identified within the study boundary of the Project	• Annexes 10 and 18 of the EIAO-TM • EIAO-GN 8/2010 (Preparation of LVIA under the Environmental Impact Assessment Ordinance)	• N/A	• Preservation of Existing Vegetation • Control of Night-time Lighting Glare • Erection of Decorative Screen Hoarding • Management of Construction Activities and Facilities • Reinstatement of Temporarily Disturbed Landscape Areas • Minimize the Direct Conflict with Lion Rock Country Park • Minimize Disturbance on Watercourses	• Moderate residual landscape impact on LR-1.1, LR-1.2, LR-3.1, LR-3.2, LR-3.3 and LR-4.2 • No discernible change in other LRs identified within the study boundary of the Project
Landscape Character Areas (LCAs)	• Substantial landscape impact on LCA-1.2 (Tai Wai Lion Rock Upland and Hillside LCA) and LCA-5.2 (Hung Mui Kuk to Sha Tin Tau Residential Urban LCA)	• Annexes 10 and 18 of the EIAO-TM • EIAO-GN 8/2010	• N/A	• Preservation of Existing Vegetation • Control of Night-time Lighting Glare • Erection of Decorative Screen Hoarding	• Moderate residual landscape impact on LCA-1.1, LCA-1.2, LCA-1.3, LCA-1.4, LCA-2.1, LCA-

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
	• Moderate landscape impact on LCA-1.1 (Kowloon Tong Lion Rock Upland and Hillside LCA), LCA-1.3 (Sha Tin Tau Lion Rock Upland and Hillside LCA), LCA-1.4 (Kowloon Tong Urban Fringe Upland and Hillside LCA), LCA-2.1 (Kowloon Tong Transportation Corridor LCA), LCA-2.2 (Tai Wai LRT Road Transportation Corridor LCA), LCA-3.2 (Tei Lung Hau Miscellaneous Urban Fringe LCA) and LCA-5.1 (Tai Wai Residential Urban LCA) • Slight landscape impact on LCA-4.1 (Kowloon Tong Residential Urban Fringe LCA) • No discernible change in other LCAs identified within the study boundary of the Project	(Preparation of LVIA under the Environmental Impact Assessment Ordinance)		• Management of Construction Activities and Facilities • Reinstatement of Temporarily Disturbed Landscape Areas • Minimize the Direct Conflict with Lion Rock Country Park • Minimize Disturbance on Watercourses	2.2, LCA-3.2, LCA-5.1 and LCA-5.2 • Slight residual landscape impact LCA-4.1 • No discernible change in other LCAs identified within the study boundary of the Project
Visually Sensitive Receivers (VSRs)	• Substantial visual impact on R-03, R-04, R-07, I-01, O-04 and T-02 • Moderate visual impact on R-02 and R-06 • Slight visual impact on R-01, R-10, O-01, O-03, T-01, T-03 and T-05 • Insubstantial visual impact on other VSRs	• Annexes 10 and 18 of the EIAO-TM • EIAO-GN 8/2010 (Preparation of LVIA under the Environmental Impact Assessment Ordinance)	• N/A	• Preservation of Existing Vegetation • Control of Night-time Lighting Glare • Erection of Decorative Screen Hoarding • Management of Construction Activities and Facilities • Reinstatement of Temporarily Disturbed Landscape Areas • Minimize the Direct Conflict with Lion Rock Country Park	• Moderate residual visual impact on R-02, R-03, R-04, R-06, R-07, I-01, O-04 and T-02 • Slight residual visual impact on R-01, R-10, O-01, O-03, T-01, T-03 and T-05 • Insubstantial residual visual impact on other VSRs

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
Operation Impact					
Landscape Resources (LRs)	• Substantial landscape impact on LR-3.2 (Vegetation on Roadside Engineered Slopes from Tai Wai to Sha Tin Tau) • Moderate landscape impact on LR-1.1 (Vegetation on Natural Terrain), LR-1.2 (Vegetation in Village Areas near Kak Tin), LR-3.1 (Vegetation on Roadside Engineered Slopes in Kowloon Tong), LR-3.3 (Vegetation in Other Roadside Areas) and LR-4.2 (Lung Cheung Road Park) • Slight landscape impact on LR-6.1 (Vegetated Areas in Service Reservoirs and Associated Landscape Areas in Kowloon Side) and LR-6.3 (Vegetated Areas in Fenced-off Area (e.g. vacant land, construction site)) • No discernible change in other LRs identified within the study boundary of the Project	• Annexes 10 and 18 of the EIAO-TM • EIAO-GN 8/2010 (Preparation of LVIA under the Environmental Impact Assessment Ordinance)	• N/A	• Compensatory Tree Planting (min. 145 heavy standard trees) for Loss of approximate 2,925 nos. of Existing Trees • Compensatory Woodland Mix Planting (7,720m.sq.) within site (about 2,070 tree whips) and provision of off-site compensation woodland (about 0.3 ha or 1,200 native seedlings/whip trees) • Aesthetically pleasing design of Aboveground Structures • Aesthetically pleasing design of Highways Structures and Slope Associated Structures • Aesthetically pleasing design of footbridges, noise barriers and noise enclosures • Provision of Green Roof • Provision of Buffer Planting / Roadside Planting • Greening Works on Slopes and associated structures	• Slight residual impact during day 1 of operation and insubstantial residual impact during year 10 of operation on LR-1.1, LR-1.2, LR-3.1, LR-3.2, LR-3.3 and LR-4.2 • Insubstantial residual impact during day 1 and year 10 of operation on other LRs
Landscape Character Areas (LCAs)	• Substantial landscape impact on LCA-1.2 (Tai Wai Lion Rock Upland and Hillside LCA) and LCA-5.2 (Hung Mui Kuk to Sha Tin Tau Residential Urban LCA) • Moderate landscape impact on LCA-	• Annexes 10 and 18 of the EIAO-TM • EIAO-GN 8/2010 (Preparation of	• N/A	• Compensatory Tree Planting (min. 145 heavy standard trees) for Loss of approximate 2,925 nos. of Existing Trees • Compensatory Woodland Mix Planting (7,720m.sq.) within site (about 2,070	• Slight residual impact during day 1 of operation and insubstantial residual impact during year 10 of operation on LCA-

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
	1.1 (Kowloon Tong Lion Rock Upland and Hillside LCA), LCA-1.3 (Sha Tin Tau Lion Rock Upland and Hillside LCA), LCA-1.4 (Kowloon Tong Urban Fringe Upland and Hillside LCA), LCA-2.1 (Kowloon Tong Transportation Corridor LCA), LCA-2.2 (Tai Wai LRT Road Transportation Corridor LCA), LCA-3.2 (Tei Lung Hau Miscellaneous Urban Fringe LCA) and LCA-5.1 (Tai Wai Residential Urban LCA) • Slight landscape impact on LCA-4.1 (Kowloon Tong Residential Urban Fringe LCA) • No discernible change in other LCAs identified within the study boundary of the Project	LVIA under the Environmental Impact Assessment Ordinance)		tree whips) and provision of off-site compensation woodland (about 0.3 ha or 1,200 native seedlings/whip trees) • Aesthetically pleasing design of Aboveground Structures • Aesthetically pleasing design of Highways Structures and Slope Associated Structures • Aesthetically pleasing design of footbridges, noise barriers and noise enclosures • Provision of Green Roof • Provision of Buffer Planting / Roadside Planting • Greening Works on Slopes and associated structures	1.1, LCA-1.2, LCA-1.3, LCA-1.4, LCA-2.1, LCA-2.2, LCA-3.2, LCA-4.1, LCA-5.1 and LCA-5.2. • Insubstantial residual impact during day 1 and year 10 of operation on other LCAs
Visually Sensitive Receivers (VSRs)	• Substantial visual impact on R-03, R-04, R-07, I-01, O-04 and T-02 • Moderate visual impact on R-02 and R-06 • Slight visual impact on R-01, R-10, O-01, O-03, T-01, T-03 and T-05 • Insubstantial visual impact on other VSRs	• Annexes 10 and 18 of the EIAO-TM • EIAO-GN 8/2010 (Preparation of LVIA under the Environmental Impact Assessment Ordinance)	• N/A	• Compensatory Tree Planting (min. 145 heavy standard trees) for Loss of approximate 2,925 nos. of Existing Trees • Compensatory Woodland Mix Planting (7,720m.sq.) within site (about 2,070 tree whips) and provision of off-site compensation woodland (about 0.3 ha or 1,200 native seedlings/whip trees) • Aesthetically pleasing design of Aboveground Structures	• Moderate residual impact during day 1 of operation and during year 10 of operation on VSRs R-04, R-07, I-01, O-04 and T-02 • Slight residual impact during day 1 of operation and during year 10 of operation on VSRs R-02 and O-03 • Slight residual impact during day 1

Sensitive Receivers / Assessment Points	Impact Prediction Results (Without Mitigation)	Key Relevant Standards/Criteria	Extents of Exceedance Predicted (Without Mitigation)	Impact Avoidance Measures / Mitigation Measures	Residual Impacts (After Implementation of Mitigation Measures)
				• Aesthetically pleasing design of Highways Structures and Slope Associated Structures • Aesthetically pleasing design of footbridges, noise barriers and noise enclosures • Provision of Green Roof • Provision of Buffer Planting / Roadside Planting • Greening Works on Slopes and associated structures	of operation and insubstantial residual impact during year 10 of operation on VSRs R-01, R-03, R-06, R-10, O-01, T-01, T-03 and T-05 • Insubstantial residual visual impact during day 1 and year 10 of operation on other VSRs
Hazard to Life					
Existing and planned population in the vicinity of the LPG Compound and Project	• The off-site individual risk level is far below 1×10^{-5} per year and the societal risk partially falls into the "ALARP" region	• Annex 4 of the EIAO-TM	• N/A	• No adverse impact is anticipated. Nonetheless, implementation of good safety practices during construction phase are recommended. These include: - Establishment of emergency response plans; - Safety/ emergency response training and drills for all personnel; and - Maintain the number of construction workers onsite to a minimum.	• No adverse residual impact anticipated