MOTT MACDONALD

MTR

Airport Railway Extended Overrun Tunnel

Project Profile

May 2023

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Mott MacDonald
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong
Kowloon
Hong Kong

T +852 2828 5757
mottmac.hk

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Project Profile

May 2023

Mott MacDonald Hong Kong Limited
registered in Hong Kong no. 236497

Contents

1 Basic Information 1
1.1 Project Title 1
1.2 Project Description 1
1.3 Project Proponent 2
1.4 Implementation Programme 2
1.5 Interactions with other Projects 3

2 Major Elements of the Surrounding Environment 4
2.1 Major Elements of the Surrounding Environment and Existing and/or Relevant Past Land Use(s) which affect the Project 4
2.2 Existing and Planned Sensitive Receivers 4

3 Possible Impact on the Environment 12
3.1 Possible Environmental Impacts during Construction Phase 12
3.2 Possible Environmental Impacts during Operation Phase 20

4 Environmental Protection Measures to be Incorporated in the Design and Further Environmental Implications 25
4.1 Construction Phase 25
4.2 Operation Phase 32
4.3 Environmental Monitoring and Audit 33
4.4 Any Further Implications 34

5 Use of Previously Approved EIA Reports 35

6 Conclusion 36

Tables

Table 1.1: Summary of Tentative Construction Programme 3
Table 1.2: Summary of Concurrent Project 3
Table 2.1: Representative Air Sensitive Receivers 4
Table 2.2: Ambient Air Quality from 2017 to 2021 at Central/Western AQMS 5
Table 2.3: Representative NSRs for Airborne Construction Noise 5
Table 2.4: Representative NSRs for Groundborne Construction Noise 6
Table 2.5: Representative NSRs for Groundborne Railway Noise 6
Table 2.6: Built Heritage Features Identified 7

Table 2.7: Pre-1969 Buildings Identified within 300m 7
Table 2.8: Sensitivity to Change of LRs 8
Table 2.9: Sensitivity to Change of LCAs 10
Table 2.10: Sensitivity to Change of VSRs 11
Table 3.1: Distance between the Representative NSRs and Construction Works Zone 15
Table 3.2: Estimated Amount of C&D Material to be Generated During Construction Phase 16
Table 3.3: Tentative Transportation Routings for Waste Disposal During Construction Phase 18
Table 3.4: Predicted Groundborne Railway Noise Levels (Unmitigated Scenario) 21
Table 3.5: Acceptable Noise Levels (ANLs) 21
Table 4.1 Landscape and Visual Mitigation Measures during Construction Phase 31
Table 4.2 Landscape and Visual Mitigation Measures during Operation Phase 33

Figures

Figure 1.1a Project Location
Figure 1.1b Figures for Temporary Works Areas
Figure 2.1 Air Quality Study Area and Sensitive Receiver
Figure 2.2a Noise Study Area and Sensitive Receivers (for Airborne Construction Noise)
Figure 2.2b Noise Study Area and Sensitive Receivers (for Groundborne Construction Noise)
Figure 2.2c Noise Study Area and Sensitive Receivers (for Groundborne Railway Noise)
Figure 2.3 Indicative Locations of Cooling Water Intakes
Figure 2.4 Locations of Declared Monuments and Built Heritage
Figure 2.5 Landscape Resource Plan
Figure 2.6 Landscape Character Area Plan
Figure 2.7 Visual Sensitive Receiver Plan
Figure 3.1 View Point Location Plan
Figure 3.2a Photomontage – VP1
Figure 3.2b Photomontage – VP2
Figure 3.2c Photomontage – VP3
Figure 3.2d Photomontage – VP4
Figure 4.1a Landscape Mitigation Plan (Sheet 1 of 2)
Figure 4.1b Landscape Mitigation Plan (Sheet 2 of 2)

Appendices

Appendix 1.1 Tentative Construction Programme of the Project and Locations of Working Zones

Appendix 2.1 Aerial Image for the LVIA Study Area and Site Photos for LRs and LCAs

Appendix 3.1 Indicative Decking Arrangement

Appendix 3.2 Selected Aerial Photos for Past Land Uses

Appendix 3.3 Site Reconnaissance Survey Detail of Project Site and Works Area

Appendix 3.4 Significance of Landscape and Visual Impact during Construction and Operation Phases with Mitigation Measures

Appendix 3.5 Visual Images Illustrating Decking Arrangements during Construction Phase

Appendix 3.6 Groundborne Noise Calculation

Appendix 4.1 Project Implementation Schedule

Appendix 4.2 Environmental Monitoring and Audit Programme

1 Basic Information

1.1 Project Title

Airport Railway Extended Overrun Tunnel (ARO)

1.2 Project Description

1.2.1 Purpose and Nature of the Project

The proposed ARO extends the Tung Chung Line (TCL) and Airport Express Line (AEL) underneath Lung Wo Road from the existing overrun tunnel with crossovers to the east of Hong Kong Station (HOK) to facilitate quicker train turnback, which will increase the passenger capacity and train operation efficiency of the two railways to meet future transportation needs. The structure for the ARO will be a multi-cell rectangular tunnel box to accommodate the running tracks for the TCL and the AEL.

1.2.2 Location and Scale of the Project (include plans) and History of Site

The project site is located along Lung Wo Road between Hong Kong Station and Central Barracks in Central District near Victoria Harbour, as shown in **Figure 1.1a**. The project site is located on reclaimed land which was completed in the 2010s. Since then, the project site has been used as roads and open area. A section of land on the north side of Lung Wo Road forms the Central Harbourfront Event Space. The western end of the project site is located within the MTR Protection Zone at HOK, and the eastern portion falls within the construction protection zones for Central Wanchai Bypass and sewage tunnel of The Harbour Area Treatment Scheme (HATS).

1.2.3 Proposed Addition, Modification or Alternation

To serve the Hong Kong International Airport at Chek Lap Kok and to improve the public transport in the Territory, it was proposed in the 1990's to construct the Lantau and Airport Railway (LAR) – now called AEL and TCL. The environmental impact study (EIS) for the LAR (EIA-029/BC) was submitted to the Environmental Protection Department (EPD) in 1994, i.e., before the Environmental Impact Assessment Ordinance (EIAO) came into operation on 1 April 1998. According to the EIS, apart from the AEL and the Lantau Line (i.e., existing TCL), overrun tunnels would also be constructed eastwards from the Hong Kong Station at a later stage (Section 2.2.1 of the LAR EIS). According to Section 2.3.2 of the LAR EIS, the construction of the overrun tunnels would be related to the construction of later stages of the Central and Wanchai Reclamation. As stated in Section 1.3.2.4 of the approved Environmental Impact Assessment (EIA) Report for Central Reclamation Phase III (CRIII) – Studies, Site Investigation, Design and Construction (Ref: AEIAR – 040/2001), the overrun tunnels are considered to be an integral part of the LAR, essential for train reversal and safety operation of the LAR; and that the key objective of the CRIII is to provide land for strategic transport structures, inter alia, the overrun tunnel. This proposed ARO project is to construct the overrun tunnel as referred to in both the LAR EIS and the EIA for CRIII.

The ARO comprising a proposed overrun tunnel to be located between east of the existing HOK along Lung Wo Road and a proposed Ventilation Building for supporting operation of ARO (ARB) will allow the AEL and TCL to operate at full design capacity. The proposed ARO is approximately 460m in length, 30m wide and reaching approximately -23.5mPD, in a multi-cell structure.

The ARB is proposed on the east end of the ARO, immediately west of the existing Lung Wui Road HSBC Building pumping station substation. The ARB is expected to be approximately +22m high with a 25m deep basement, which will be connected to the overrun tunnel. In **Figure 1.1a**, works site refers to the area where construction works, i.e., cut and cover works of the tunnel, construction of ventilation building, most of utilities diversion (e.g. electrical cable, drainage pipeline, sewage pipeline and telecommunication cable) including

Culvert F diversion and part of Temporary Traffic Management (TTM), will be conducted. Works area illustrated in **Figure 1.1a** refers to construction site offices, site access, material storage, rest of utilities diversion and/or TTM where their associated environmental impacts are not expected to be significant. Subject to land availability, other off-site works area (as shown in **Figure 1.1b**) will be used for material storage only, and is not expected to involve open storage nor stockpiling of dusty materials.

1.2.4 Material Change to an Exempted Project

The construction of LAR commenced in 1995 when the EIAO had not yet come into effect during the planning and construction of the AEL and TCL.

Section 9(2) of the EIAO specifies that Designated Projects (DPs) in Part I of Schedule 2 that have commenced construction or been in operation before the Ordinance had come into operation are exempted and no environmental permits are required. As such, the LAR is an exempted DP.

Section 9(4) of the EIAO specifies that material change to an exempted project requires an EP under the Ordinance unless it is subsequently exempted. Material Change as defined in Schedule 1 of the EIAO means *a physical addition or alteration to a designated project which results in an adverse environmental impact as defined in the technical memorandum.* Section 6.1 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) issued under the EIAO has listed out the circumstances of changes that are considered as material change. The proposed ARO is considered to constitute material changes to the exempted DP, i.e., the LAR, where the following circumstances under Section 6.1 of the EIAO-TM are considered applicable:

- *6.1 (a) a change to physical alignment, layout or design of the project causing an environmental impact likely to affect existing or planned community, ecologically important areas or sites of cultural heritage;*
- *6.1 (c) an increase in pollution emissions or discharges or waste generation likely to violate guidelines or criteria in this technical memorandum without mitigation measures in place;*
- *6.1 (e) a change resulting in physical works that are likely to affect a rare, endangered or protected species, or an important ecological habitat, or a site of cultural heritage.*

This Project Profile has been prepared for direct application of an environmental permit for the material changes to the exempted DP, i.e., the LAR, under Section 5(10) of the EIAO.

1.3 Project Proponent

1.3.1 Name of Project Proponent

MTR Corporation Limited (MTRCL)

1.3.2 Name and Telephone Number of Contact Person

Name of Contact Person: Mr. Alex Siu

Telephone Number of the Contact Person: 2688 1283

1.4 Implementation Programme

The Project is expected to commence construction in Q1 2025 and finish by Q4 2030. The installation and test of the operation system will be conducted from Q1 2031 and the operation of the Project is proposed to commence by Q4 2032. The tentative construction programme of the Project is summarised in **Table 1.1** below and details are shown in **Appendix 1.1**. Major construction works are expected to involve tunnel construction using cut and cover method, superstructure construction, and reinstatement of roads and pedestrian footpath.

Table 1.1: Summary of Tentative Construction Programme

Activities	Tentative Programme
TTM implementation, traffic decking and utility diversion	Q1 2025 to Q4 2030
Site setup and hoarding	Q3 2025 to Q4 2025
Installation of diaphragm wall and associated works [1]	Q4 2025 to Q3 2027
Bulk excavation works [2]	Q4 2026 to Q3 2028
Tunnel/building structure, backfilling and associated works	Q3 2027 to Q4 2029
Electrical and Mechanical (E&M) works	Q3 2028 to Q4 2030

Notes:
[1] Zone B2 includes Culvert F diversion and associated works
[2] Bulk excavation works will be conducted in different zones, namely, Zone A, Zone B1, Zone B2, Zone C1, Zone C2 and Zone ARB (see **Appendix 1.1**).

1.5 Interactions with other Projects

Based on the available information at the time of preparing this Project Profile, one potential concurrent project has been identified within 500m of the Project Site boundary, namely the New Central Harbourfront Site 3, with its location illustrated in **Figure 1.1a**. Details of the concurrent project which may have construction phase interaction with the project are summarized in **Table 1.2**.

Table 1.2: Summary of Concurrent Project

Project Name	Project Description	Tentative Construction Period	Potential Cumulative Impacts
New Central Harbourfront Site 3	The site is approximately 47,967m^2 in size and is currently zoned as "Comprehensive Development Area" under the approved Central District (Extension) Outline Zoning Plan No. S/H24/9. The site will be developed into a comprehensive commercial development mainly for office and retail uses in building blocks with a continuous landscaped deck (incorporated with amphitheatre) from Statute Square to Central Piers, across Lung Wo Road and Yiu Sing Street (landscape area). The Site 3 development is tentatively separated into 2 sites and phases, namely, Site 3A and Site 3B.	Site 3A: Q2 2022 – end of 2026 Site 3B: start of 2027 – end of 2031	Air quality Noise

2 Major Elements of the Surrounding Environment

2.1 Major Elements of the Surrounding Environment and Existing and/or Relevant Past Land Use(s) which affect the Project

The Project site is located in Central, which is an urban area with majority business and commercial development and leisure facilities near the harbourfront. The existing HOK along Lung Wo Road was constructed within land that was reclaimed in last two decades.

2.2 Existing and Planned Sensitive Receivers

2.2.1 Air Quality

The study area for air quality assessment covered an area of 500m distance from the Project Site boundary as indicated in **Figure 2.1**. The representative Air Sensitive Receivers (ASRs) identified with the study area are listed in **Table 2.1** and presented in **Figure 2.1**.

Table 2.1: Representative Air Sensitive Receivers

ASR	Description	Uses [1]	Existing/Planned	Nearest Horizontal Distance from Works Site Boundary [3]
A1 [2]	Waterfront Area near Central Piers	Rec	Existing	~40m
A2 [2]	The Tamar Cultural Plaza	Rec	Existing	~50m
A3	Central Barracks Amethyst Block	R	Existing	~20m
A4	Central Barracks Blake Block	R	Existing	~20m
A5	City Gallery	G/IC	Existing	~20m
A6	Hong Kong City Hall	G/IC	Existing	~40m
A7 [2]	New Central Harbourfront Site 3 development - Site 3A	Rec	Planned (to be completed by end of 2026)	~15m
A8	New Central Harbourfront Site 3 development - Site 3A	C	Planned (to be completed by end of 2026)	~20m

Notes:
[1] R- Residential; Rec – Recreational; G/IC – Government, Institutional and Community; C – Commercial.
[2] Passive recreational uses.
[3] Distances are measured from the nearest building blocks/structures.

For ASR A7, its nearest horizontal distance from the open area of proposed piazza of Site 3A has been identified as the worst case scenario.

As mentioned in **Section 1.5**, the construction of New Central Harbourfront Site 3B is expected to complete by the end of 2031. As the construction of ARO Project will also be completed by Q4 2030, there will be no construction impact upon the Site 3B, hence it has not been identified as a representative ASR during construction stage.

The nearest EPD air quality monitoring station from the Project is the Central Air Quality Monitoring Station (AQMS) at about 300m away but it is a roadside monitoring station at a heavily trafficked junction which is not representative to the condition of the Project site. Central/Western AQMS, the urban type AQMS at 1.5km west of the Project site has therefore been selected to be a more representative monitoring station. The latest 5 years of air quality data of most concerned air pollutants of EPD's Central/Western AQMS are summarised in **Table 2.2** to depict the trend of the localised air quality.

Table 2.2: Ambient Air Quality from 2017 to 2021 at Central/Western AQMS

Pollutant	Averaging Time	AQO Conc. Limits (µg/m^3)	No. of Exceedances Allowed	Conc. (µg/m^3)					Remark
				2017	2018	2019	2020	2021	
SO_2	10-min	500	3	125	135	62	31	51	4th highest
	24-hr	50	3	29	22	12	9	10	4th highest
NO_2	1-hr	200	18	164	159	153	128	149	19th highest
	Annual	40	NA	40	39	37	32	33	NA
PM_{10}	24-hr	100	9	84	70	69	60	65	10th highest
	Annual	50	NA	35	34	30	25	26	NA
$PM_{2.5}$	24-hr	50	35	40	34	33	29	27	36th highest
	Annual	25	NA	23	21	20	16	16	NA

Note: NA: Not Applicable; na: not available; Bold concentrations indicate exceedance of air quality objectives

The historical ambient air quality in vicinity of the Project complied with the Air Quality Objectives (AQOs). As shown in **Table 2.2**, concentrations of key pollutants have been generally decreasing from 2017 to 2021.

2.2.2 Noise

The Project site is located in Central which is an urban area with majority business and commercial development and leisure facilities near the harbourfront. Connaught Road Central to the south of the Project site has an annual average daily traffic flow (AADT) of 98,640 (station no. 1030) according to the Annual Traffic Census 2021, which is three times than the standard of an Influencing Factor (i.e. 30,000 AADT) in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM).

Prevailing background noise measurement was conducted near the Central Barracks. The prevailing background noise levels ranged from 61-66dB(A) during day and evening time, and 56-61 dB(A) during night-time.

2.2.2.1 Noise Sensitive Receivers for Airborne Construction Noise

The representative Noise Sensitive Receivers (NSRs) identified within area of 300m distance from the Project Site boundary in accordance with Annex 13 of the EIAO-TM for airborne construction noise is summarised in **Table 2.3** below and illustrated in **Figure 2.2a**.

Table 2.3: Representative NSRs for Airborne Construction Noise

NSR ID [1][2]	Description	Uses	Existing/Planned	Nearest Horizontal Distance from Works Site Boundary
CN1	New Central Harbourfront Site 3 development (Site 3A)	Amphitheatres [3]	Planned (to be completed by end of 2026)	~161m

Note:

[1] With reference to the approved EIA Report of Central-Wan Chai Bypass and Island Eastern Corridor Link (AEIAR-041/2001), the Chinese People's Liberation Army Forces (PLA) Headquarters (i.e. Central Barracks Blake Block and Central Barracks Amethyst Block) are already provided with air-conditioning. No adverse noise impacts to the indoor environment of the said buildings are anticipated. Hence, these buildings have not been identified for the airborne construction noise assessment.

[2] Based on the site observations, City Gallery and Hong Kong City Hall have been installed with air-conditioning and do not rely on opened window for ventilation. The noise standard as stipulated in Table 1 of EIAO-TM would not be applicable, and hence these buildings have not been identified for the airborne construction noise assessment.

[3] Based on the Explanatory Statement for Inland Lot No.9088, New Central Harbourfront Site 3 Development is mainly zoned "Comprehensive Development Area" (CDA), hotel, office and amphitheatre (performing art centre) will possibly be provided in the future Site 3 development. It is assumed that the hotel and office will be equipped with air-conditioning. According to the latest information from the developer, the amphitheatre will be located at the north of Site 3A. Site 3B will be completed by end of 2031 whereas construction of the ARO Project will be completed by Q4 2030. Site 3B will not be identified as a representative NSR during the construction phase.

2.2.2.2 Noise Sensitive Receivers for Groundborne Construction Noise

The representative NSRs for groundborne construction noise is summarised in **Table 2.4** below and illustrated in **Figure 2.2b**.

Table 2.4: Representative NSRs for Groundborne Construction Noise

NSR ID [2][3]	Description	Uses	Existing/Planned	Nearest Horizontal Distance from Proposed Overrun Tunnel and Ventilation Building [4]
GBN1	Central Barracks Amethyst Block	Residential	Existing	~43m
GBN2	Central Barracks Blake Block	Residential	Existing	~42m
GBN3	Hong Kong City Hall	Performing Art Centre	Existing	~60m
GBN4	New Central Harbourfront Site 3 development (Site 3A)	Performing Art Centre [1]	Planned (to be completed by end of 2026)	~37m

Note

[1] According to information provided from the developer, a theatre will be provided at Site 3A. Assume the theatre use in Site 3 (GBN4) is similar to the use of performing art centre.

[2] According to information provided from the developer, the amphitheatre of Site 3A would be located further away from the ARO compared to GBN4. Therefore, the amphitheatre is not considered as the representative NSR in the groundborne construction noise assessment.

[3] Site 3B construction will be completed by end of 2031. As construction of the ARO Project will be completed by Q4 2030, Site 3B will not be identified as a representative NSR during the construction phase.

[4] Since the potential groundborne construction noise sources would be the hydraulic breaker and pile rig, the use of said equipment would be mainly carried out at the proposed overrun tunnel and ventilation building. Hence, the distance is measured from the nearest building block/structure to the proposed overrun tunnel and ventilation building.

2.2.2.3 Noise Sensitive Receivers for Groundborne Railway Noise during Operation Phase

Representative NSRs in the vicinity, which may be affected during operation phase of the ARO is identified in **Table 2.5** below and illustrated in **Figure 2.2c**.

Table 2.5: Representative NSRs for Groundborne Railway Noise

NSR ID [4][5]	Description	Uses	Existing/Planned	Approximate Nearest Horizontal Distance	
				TCL	AEL
GBN1	Central Barracks Amethyst Block	Residential	Existing	~48m [1]	~48m [1]
GBN2	Central Barracks Blake Block	Residential	Existing	~45m [1]	~45m [1]
GBN3	Hong Kong City Hall	Performing Art Centre	Existing	~66m [1]	~66m [1]
GBN4	New Central Harbourfront Site 3 Development (Theatre 1 - Site 3A)	Performing Art Centre [6]	Planned	~45m [2]	~45m [2]
GBN5 [5]	New Central Harbourfront Site 3 Development (Theatre 2 - Site 3B)	Performing Art Centre [6]	Planned	~31m [2]	~28m [2][3]

Note

[1] Based on the layout information from the ARO Project Team.

[2] Based on the layout information from the ARO Project Team and the developer.

[3] As advised by ARO Project Team, the section of AEL alignment at GBN5 could be located closer to the GBN5.

[4] According to information provided from the developer, the amphitheatre of Site 3A would be located further away from the ARO compared to GBN4. Therefore, the amphitheatre is not considered as the representative NSR in the groundborne railway noise assessment.

[5] According to information provided from the developer, GBN5 will exist after completion of the ARO construction works.

[6] Assume the theatre use in Site 3 (GBN4 and GBN5) is similar to the use of performing art centre.

2.2.3 Water Quality

The water sensitive receivers (WSRs) identified within 500m study area are as below and indicative locations of cooling water intakes are shown in **Figure 2.3**.

- Cooling Water Intakes
  - C1 – MTR New South Intake
  - C2 – Princes's Building Group
  - C3 – HSBC & AIA Tower
  - C4 – Queensway Government Offices

2.2.4 Cultural Heritage

The Project site is formed on reclaimed land with a highly urbanised setting and is not expected to have any archaeological potential. The potential for marine archaeology is also limited as the surrounding seabed would have already been highly disturbed during reclamation. No cultural heritage features have been identified within the Project site. The following declared monuments are located near the Project Site as summarised in **Table 2.6** and their locations illustrated in **Figure 2.4**.

Table 2.6: Built Heritage Features Identified

ID	AMO ID	Name / Address	Grade	Approx. Nearest Horizontal Distance		
				from Works Area	from Works Site Boundary	from Proposed Overrun Tunnel
H1	DM132	Hong Kong City Hall, Edinburgh Place, Central [1]	Declared Monument	~0m	~22m	~44m
H2	DM102	The Cenotaph, Central	Declared Monument	~130m	~150m	~179m
H3	DM26	Old Supreme Court, 8 Jackson Road, Central	Declared Monument (exterior)	~202m	~220m	~251m

Note
[1] Measured from the City Hall boundary as per land registry plan which is shown in Figure 2.4.

Although the nearest declared monument, i.e., the Hong Kong City Hall, is located immediately next to the Works Area, there will be no direct encroachment onto the monument. Based on the available design information, the area immediately north of the monument is expected to be used for temporary traffic management (TTM) only, and no heavy machineries would be used.

Other cultural heritage resources and historic buildings or structures built in or before 1969 located within 300m of the Project Site have also been identified and are summarised in **Table 2.7**, with locations illustrated in **Figure 2.4**.

Table 2.7: Pre-1969 Buildings Identified within 300m

ID	Building Name	Address	Completion / Opening Date	Approx. Nearest Horizontal Distance from Works Site Boundary
B1	St George's Building	2 Ice House Street, Central	1969	~210m
B2	Mandarin Oriental Hong Kong	5 Connaught Road, Central	1963	~170m
B3	Prince's Building	10 Chater Road, Central	1965	~243m
B4	Grand Building	15-18 Connaught Road, Central	1963	~261m
B5	On Lok Yuen Building	25 Des Voeux Road, Central	1961	~286m

2.2.5 Ecology

The Project Site is in an entirely developed area in which the ecological value is very limited. Ecological feature is basically lacking in the Project Site, and it is an urban area with no feature that are specialized for wildlife use.

2.2.6 Landscape and Visual

The extent of Landscape Study Area covers the 100m distance from the Project Site as a baseline survey to identify existing Landscape Resources (LRs) and Landscape Character Areas (LCAs), and to assess the potential landscape impact during the construction and operation phases of the Project. The aerial image of the Landscape Study Area is shown in **Appendix 2.1**.

The baseline study of LRs that may be affected during the construction phase and operational phase, together with their sensitivity to change are described in **Table 2.8**. The locations of the LRs are shown in **Figure 2.5** and photo-views illustrating the LRs are shown in **Appendix 2.1**.

Table 2.8: Sensitivity to Change of LRs

LR ID.	Description	Sensitivity to Change (low/medium/high)
LR1	**Coastal Water** This LR includes the vast water body in Victoria Harbour between Hong Kong Island and Kowloon Peninsula. It is a modified landform harbour. Reclamations have been carried out on both shores since 1850s. Numerous studies have been commissioned by the government to improve the water quality and resolve the odour nuisance caused by the discharge of urban residual pollutants into the harbour. Regular ferry routes operate in the harbour. This LR has dominance among other LRs in scale and visual landscape. The sensitivity to change of this LR is considered to be medium.	Medium
LR2.1	**Amenity Landscape Area in Tamar Park** The amenity landscape area in Tamar Park has about 1.76 hectares comprises of large green carpet of lawn areas. There are young trees of common urban species including *Chukrasia tabularis*, *Michelia chapensis*. on the lawn-featured park and various shrubs species. The amenity landscape area provides medium degree of green buffers that enhances the overall landscape quality of the study area. As this LR is modified and could accommodate changes, the sensitivity to change of this LR is considered to be medium.	Medium
LR2.2	**Amenity Landscape Area in Harbourfront Promenade** The amenity landscape area along harbourfront is about 900m long, featured with trees, plantings, play area, lawn, and leisure angling facilities. There are strip plantings along the harbourfront with common shrub species like *Alpinia zerumbet* and *Schefflera arboricola*. The amenity landscape area provides medium degree of greenery that enhances the overall landscape quality of the study area. This LR is common in the region with medium landscape value. It has medium sensitivity to change in the regional context.	Medium
LR2.3	**Amenity Landscape Area in City Gallery** The amenity landscape area in City Gallery is mainly hard paved with a row of 5 nos. of *Araucaria heterophylla* of 12-15m tall and various shrub plantings. The amenity landscape area provides low degree of greenery to enhance the overall landscape quality of the study area. This LR is common in the region with medium landscape value and easy to accommodate in change. It has medium sensitivity to change in the regional context.	Medium

LR2.4	**Amenity Landscape Area in City Hall Memorial Garden** The amenity landscape area in City Hall Memorial Garden is mainly hard paved with some mature trees, shrub plantings and lawn area. The mature trees in the Memorial Garden has cultural significance in the context,.including the *Crateva unilocularis* and *Kigelia pinnata.* The amenity landscape area provides medium degree of greenery to enhance the overall landscape quality of the study area. This LR is common in the region with medium landscape value. It has high sensitivity to change in the regional context.	High
LR3	**Roadside Infrastructure Landscape** Roads and urban infrastructures refer to highways, flyovers, bridged highways, main roads, secondary roads, local distributors, car parks, stations, piers etc. with typical associated infrastructure includes lighting, signage, and all other necessities to facilitate the transportation within the study area. Significant roads and urban infrastructures include Lung Wo Road, Connaught Road Central, Man Yiu Street, Yiu Sing Street, the Hong Kong Station and the Central Ferry Piers. There are street trees planted at roadside planters and central dividers including common young species such as *Koelreuteria paniculate* and *Xanthostemon chrysanthus*. This LR is extremely common in the context of study area and easily accommodate changes. The sensitivity to change of the LR is low.	Low
LR4	**Urban Landscape Greenery** Urban landscape greenery comprised of planters scattered along or in between roads and pathways and pocket open spaces at commercial or institutional premises. Amenity tree and shrub planting, and/or recreational facilities are found in these open spaces. This LR is common and can easily accommodate changes, it is considered to have low sensitivity to change in the study area.	Low
LR5	**Vegetation in Construction Works Site on Lung King Street** This LR is currently a construction site mainly occupied by construction materials and machinery. 1 no. of tree, which is Aleurites moluccana, was found along the fence surround in construction site. This LR is common in the region with low landscape value. It has low sensitivity to change in the regional context.	Low

Several Landscape Character Areas (LCAs) that have been identified within 100m from the Project Site boundary are described in **Table 2.9**. The locations of the LCAs are indicated in **Figure 2.6** and the photographs of the LCAs are illustrated in **Appendix 2.1**.

Table 2.9: Sensitivity to Change of LCAs

LCA ID.	Description	Sensitivity to Change (low/medium/high)
LCA1	**Harbourfront Landscape** This LCA is featured with a continuous promenade with various facilities for leisure activities with a prominent view to the vast water body. Regular ferry routes operate in the harbour, which is a major tourist attraction of the city. It is a high-quality landscape character to the district.	Medium
LCA2	**Urban Park Landscape** This LCA includes vegetated public open spaces featured with various tree and plant species, sitting-out facilities, and pathways that enhances the overall landscape quality in the area. This type of LCA is common in Hong Kong and have medium quality landscape character to the district.	Medium
LCA3	**Construction Works Areas Landscape** This LCA refers to the flat and open area reserved for the proposed development or other concurrent projects. Vegetation in this LCA is limited to grasses, low lying shrubs and groundcovers. Largely defined by its vastness and visual openness, the sensitivity to change of this LCA is considered to be low.	Low
LCA4	**Transportation Corridor Landscape** This LCA mainly includes major roads, footbridges, associated furniture and central dividers vegetated with tree rows and shrubs. This type of LCA is common in Hong Kong and the sensitivity to change of this LCA is considered to be low.	Low
LCA5	**Commercial or Institutional Urban Landscape** The district is largely attributed to this LCA, which consists of high-rise private office buildings and government or institutional office buildings. Some vegetations are included in the open spaces adjacent to some of the office buildings. This LCA is very common in Hong Kong and considered to have low sensitivity to change.	Low
LCA6	**Miscellaneous Urban Fringe Landscape** This LCA consists of public transport interchange, bus depot and piers. This LCA is very common in Hong Kong and its sensitivity to change is considered to be low.	Low

A total of 214 nos. of trees were assessed within the surveyed area (within the Project Site boundary). The tree species recorded are common species in Hong Kong. No rare or endangered species and no 'Old and Valuable Trees' (OVTs) were identified within the extent of the tree survey.

Within the visual envelope for the Project, key Visual Sensitive Receivers (VSRs) located on prominent sightlines to the proposed development are identified as shown in **Table 2.10** and **Figure 2.7**. VSRs with similar visual sensitivity are grouped into Travelling VSRs, Recreational VSRs, and Occupational VSRs.

Table 2.10: Sensitivity to Change of VSRs

VSR ID.	VSR	Approx. Minimum Distance between VSRs and the Source (in metre)	Number of Individuals (Few/Medium/Many)		Duration of View (short /medium/ long)	Frequency of View (Occasional / Frequent)	Sensitivity to Change (low/medium/high)	
			Construction	Operation			Construction	Operation
Travelling VSRs								
T1	Travellers on Lung Wo Road	0	Few	Few	Short	Occasional	Medium	Medium
T2	Travellers across Lung Wo Road on Tamar Park's landscape deck	190	Medium	Medium	Medium	Occasional	Medium	Medium
Recreational VSRs								
R1	Visitors at Hong Kong Observation Wheel	300	Medium	Medium	Medium	Occasional	High	High
R2	Visitors on the landscape deck in Site 3	300	N/A*	Many	Medium	Occasional	N/A*	High
R3	Visitors in the Tamar Culture Plaza	100	Few	Few	Medium	Occasional	Medium	Medium
Occupational VSRs								
O1	Workers at Site 3 building	300	N/A*	Many	Long	Occasional	N/A*	Medium
O2	Workers at City Gallery	170	Medium	Medium	Short	Occasional	Low	Low
O3	Workers at Central Barracks	60	Medium	Medium	Medium	Frequent	Medium	Medium
O4	Workers at Chinese People's Liberation Army Forces Hong Kong Building	110	Many	Many	Medium	Occasional	Medium	Medium
O5	Workers at Legislative Council Complex	300	Few	Few	Short	Occasional	Low	Low

* The VSR is from a concurrent project, which no individuals would expect to be affected during the construction of the Project.

2.2.7 Hazard to Life

The Project Site is outside any 1-km consultation zone of Potentially Hazardous Installation (PHI).

3 Possible Impact on the Environment

3.1 Possible Environmental Impacts during Construction Phase

3.1.1 Air Quality

Based on the construction works as given in the tentative construction programme (**Appendix 1.1**) and information provided by the Design Engineers, the potential dust emission sources of the Project are identified as follows:

3.1.1.1 Construction Works within Works Site

Excavation works are expected to take place in six zones (i.e., Zones A, B1, B2, C1, C2 and ARB as shown in **Appendix 1.1**) within the works site (approx. 27,000m^2 in area). The excavation works in different zones will be carried out in sections to minimise the construction dust emissions. Each section of works will be limited to about 20m long and 30m wide (600m^2). Sections of works within each zone will be separated as far as practicable. Each section of works would be only about 2% of the total footprint of the works site. There would be maximum 4 zones to be excavated concurrently, which will account for approximately 9% of the works site area.

In the works site, the total major area requiring excavation for the tunnel, Culvert F diversion and ventilation building is about 8,350m^2. In the remaining area of the works site (i.e., 27,000m^2 – 8,350m^2 = 18,650m^2), the key activities will include utility works for the tunnel and ventilation building, TTM and utility diversion. Good site practice and control measures as described in **Section 4.1.1** will be applied as far as practicable for the works in the remaining area to minimise the potential dust impact.

The major area requiring excavation for the tunnel, Culvert F diversion and ventilation building within the works site would be, as far as practicable, conducted under decking (including construction deck and traffic deck), the extent of which is, subject to detailed design, as illustrated in **Appendix 3.1**. It is estimated that about 65% of the total major area requiring excavation for the tunnel, Culvert F diversion and ventilation building would be covered by the decks. It should be noted that the extent of the decking is constrained by various constructability considerations including access needed for loading of sizeable prefabricated components, construction sequence, mucking out rate, delivery route and construction programme. As a matter of good practice, the undecked areas would be provided with dust screen/ mesh cover as far as practicable and supplemented by the use of automatic sprinklers for regular water spraying wherever practicable. Hence the potential dust impact on the identified ASRs would be significantly reduced.

Taking into account of the aforementioned bulk excavation construction programme and tentative decking arrangements, it is estimated that approximately 78% to 99% of the total major area requiring excavation[1] would be either having excavation carried out under decking or having no excavation in-progress (explained below and in **Appendix 3.1**):

- Period P1 (Q4 2026 – Q1 2027): excavation will only be carried out in Zone C2 where part of the excavation works will be covered by decking. Excavation works for the other five zones are yet to be started. Therefore, about 99% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.
- Period P2 (Q1 2027 – Q2 2027): excavation will only be carried out in Zones C2 and B1 where part of the excavation works will be covered by decking. Excavation works for the other four zones are yet to be started. Therefore, about 87% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.

[1] Total major area requiring excavation for the tunnel, Culvert F diversion and ventilation building only (i.e., 8,350m^2).

- Period P3 (Q2 2027 – Q3 2027): excavation will only be carried out in Zones C2, B1, and ARB where part of the excavation works will be covered by decking. Excavation works for the other three zones are yet to be started. Therefore, about 86% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.
- Period P4 (Q3 2027): excavation will only be carried out in Zones ARB and A where part of the excavation works will be covered by decking. Excavation works at Zones C2 and B1 would be finished while excavation works for the other two zones are yet to be started. Therefore, about 91% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.
- Period P5 (Q4 2027): excavation will only be carried out in Zones ARB, A, B2 and C1 where part of the excavation works will be covered by decking. Excavation works at Zones C2 and B1 would be finished. Therefore, about 78% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.
- Period P6 (Q4 2027 – Q2 2028): excavation will only be carried out in Zones A, B2 and C1 where part of the excavation works will be covered by decking. Excavation works at Zones C2, B1, and ARB would be finished. Therefore, about 79% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.
- Period P7 (Q3 2028): excavation will only be carried out in Zone B2 where part of the excavation works will be covered by decking. Excavation works at Zones C2, B1, ARB, A and C1 would be finished. Therefore, about 94% of the total major area requiring excavation would be either having excavation carried out under decking or having no excavation in-progress during this period.

No concrete batching activity will be carried out on site. In view of the space constraints of Project site and as explained in **Section 3.1.4.1**, the C&D materials will not be reused on site but delivered offsite for proper reuse or disposal. Therefore, there would be a limited amount of excavated materials that would be stockpiled above ground. Based on information provided by the Design Engineers, the estimated total amount of construction and demolition (C&D) materials to be excavated is about 321,990m^3. With the excavation work spreading over a period of about 20 months as indicated in the tentative construction programme (**Appendix 1.1**); and assuming 26 working days per month, it can be estimated that on average about 620m^3 per day of C&D material would be generated during excavation.

The area of excavation activity in the works site at a time (i.e., 20m x 30m = 600m^2 per section in a zone or maximum 4 zones of concurrent works 600m^2 x 4 zones = 2,400m^2) represents only about 2% to 9% of the works site area. The major area requiring excavation for the tunnel, Culvert F diversion and ventilation building would be carried out under the decking or carried out under dust screen/ mesh cover supplemented by automatic sprinkler system as far as practicable. As explained above, stockpiling of excavated materials on site would be limited. To further reduce potential dust emission, it is recommended to implement the suitable mitigation measures as stipulated in **Section 4.1.1**.

In view of the provision of decking for covering a large portion of the major area requiring excavation; the use of dust screen/ mesh cover supplemented by automatic sprinkler system for the remaining undecked major area requiring excavation as far as practicable; the limited stockpiling of excavated materials above ground; the implementation of recommended mitigation measures; and the proposed Environmental Monitoring and Audit (EM&A) programme (**Section 4.3**), no adverse dust impacts at the identified ASRs in the vicinity of the Project Site are anticipated. Given the close separation distances between works site boundary and nearby ASRs, i.e. about 20m for existing ASRs and about 15m for planned ASRs as given in **Table 2.1**[2], further mitigation measures are recommended for minimization of construction dust impacts at these ASRs as far as practicable, such as:

- Plan site layout so that machinery and dust causing activities (e.g., haul roads and stockpiling areas) are located away from nearby ASRs;

[2] 15m is the nearest horizontal distance from the open area of proposed piazza of Site 3A that has been identified as the worst case scenario.

- Avoid concurrent construction works around ASRs in close proximity at the same time and
- Taller hoarding are recommended along site boundary with ASRs in close proximity

3.1.1.2 Other Construction Works

Limited dust generation from installation of diaphragm wall along the tunnel, small-scaled piling works (estimated total piling works area of about 310 m^2) and utility diversion is expected. With implementation of the suitable mitigation measures, the dust impact from these works is considered to be insignificant.

The estimated surface excavation area of temporary roads is about 9,500m^2, about 60% of which would be along Lung Wo Road within the works site and the remaining about 40% would be close to the north boundary of the works area (between the proposed ventilation building and Yiu Sing Street). The surface excavation would be less than 1m in depth only. With implementation of proper dust control measures and further mitigation measures as mentioned in Section 4.1.1, the impacts of surface excavation of temporary roads is considered as limited.

3.1.1.3 Use of Dump Trucks

There would be dust emissions generated from use of dump trucks. Based on information provided by the Design Engineers, it can be estimated that the average number of dump trucks would be around 12 vehicles per hour. All construction vehicles will be wheel-washed thoroughly and dusty contents will be well covered before leaving the site. Hence, the dust generated from use of dump trucks is considered to be limited.

3.1.1.4 Gaseous Emissions from the Project

The Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation came into effect to control the emissions from diesel powered engines and limited amount of diesel-powered mechanical equipment will be used on-site during construction phase. There will be limited numbers of diesel-powered machinery to be used at the site – estimated to be around 1 excavator mounted breaker; 2 mobile cranes and 4 excavators at each zone which would be further reviewed subject to site condition and detailed construction methods. According to the Air Pollution Control (Fuel Restriction) Regulations, liquid fuel with a sulphur content of less than 0.005% by weight should be used. Under the effects of the two regulations, emissions of gaseous pollutants from the operation of on-site diesel powered mechanical equipment is considered to be minimal.

3.1.1.5 Cumulative Impact

As described in **Section 1.5**, the Site 3 development is separated into two stages, Site 3A and Site 3B, with construction from Q2 2022 to end of 2026 and start of 2027 to end of 2031 respectively.

The Site 3 construction works will overlap the construction works of the Project. The excavation works of the Project will tentatively start in Q2 2026 and end in Q3 2028. During the excavation work period of the Project, excavation works for Site 3A will be completed. Therefore, potential cumulative construction dust impact with Site 3A is not expected and thus not considered.

However, the excavation works of the Project are expected to overlap with the demolition of General Post Office and Star Ferry Car Park, foundation and basement works of Site 3B. The north boundary of Site 3B is adjacent to the Project site boundary (see **Figure 1.1a**). Proper dust control measures will be implemented by the developer according to the Air Pollution Control (Construction Dust) Regulation to minimise the dust impact. Concurrent dusty activities for both ARO Project and Site 3 development would be avoided as far as practicable through liaison between contractors of this Project and Site 3 development. Moreover, construction dust monitoring is also proposed as part of the EM&A programme for the Project (**Section 4.3**).

With implementation of the recommended mitigation measures and the proposed dust monitoring as part of the EM&A programme, cumulative adverse dust impact from the Project and the Site 3 development would not be expected.

3.1.2 Noise

3.1.2.1 Airborne Construction Noise

The major construction works are expected to involve tunnel construction using cut and cover method, superstructure construction, and reinstatement of roads and pedestrian footpath. These activities will be mainly conducted in the Works Site as shown in **Figure 1.1a**. Powered Mechanical Equipment (PME) used in the Works Site are considered as the construction noise sources.

The major construction works will take place in six zones (Zones A, B1, B2, C1, C2 and ARB as shown in **Appendix 1.1**) of the works site. The separation distances between the representative NSR (i.e. CN1 as shown in **Figure 2.2a**) and the six zones range from 180m to 430m, as summarised in **Table 3.1**

The nearest construction zone (i.e. Zone A) would be decked by the landscape features of the Site 3 Development, no direct line-of-sight between the CN1 and Zone A is anticipated. Considering that the separation distances of the remaining construction zones (i.e. Zones B1, B2, C1, C2 and ARB) are at least 235m from CN1, no adverse construction noise impact is anticipated. In addition, it is anticipated that the traffic or construction deck (with concrete pavement) provided under the Project (as shown in **Appendix 3.1)** which could provide certain screening effect to the PME underneath the decking and minimise the construction noise impact to the CN1. Nevertheless, to further reduce potential construction noise impacts, it is recommended to implement the suitable mitigation measures as stipulated in **Section 4.1.2**.

Table 3.1: Distance between the Representative NSRs and Construction Works Zone

NSR ID	Description	Uses	Existing/Planned	Approximate Nearest Horizontal Distance from Construction Zone	
				Zone	Distance (m)
CN1	New Central Harbourfront Site 3 development (Site 3A)	Amphitheatres	Planned (to be completed by end of 2026)	A	180
				B1	235
				B2	290
				C1	350
				C2	430
				ARB	385

As given in **Section 1.5**, the Site 3 Development is located next to the Project Site and its construction period would overlap with that of the ARO Project. However, as no adverse construction noise impact is anticipated for the ARO Project, no potential cumulative construction noise impact with the Site 3 Development is expected.

3.1.2.2 Groundborne Construction Noise

Potential groundborne noise during construction phase is expected to mainly arise from the PME for rock breaking/drilling works (such as hydraulic breaker, rock drill, pile rig, etc).

The cut-and-cover method is the most appropriate method taking account of the site conditions and constraints, cost and programme of ARO Project. Moreover, excavation of the tunnels and the ventilation building are expected to be mostly in soil instead of rock. Removal or breaking of large old seawall stones might be necessary at locations where the tunnel run across buried old seawalls. The diaphragm walls are designed to be founded in rock and thus rock chiselling will have to be carried out by hydraulic breaker. In addition, drill rig would be used for the diaphragm walls construction of the ARO Project. Therefore, the potential groundborne construction noise source under the ARO Project would be the hydraulic breaker and pile rig and the use of said equipment would be mainly carried out at the proposed overrun tunnel and ventilation building.

It is anticipated that only limited use of pile rig/hydraulic breaker would be employed within each construction zone of the Project. In general, hydraulic breaker and pile rig are not expected to be used at the same time in each zone throughout the construction activities. In addition, the separation distances between the representative NSRs (i.e. GBN1 to GBN4 as shown in **Figure 2.2b**) and the proposed overrun tunnel / ventilation building are at least 37m to 60m as shown in **Table 2.4**. As a result, no adverse groundborne construction noise impact from the Project is anticipated.

3.1.3 Water Quality

The potential sources of water quality impacts during the construction phase of the Project include culvert diversion activities, construction site runoff, general construction activities, wastewater discharge from excavation, sewage effluent generated from workforce and accidental spillage. These impacts can be readily mitigated by implementing proper hydraulic isolation of the existing and diverted culvert; provision of a suitable onsite drainage system with silt traps and sedimentation basins; good site management practices; careful working practices; and proper sewage collection and disposal system as described **Section 4.1.3**. Adverse water quality impact is not anticipated with implementation of recommended mitigation measures.

3.1.4 Waste Management

Construction of the Project is expected to generate the following categories of wastes:

- Construction and Demolition (C&D) materials;
- Chemical waste; and
- General refuse.

3.1.4.1 C&D Materials

C&D materials would be generated from roadwork, utility and culvert diversion, excavation and reinforced concrete construction works. These C&D materials shall be sorted on-site into inert (e.g. rocks, soil, broken concrete, building debris) and non-inert components (e.g. vegetation and wood).

The amount of C&D materials expected to be generated during construction phase has been estimated in **Table 3.2** below:

Table 3.2: Estimated Amount of C&D Material to be Generated During Construction Phase

	Estimated Quantity of C&D Material to be Generated (m^3) [1]				
	Inert C&D Material (m^3) [2] [3]	Non-inert C&D Material (m^3) [4]	Inert C&D Material Reused on Site	Delivered to PFRFs (m^3)	Disposed Offsite (m^3)
				Inert C&D Material [5]	Non-inert C&D Material
Total	321,500	490	0	321,500	490

Notes:
(1) In-situ volume is used.
(2) Inert C&D material, e.g. soil, rock, crushed concrete, asphalt and bentonite slurry.
(3) Bentonite slurry will be recycled and reused on-site until completion of diaphragm wall construction and then deemed as generated inert C&D material presented in this column.
(4) Non-inert C&D material, e.g. timber, paper, steel, aluminium and plastic.
(5) Bentonite slurry will be deemed as inert C&D material upon completion of diaphragm wall construction. For disposal of bentonite slurry, 85% of volume would be in soil form, while 15% would be in broken rock form.

It is envisaged that bentonite slurry would be generated from diaphragm wall construction. The slurry is normally recycled and reused on-site, until completion of diaphragm wall construction, such that no wastewater would be generated. The storage, treatment and recycling of the bentonite slurry will mainly be conducted at the slurry treatment plant. The spoil generated from diaphragm wall construction after treatment to remove the bentonite slurry will be delivered to public fill reception facilities (PFRFs) as normal spoil. After completion of diaphragm wall construction, the bentonite slurry would be delivered to the PFRFs and based on the best

available information, the final form of bentonite slurry to be delivered to PFRFs is expected to be 85% in soil form and 15% in broken rock form.

On-site reuse of inert C&D materials has been considered. However, due to limited space of the Project Site, it is not practicable to provide a stockpile area of inert C&D materials for subsequent reuse on-site. The inert C&D materials would be delivered to the PFRFs, i.e. Tseung Kwan O Area 137 Fill Bank and Chai Wan Public Fill Barging Point, or other projects, for beneficial reuse. The non-inert C&D materials generated would be reused and recycled as much as possible before disposal of at designated landfill site (e.g. SENT landfill), to be agreed with EPD.

3.1.4.2 Chemical Waste

The maintenance and servicing of construction plant and equipment may generate chemical waste such as used solvents, cleaning fluids and waste lubricating oil. It is anticipated that the quantity of chemical waste, such as waste lubricating oil and solvents produced from plant maintenance, will be small and in the order of few hundred litres per month. The amount of chemical waste to be generated will be quantified in the Waste Management Plan to be prepared by the Contractor for the site. For the disposal of chemical waste, the Contractor would be required to register with the EPD as a Chemical Waste Producer and to follow the requirements stated in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. Chemical waste arising during the construction phase may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as stipulated in the Waste Disposal (Chemical Waste) (General) Regulation.

Materials classified as chemical waste will require special handling and storage arrangements before removal for off-site disposal/treatment at the approved Chemical Waste Treatment Centre (CWTC) or licensed chemical waste treatment facilities. Wherever possible, opportunities should be taken to reuse and recycle materials. Provided that the handling, storage and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts are not expected.

3.1.4.3 General Refuse

The construction workforce will generate refuse comprising food scraps, waste paper, aluminium cans and plastic bottles during construction period.

The number of workforce to be employed for the Project is not available at this stage, but it is anticipated to be not to be over 600 staff at one time. Based on the generation rate of 0.65kg/person/day, the total refuse generated per day would be less than 390 kg.

Recyclable materials (i.e. paper, plastic bottles and aluminium cans) will be separated for recycling in order to reduce the amount of general refuse to be disposed of at landfill. Adequate number of enclosed waste containers will be provided to avoid over-spillage of waste. Reputable licensed collector should be employed to collect the general refuse for disposal at designated landfill sites on a regular basis.

Provided that mitigation measures are adopted, the potential environmental impacts from the storage, handling, transportation and disposal of general refuse are expected to be minimal. Mitigation measures to minimise potential environmental impacts are recommended in **Section 4.1.4**.

3.1.4.4 Land-based Sediment

The work site cuts across the shoreline before Central Reclamation Phase III (CR III). Before completion of CR III in early 2010s, significant part of the site was offshore, while other parts of the site are onshore. Having review the best available site geology information, land-based sediment is not anticipated to be encountered during tunnelling and ventilation building basement construction. However, since no recent (i.e. after completion of CR III) ground investigation at the work site of the Project is available at the moment, to err on the conservative approach, sampling in gird size 100m x 100m with vertical profile of samples has been proposed to confirm if the site geology information is valid for the work site of the Project.

The SI was completed in October 2022 and no land-based sediment was encountered and identified. As such, land-based sediment is not anticipated to be encountered during tunnelling and ventilation building basement construction, and thus no sediment disposal is anticipated. A Preliminary Sediment Quality Report (PSQR) was submitted to EPD on 15 November 2022. On 22 November 2022, EPD acknowledged that as no sediment was encountered in the sampling according to the approved SSTP, no marine disposal is required and thus no approval of the Report is required.

3.1.4.5 Transportation Arrangement for Waste Disposal during Construction Phase

Land transport would be used to deliver and dispose of the waste generated from the Project to the designated disposal outlets. It is expected that in average about 12 vehicles per hour for transporting waste during the construction phase of the Project. The tentative transportation routings for the disposal of various types of wastes generated during the construction phase are shown in **Table 3.3**.

The transportation routings may change subjecting to the actual traffic conditions of the roads. Nevertheless, with the implementation of appropriate mitigation measures (e.g. using water-tight containers and covered trucks), no adverse environmental impacts are expected due to the transportation of waste.

Table 3.3: Tentative Transportation Routings for Waste Disposal During Construction Phase

Type of Waste	Disposal Outlet	Tentative Transportation Routing
Non-inert C&D material	SENT Landfill (tentatively selected, to be agreed with EPD)	Via Lung Wo Road, Central-Wan Chai Bypass, Island Eastern Corridor, Eastern Harbour Crossing, Tseung Kwan O Tunnel, and Wan Po Road
Surplus Inert C&D material	Chai Wan Public Fill Barging Point	Via Central-Wan Chai Bypass, Island Eastern Corridor, Wing Tai Road, and Ka Yip Street
	Tseung Kwan O Area 137 Fill Bank	Via Central-Wan Chai Bypass, Island Eastern Corridor, Eastern Harbour Crossing, Tseung Kwan O Road and Wan Po Road
Chemical Waste	Chemical Waste Treatment Centre (tentatively selected)	Via Western Harbour Crossing, West Kowloon Highway, Tsai Kwai Highway, and Tsing Yi Road
General Refuse	WENT Landfill (tentatively selected, to be agreed with EPD)	Via Western Harbour Crossing, West Kowloon Highway, Tsai Kwai Highway, Ting Kau Bridge, New Territories Circular Road, and Nim Wan Road

3.1.5 Land Contamination

With reference to EPD's Practice Guide for Investigation and Remediation of Contaminated Land, a contamination review has been conducted in 2022 to review the potential sources of land contamination and hence assess the land contamination potential within the Project Site and offsite works area.

Desktop study has been conducted including a review of collected information and aerial photos as presented in **Appendix 3.2** (for the ease of assessing the land contamination potential of the areas, the Project Site is divided into Area A to E and the offsite works area is labelled as Works Area 1), and no potentially contaminated area was identified within the Project Site and offsite works area. Multiple rounds of site reconnaissance surveys were also conducted in 2022 (Photos of reconnaissance survey are presented in **Appendix 3.3**), and the survey results coincide with the desktop study findings, concluding that no potentially contaminated area within the Project Site and offsite works area is identified. As parts of the Project Site and offsite works area (namely Project Site – Area A and Works Area 1 as presented in **Appendix 3.2**) were fenced off and inaccessible during site reconnaissance at the time of preparation of this Project Profile, site reappraisal will be conducted for the Project Site and offsite works area, including those inaccessible areas at the time of preparation of this Project Profile, and where necessary a supplementary Land Contamination Review Report, will be submitted to EPD for agreement prior to commencement of any construction works.

3.1.6 Ecology

As there is no ecological feature within the Project Site, potential impact due to loss of natural habitats for wildlife in construction phase of the Project is not a concern. Off-site impact is also negligible as the Project Site is surrounded by developed areas that are not ecologically important habitat.

Furthermore, while the Project Site is located at waterfront, all construction activities are land-based without any marine works. Thus, no impact to marine ecology is anticipated.

3.1.7 Fisheries

There is no Site of Fisheries Importance or Fish Culture Zone identified within the study area of 500m from the Project Site boundary.

While the Project Site is located at waterfront, all construction activities are land-based without any marine works. Any effluent discharge from the Project during both construction and operation phases will be subject to control by the WPCO licence conditions. With the implementation of mitigation measures and good site management practices where necessary, no adverse water quality impact is anticipated. Fisheries impact is therefore not anticipated.

3.1.8 Cultural Heritage

As there are no cultural heritage features within the Project Site, no direct impacts on cultural heritage features are anticipated. As mentioned in **Section 2.2.4**, there will be no encroachment onto any of the identified declared monuments. Based on the available design information, the Works Area immediately north of the nearest identified monument, i.e., Hong Kong City Hall, is expected to be used for temporary traffic management (TTM) only, and no heavy machineries would be used. The potential indirect impact from passing traffic is expected to be minimal.

Potential vibration from construction activities is expected to be an indirect impact during construction stage. The key construction activity which may generate vibration is expected to be the installation of diaphragm wall for the proposed overrun tunnel. As piling activities are expected to be carried out in phases, only works in Zone B1 and B2 will be closely located to the nearest built heritage, i.e., the Hong Kong City Hall (with approximately 44m separation distance from the overrun tunnel). Furthermore, it is anticipated that the piling works involved with the installation of diaphragm wall are expected to be of small scale only. Hence, potential vibration impact on the built heritage is anticipated to be not significant.

Given the large separation distance of the construction activities to the identified pre-1969 buildings, i.e., 170 m to 286 m, potential vibration impacts to these buildings are not expected.

3.1.9 Landscape and Visual

Among the 214 nos. surveyed existing trees, 124 nos. located within the works area will be unavoidably affected by the proposed construction works. Retaining the trees is not considered feasible. They are common tree species and are recommended to be felled. 90 nos. of surveyed trees are located at the Project Site without construction or excavation activity. The impact on these existing trees is insignificant. The exact number of trees involved in the Project and the proposed tree treatment are subject to the approval of Tree Preservation and Removal Plan (TPRP).

Under the Project, most of the LRs and LCAs as presented in **Table 2.8** and **Table 2.9** are not affected by the Project since the extent of proposed works does not reach to them. LR2.3, LR3 and LCA4 would experience moderate landscape impact before mitigation, as the existing pavement on roads and/or footpaths, trees and vegetations would be removed (as shown in **Appendix 3.4**). It is expected that the landscape impacts would sustain during the construction phase.

During the construction phase, there would be moderate residual visual impact on VSR R1 (**Table 2.10**), which has a view overseeing the excavation works area and the construction area of the ventilation building for a relatively long duration.

VSRs T1, T2 and O3 are those with close views to the source of impact, therefore, it is anticipated that there would be moderate residual visual impact during construction phase.

For VSR O2, there would be slight residual impact during construction phase due to temporary traffic arrangement at Edinburgh Place.

For VSRs R2 and O1, there would not be any residual visual impact on them during construction phase as they are VSR from a concurrent project (i.e. New Central Harbourfront Development), which no individuals would expect to be affected during the construction of the Project.

For the rest of the VSRs, there would be 'Slight' or 'Insubstantial' residual visual impact on them during construction phase, as they have a relatively long distance from the source of impact.

The potential significances of the landscape and visual impacts during the construction phase, before and after mitigation (if necessary), are presented in **Appendix 3.4**. Visual images illustrating the decking arrangements during different periods within the construction phase of the Project are given in **Appendix 3.5.**

To conclude, the overall residual landscape and visual impacts of the Project would be acceptable with mitigation measures implemented as described in **Section 4.1.8** during construction phase.

3.1.10 Hazard to Life

The construction method for the Project would be cut-and-cover where no explosives would be used. Hazard-to-life impact due to the construction of the Project is not anticipated.

3.2 Possible Environmental Impacts during Operation Phase

3.2.1 Air Quality

All trains to be operated within the proposed overrun tunnel are electrified and there will be neither fuel burning facilities/ activities nor dusty works, hence there would be no associated air pollutant or dust emission from the proposed ventilation building during the operation phase. Hence, no adverse air quality impact is therefore anticipated during operation phase of the Project.

3.2.2 Noise

3.2.2.1 Airborne Railway Noise

Given that the railway lines of TCL and AEL at ARO section would be operated inside the tunnel, no airborne railway noise impact is anticipated.

3.2.2.2 Groundborne Railway Noise

As shown in **Table 3.4** below, the predicted groundborne railway noise levels at all representative NSRs comply with the most stringent noise criteria (i.e. night-time noise criteria). No adverse groundborne railway noise impact arising from operation of the Project is anticipated. Detailed calculations of the groundborne railway noise are presented in **Appendix 3.6**.

Table 3.4: Predicted Groundborne Railway Noise Levels (Unmitigated Scenario)

NSR ID	Uses	Existing/Planned	ASR [1]	Predicted Noise Level, dB(A)	Nigh-time Noise Criteria, dB(A)	Compliance [Y/N]
GBN1	Residential	Existing	C	22 [2]	50	Y
GBN2	Residential	Existing	C	22 [2]	50	Y
GBN3	Performing Art Centre	Existing	C	24 [2]	50	Y
GBN4	Performing Art Centre [3]	Planned	C	27 [2]	50	Y
GBN5	Performing Art Centre [3]	Planned	C	34 [2]	50	Y

Note [1] – Area Sensitivity Rating (ASR) will be reviewed subject to detailed design and further assessment. (e.g. ASR "B" or ASR "C").
Note [2] – The noise levels are also complied with other Area Sensitive Rating (i.e. ASR"B").
Note [3] – Assume the theatre use in Site 3 (GBN4 and GBN5) is similar to the use of performing art centre.

3.2.2.3 Fixed Noise

Table 1A in Annex 5 of the EIAO-TM and the IND-TM stipulate the appropriate Acceptable Noise Level (ANL) for fixed noise sources. The ANLs as shown in **Table 3.5** are dependent on the Area Sensitivity Ratings (ASRs) of the NSRs, as defined in accordance with the IND-TM. The EIAO-TM requires that the planned fixed noise sources shall comply with 5 dB(A) below the ANLs shown in **Table 3.5** or the prevailing background noise levels, whichever lower.

Table 3.5: Acceptable Noise Levels (ANLs)

Time Period	Acceptable Noise Levels, dB(A)		
	ASR A	ASR B	ASR C
Day (0700 to 1900 hours)	60	65	70
Evening (1900 to 2300 hours)	60	65	70
Night (2300 to 0700 hours)	50	55	60

With reference to the approved EIA Report of Central-Wan Chai Bypass and Island Eastern Corridor Link (AEIAR-041/2001), the Chinese People's Liberation Army Forces (PLA) Headquarters (i.e. Central Barracks Blake Block and Central Barracks Amethyst Block) are already provided with air-conditioning. No adverse noise impacts to the indoor environment of the said buildings are anticipated. According to the on-site observations, City Gallery and Hong Kong City Hall have been installed with air-conditioning and do not rely on opened window for ventilation. Based on the above, no sensitive facades in the vicinity of the proposed ARB were observed. In addition, the amphitheatre of Site 3 (i.e. CN1) would be located over 350m to the proposed ARB.

Considering that there is sufficient separation distance to the amphitheatre of Site 3 (i.e. at least 350m with sufficient noise attenuation effect of at least 59dB(A)) and there is no sensitive façade in the vicinity of the proposed ARB, no adverse fixed noise impact is anticipated.

Nevertheless, the proposed ARB should be complied with the above planning noise standard (i.e. ANL -5 or prevailing background noise levels, whichever lower). Relevant noise mitigation measures (e.g. discharge silencer and enclosure) should be incorporated into the detailed design, where necessary. Details could be reference to the "Good Practices on Ventilation System Noise Control" issued by EPD.

3.2.3 Water Quality

All tracks are contained in concrete tunnel box, therefore there will be no rainwater runoff. The tunnel wall will be equipped with water-tight liner and designed for no seepage. The amount of groundwater seepage into the

tunnel will be limited. The proposed ARB is unmanned building structure. There will only be limited amount of negligible amount of wastewater to be generated during routine maintenance. Rainwater runoff from the building structure is not contaminated. As a result, limited wastewater would be discharged from the proposed overrun tunnel and ventilation building to public foul sewer, and any wastewater discharge would be subject to control by the WPCO licence conditions. No additional surface runoff is anticipated as the Project site is situated in well-developed urban area and the paved area would be about the same as that after completion of the Project. Therefore, no adverse water quality impact is expected.

3.2.4 Waste Management

3.2.4.1 General Refuse

General refuse such as paper and plastics could be expected to be generated by the staff for maintenance of the railway. The amount of general refuse that would arise during operation phase of the Project could not be confirmed at this stage since it would be subjected to the operational needs and the no. of staffing in the future. With reference to the EIA study of Tung Chung Line Extension (Ref: AEIAR-235/2022 and by taking a conservative approach in view of the project scale, it could be reasonably assumed that less than hundreds kilograms of general refuse per month would be generated during operation.

Plastics, paper and other recyclables would be separated from general refuse for recycling as far as possible, with the remaining waste to be collected by waste collectors and disposed of at refuse transfer stations. Therefore, the quantity of general refuse to be generated during the operation phase is not expected to be significant.

3.2.4.2 Chemical Waste

Chemical waste such as used solvents, cleaning fluids and waste lubricating oil would be generated during maintenance activities. However, it is difficult to quantify the amount of chemical waste to be generated as it largely depends on the maintenance requirement. It is preliminarily anticipated that the quantity of chemical waste will be small and in the order of few hundred litres per month. Should any chemical waste to be generated on site, the operator should be registered as a chemical waste producer, and strictly follow the requirements stated in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. With proper mitigation measures implemented, no adverse environmental impact regarding chemical waste will be anticipated.

3.2.5 Ecology

The Project Site is surrounded by developed areas and limited wastewater would be discharged to public foul sewer. Thus, no impact to land based and marine ecology is anticipated.

3.2.6 Fisheries

As limited wastewater would be discharged to public foul sewer, no fisheries impact is anticipated.

3.2.7 Cultural Heritage

During operation stage, vibration from tracks and train movement are expected to be the key indirect impact. The nearest built heritage potentially subjected to such indirect impact is the Hong Kong City Hall.

The proposed ARO and ARB are expected to reach approximately -23.5mPD and -25mPD respectively. Based on the as-built drawings of the Hong Kong City Hall, the foundation of the Low Block, i.e., located nearest to the Project Site, reaches approximately +2.00mPD to +6.00mPD. Furthermore, based on review of available geological record, the ground within the Project Site and between the Hong Kong City Hall consists of decomposed granite.

In view of the above, it is considered that there is potentially sufficient vertical separation (over 10m) of soft ground from the tunnel to the nearest built heritage, i.e., Hong Kong City Hall. Hence, significant adverse impact on cultural heritage and identified pre-1969 buildings during operation phase is not expected.

3.2.8 Landscape and Visual

Opportunities for tree compensation within the Project site boundary have been explored. 124 nos. of compensatory trees will be planted to at the roadside planters and central dividers along Lung Wo Road to achieve the required 1:1 compensation ration in terms of quantity. The numbers of trees and proposed tree treatment are subject to the approval of TPRP.

The following representative viewpoints have been selected for the photomontages to illustrate the potential landscape and visual impact of the Project:

- viewpoints that offer direct visibility to the aboveground structure of the proposed ventilation building. They are considered major public viewpoints representing key VSRs or VSR groups that would be potentially affected by the proposed works; and
- viewpoints that can represent the most influenced scenarios and demonstrate the compatibility of the aboveground structure of the proposed ventilation building with the adjacent visual context and illustrate the visual effect on Day 1 without mitigation measures, Day 1 with mitigation measures (if necessary) and in Year 10 with mitigation measures (if necessary).

Based on the location of the proposed ventilation building, the following 4 viewpoints (VPs) from key representative VSRs are selected as shown in **Figure 3.1**:

VP-1: from the top of Hong Kong Observation Wheel to represent the view of the tourists overlooking the harbourfront.

VP-2: from the footbridge connect to the Central Pier along Man Yiu Street to represent the typical view from the landscape deck in Site 3.

VP-3: from Central Barracks to represent the typical view of pedestrian walking on Lung Wo Road.

VP-4: from Tamar Park's landscape deck to represent the typical view of the visitor in the park.

The photomontages from the 4 VPs to illustrate the potential landscape and visual impacts of the Project are shown in **Figure 3.2a** to **Figure 3.2d**. The potential significances of the landscape and visual impacts during the operation phase, before and after mitigation (if necessary), are presented in **Appendix 3.4**.

It is expected that the landscape impacts would be reduced to 'Slight' or 'Insubstantial' in operation phase (Day 1) or operation phase (Year 10) when the affected hard landscape and vegetations have been reinstated and the compensatory trees become more mature in size.

The proposed ventilation building will be permanently located in LCA6. Given that the size of the proposed ventilation building is relatively small to this LCA, and the nature of use of this LCA will not be affected, it is anticipated that the landscape impact and residual landscape impact would be 'Insubstantial'.

The residual impact of VSR R1 would be 'Slight' on Day 1 and further reduced to 'Insubstantial' in Year 10 when the compensatory planting and landscape reinstatement works become mature during operation phase.

The residual impact of VSRs T1, T2 and O3 would be 'Slight' on Day 1 and further reduced to 'Insubstantial' in Year 10 when the compensatory planting and landscape reinstatement works become mature.

For VSR O2, as the affected road during construction of the project will be restored and the existing trees adjacent to the road will be preserved, the residual impact during operation phase (Day 1 and Year 10) would be 'Insubstantial'.

For VSRs R2 and O1, there would not be any residual visual impact on them during operation (Day 1) phase as they are VSR from a concurrent project (i.e. New Central Harbourfront Development). It is anticipated that the residual visual impact during operation phase (Year 10) would be 'Insubstantial' as the soft and hard

landscape in the affected areas along Lung Wo Road would already be reinstated and become mature by then, and these VSRs have a relatively long distance from the source of impact (i.e. the aboveground structure of the ventilation building).

Occupational VSRs O4 and O5 are those with less frequency of view to the source of impact. Therefore, it is anticipated that the residual visual impact would be 'Slight' and 'Insubstantial' respectively.

For the rest of the VSRs, there would be 'Insubstantial' residual visual impact on them during operation phase, as they have a relatively long distance from the source of impact.

To conclude, the overall residual landscape and visual impacts of the Project is considered to be acceptable with mitigation measures implemented during operational phase.

3.2.9 Hazard to Life

During the operation phase, storage, use or transport of hazardous materials are expected to be not significant and less than the threshold quantities constituting a PHI as specified in the Hong Kong Planning Standards and Guidelines (HKPSG). Therefore, hazard-to-life impact due to the operation of the Project is not anticipated.

4 Environmental Protection Measures to be Incorporated in the Design and Further Environmental Implications

4.1 Construction Phase

4.1.1 Air Quality

In addition to provision of the decking for covering, as far as practicable, to effectively reduce potential dust emissions from major excavation work areas of the tunnel, Culvert F diversion and ventilation building, the following construction dust control measures should also be implemented to minimise dust nuisance arising from the Project to acceptable levels:

- Provision of dust screen/ mesh cover for those excavation areas without the decking as far as practicable, which will be supplemented by the use of automatic sprinkler system for regular water spraying wherever practicable;
- The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. Effective dust suppression measures, as necessary, should be installed to minimise air quality impacts, at the boundary of the site and at any sensitive receivers;
- The working area of any excavation or earthmoving operation shall spray with water immediately before, during and immediately after the operation so as to maintain the entire surface wet;
- Exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen or other suitable surface stabiliser within six months after the last construction activity on the construction site or part of the construction site where the exposed earth lies;
- Effective water sprays shall be used during the delivery and handling of all raw sand, aggregate and other similar materials, when dust is likely to be created, to dampen all stored materials during dry and windy weather;
- Watering of exposed surfaces shall be conducted as often as possible depending on the circumstances;
- Areas within the site where there is a regular movement of vehicles shall have an approved hard surface, be kept clear of loose surface materials and / or regularly watered;
- The Contractor shall confine haulage and delivery vehicles to designated roadways inside the site. If in the opinion of the Engineer, any motorised vehicle is causing dust nuisance, the Engineer may require that the vehicle be restricted to a maximum speed of 10 km per hour while within the site area;
- Wheel cleaning facilities shall be installed and used by all vehicles leaving the site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be treated before discharge /recycling and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel cleaning facilities shall be usable prior to any earthwork excavation activity on site. The Contractor shall provide a hard surfaced road between any cleaning facility and the public road;
- Any stockpile of dusty material shall be either: a) covered entirely by impervious sheeting; b) placed in an area sheltered on the top and the three sides; or c) sprayed with water so as to maintain the entire surface wet;
- Chemical wetting agents shall only be used on completed cuts and fills to reduce wind erosion;
- All site vehicular exhausts should be directed vertically upwards or directed away from ground to minimise dust nuisance;
- Ventilation system, equipped with proprietary filters, should be provided to ensure the safe working environment inside the tunnel. Particular attention should be paid to the location and direction of the

ventilation exhausts. The exhausts should not be allowed to face any sensitive receivers directly. Consideration should also be given to the location of windows, doors and direction of prevailing winds in relation to the nearby sensitive receivers;

- Where a vehicle leaving the Project site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle;
- Restricting heights from which materials are to be dropped, as far as practicable to minimise the fugitive dust arising from unloading/ loading;
- Where practicable and subject to any site constraints, hoarding of not less than 2.4 m high from ground level shall be provided along the site boundary;
- Plan site layout so that machinery and dust causing activities (e.g. haul roads and stockpiling areas) are located away from nearby ASRs;
- Avoid concurrent construction works around ASRs in close proximity at the same time;
- Taller hoarding are recommended along site boundary with ASRs in close proximity;
- Other suitable dust control measures as stipulated in the Air Pollution Control (Construction Dust) Regulation, where appropriate, should be adopted;
- Deploy electrified NRMMs as far as practicable; and
- Use of exempted NRMMs should be avoided as far as practicable.

With the implementation of the dust suppression measures, unacceptable construction dust impact exceeding the relevant air quality criteria due to construction activities of the proposed Project would not be anticipated.

4.1.2 Noise

Good Site Management Practices

Good site practices should be implemented to minimize impacts. The site practices listed below should be followed during the construction phase:

- Only well-maintained plant should be operated on-site and plant should be serviced regularly during construction;
- Silencers or mufflers on construction equipment should be utilised and should be properly maintained during construction;
- Mobile plant, if any, should be sited as far from NSRs as possible;
- Machines and plant (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- The engine of lorry should be switched off after arriving the unloading position;
- Plant known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from the nearby NSRs;
- Material stockpiles should be effectively utilized, wherever practicable, in screening noise from on-site construction activities; and
- Use of purpose-built acoustic barriers, panels and enclosures, where practicable and applicable.

In addition, the “Recommended Pollution Control Clauses for Construction Contracts” published by the EPD should be adopted in the Contract Specification for the Contractor to follow and implement relevant measures and good site practices in minimising noise impact.

Use of Quality Powered Mechanical Equipment (QPME)

The use of quiet plant associated with the construction works is made reference to the QPME / other commonly used PME listed in EPD web pages as far as possible which includes the SWLs for specific quiet PME. It is generally known (supported by field measurement) that particular models of construction equipment are quieter

than standard types given in the Technical Memorandum on Noise from Construction Work Other Than Percussive Piling (GW-TM).

Use of Quiet Construction Method

The use of some advanced quieter construction methods (e.g., hydraulic crusher for concrete breaking, silent piling by press-in method and non-explosive chemical agent, etc.) are commercially available, which could reduce the noise emission from the construction works. More examples and details are shown in "Good Practices on Mitigating Construction Noise" under EPD webpage and EIAO Guidance Note No.9/2010. It is recommended that the contractor to adopt the quiet construction methods as far as practicable.

4.1.3 Water Quality

Contractor should obtain a discharge license under the WPCO for any effluent discharge generated from the construction of the Project and should comply with the requirements specified in the discharge licence under the WPCO and its subsidiary regulations. All site runoff and wastewater generated from the Project site should be treated so that it satisfies the relevant standards listed in the "Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters". In accordance with the Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94), construction phase mitigation measures are described in following sections.

4.1.3.1 Culvert Diversion

The existing and temporary diversion for Culvert F should be kept hydraulically isolated from other construction works areas of the Project at all times to ensure no uncontrolled discharge of construction site runoff or excavation wastewater into the existing or diverted culvert system. Controlled discharge of treated runoff and excavation wastewater into the culvert system is only permitted with a valid discharge license under the WPCO. The Contractor is responsible for ensuring the discharge quality complies with the conditions of the discharge license.

4.1.3.2 Construction Site Runoff and General Construction Activities

The good site practices outlined in ProPECC PN1/94 should be followed as far as practicable in order to minimise surface runoff and erosion, and also to retain and reduce any SS prior to discharge. The following measures are recommended to minimize water quality impacts:

- Surface run-off from construction sites should be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sedimentation basins. Channels or earth bunds or sandbag barriers should be provided on site to properly direct stormwater to such silt removal facilities.
- Perimeter channels should be provided on site boundaries where necessary to intercept storm run-off from outside the Site so that it will not wash across the Site. Catch-pits and perimeter channels should be constructed in advance of site formation works and earthworks.
- Silt removal facilities, channels and manholes should be maintained, and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to prevent local flooding.
- Construction works should be programmed to minimise soil excavation works in rainy seasons (April to September). If excavation in soil cannot be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporary exposed slope surfaces should be covered e.g. by tarpaulin and the size of the excavation should be minimised as far as practicable. Arrangements should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm. Measures should be taken to minimize the ingress of rainwater into trenches.

- If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or excavations should be discharged into storm drain via silt removal facilities.
- Temporary access roads should be protected by crushed stone or gravel. Appropriate drainage such as intercepting channels should be provided where necessary.
- Earthworks final surfaces should be well compacted and the subsequent permanent work or surface protection should be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms.
- As bentonite slurries are required for construction of diaphragm walls, they should be reconditioned and reused wherever practicable to minimise the disposal volume of used bentonite slurries. Temporary enclosed storage locations should be provided on-site for any unused bentonite that needs to be transported away after the related construction activities are completed. Requirements as stipulated in ProPECC Note PN 1/94 should be closely followed when handling and disposing bentonite slurries.
- Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers. Discharge of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system.
- Good site practices should be adopted to remove rubbish and litter from construction sites so as to prevent the rubbish and litter from spreading from the site area. It is recommended to clean the construction sites on a regular basis.
- Any open stockpiles on site should be covered with by impervious sheeting or placed in sheltered area during rainstorms to prevent wash away of construction materials, soil, silt or debris into any drainage system.
- Any groundwater that may be pumped out during tunnel/ foundation construction should be discharged into storm drains after the removal of silt in silt removal facilities.
- Water used in ground boring and drilling should as far as practicable be recirculated after sedimentation. When there is a need for final disposal, the wastewater should be discharged into storm drains via silt removal facilities.
- Wastewater discharged from wheel washing bay should have sand and silt settled out or removed before discharging into storm drains. The section of construction road between the wheel washing bay and the public road should be paved with backfall to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.

4.1.3.3 Wastewater Discharge from Excavation

Wastewater may have a high level of SS, which should be treated before discharge by settlement in tanks with sufficient retention time or via other silt removal facilities. Oil interceptors would be required to remove the oil, lubricants, and grease from wastewater. A discharge licence under the WPCO would be required for the discharge. The Contractor should monitor the quantity and quality of discharge to ensure compliance with the conditions of the discharge license issued under the WPCO.

4.1.3.4 Sewage Effluent from Workforce

The Contractor should provide temporary sanitary facilities, such as portable chemical toilets within the construction site to handle sewage from the workforce. The Contractor has the responsibility to ensure that chemical toilets are used and properly maintained, and that licensed Contractors are employed to collect and dispose of the waste off-site at approved locations.

4.1.3.5 Accidental Spillage

Any chemical storage, service shop and maintenance facilities should be located on hard standings within a bunded area, sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving

activities with potential of leakage and spillage should only be undertaken within the areas appropriately equipped to control these discharges.

Disposal of chemical wastes should be carried out in compliance with the Waste Disposal Ordinance and the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.

4.1.4 Waste Management

The mitigation measures for construction phase are recommended based on the waste management hierarchy principles. Recommendations of good site practices, waste reduction measures as well as the waste transportation, storage and collection are described in following sub-sections.

4.1.4.1 Good Site Practices

Adverse impacts related to waste management are not expected to arise, provided that good site practices are strictly followed. Recommendations for good site practices during the construction activities include:

- Nomination of an approved person, such as a site manager, to be responsible for implementation of good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site and effective disposal to appropriate facilities;
- Training of site personnel in proper waste management and chemical handling procedures;
- Provision of sufficient waste disposal points and regular collection of waste for disposal;
- Minimisation of windblown litter and dust/odour during transportation of waste by transporting wastes in enclosed containers;
- Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors;
- An EMP should be prepared by the Contractor with reference to the requirements in ETWB TCW No. 19/2005 and should be submitted to the Engineer for approval before construction;
- A Waste Management Plan (WMP), as part of EMP, should be submitted to the Engineer for approval prior to the commencement of construction works; and
- Well planned delivery programme for offsite disposal such that adverse environmental impact from transporting the C&D materials is not anticipated.

In order to monitor the disposal of C&D material at landfills and public fill reception facilities, as appropriate, and to control fly tipping, a trip-ticket system should be included as one of the contractual requirements to be implemented by the Contractor. Warning signs should also be displayed to remind the designated disposal sites. Reference shall be made to DEVB TCW No. 6/2010 for details.

4.1.4.2 Waste Reduction Measures

Good management and control could prevent the generation of a significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:

- Sort non-inert C&D materials to recover any recyclable portions;
- Segregation and storage of different types of waste in different containers or skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;
- Any unused chemicals or those with remaining functional capacity shall be recycled;
- Maximising the use of reusable steel formwork to reduce the amount of C&D material;
- Encourage collection of recyclable waste such as waste paper and aluminium cans by providing separate labelled bins to enable such waste to be segregated from other general refuse generated by the work force;
- Prior to disposal of non-inert C&D material, it is recommended that wood, steel and other metals shall be separated for re-use and / or recycling to minimise the quantity of waste to be disposed of to landfill;
- Proper storage and site practices to minimise the potential for damage or contamination of inert C&D materials;

- Provide training to workers on the importance of appropriate waste management procedures, including waste reduction, reuse and recycling;
- Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste; and
- Minimise over ordering of concrete, mortars and cement grout by doing careful check before ordering.

4.1.4.3 C&D Materials

Any surplus inert C&D materials will be disposed of at the Government's public fill reception facilities for beneficial use by other projects in Hong Kong. Due to the site constraint, it is anticipated that there will be insufficient area for stockpiling, such that there no provision of reusing inert C&D material is anticipated at this stage. Nevertheless, the opportunity for on-site reuse of C&D materials will be actively sought throughout the construction phase.

If sufficient and suitable areas being identified, it will be designated within the site for temporary stockpiling of C&D material as far as practical and to facilitate the sorting process. Within stockpile areas, the following measures should be taken to control potential environmental impacts or nuisance:

- Covering material during heavy rainfall;
- Locating stockpiles to minimise potential air quality, water quality and visual impacts; and
- Minimising land intake of stockpile areas as far as possible.

Non-inert C&D materials / C&D wastes should be reused and recycled on-site as far as possible before disposal at the designated landfill site.

The Contractor shall record the amount of wastes generated, recycled and disposed of (including the disposal sites). A trip ticket system (i.e. DEVB TC(W) No. 6/2010) shall be implemented for the disposal of C&D materials and/or C&D waste to any designated public filling facility and/or landfill respectively.

4.1.4.4 Chemical Waste

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

In addition, the following measures shall be observed:

- The Contractor will be required to register with the EPD as a chemical waste producer and to follow the guidelines stated in the "Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes";
- Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately;
- Appropriate labels should be securely attached on each chemical waste container indicating the corresponding chemical characteristics of the chemical waste, such as explosive, flammable, oxidising, irritant, toxic, harmful, corrosive, etc; and
- The Contractor should use a licensed collector to transport and dispose of the chemical wastes at the approved Chemical Waste Treatment Centre or other licensed recycling facilities, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.

4.1.4.5 General Refuse

General refuse should be stored in enclosed bins or compaction units separated from inert C&D materials. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from C&D materials. An enclosed and covered area is preferred to reduce the occurrence of 'wind-blown' light material.

4.1.5 Ecology

As no ecological impact is anticipated, specific mitigation measures are not necessary.

4.1.6 Fisheries

As no fisheries impact is anticipated, specific mitigation measures are not necessary.

4.1.7 Cultural Heritage

As detailed in **Sections 3.1.8** and **3.2.7**, significant or adverse impact on cultural heritage is not anticipated. Therefore, specific mitigation measures are not necessary.

However, in accordance with the Antiquities and Monuments Ordinance (Cap. 53), any discovery of an antiquity or supposed antiquity during the course of work shall be reported to the Antiquities and Monuments Office (AMO).

In addition, as a precautionary measure, monitoring of building settlement, tilting and vibration shall take place during the course of construction under the requirement of the Buildings Ordinance. Pre- and post-construction condition surveys shall be carried out to record the condition of the Hong Kong City Hall. Details of the monitoring proposal to be formulated during detailed design stage shall be submitted to the AMO for agreement.

4.1.8 Landscape and Visual

The proposed works has been designed to minimise the potential landscape and visual impacts as much as possible. Unavoidably, there would be some potential landscape and visual impacts. Landscape and visual mitigation measures as shown in **Table 4.1** are therefore proposed to alleviate the potential adverse landscape and visual impacts during construction phase. The proposed mitigation measures are illustrated on plans (**Figure 4.1a** and **Figure 4.1b)**.

Table 4.1 Landscape and Visual Mitigation Measures during Construction Phase

ID.	Landscape and Visual Mitigation Measures	Funding & Implementation Agency
CM1	**Preservation of Existing Trees and Other Vegetation** All the existing Trees to be retained and not affected by the Project should be carefully protected during the construction phase in accordance with DEVB TCW No. 4/2020 – titled "Tree Preservation" and the latest "Guidelines on Tree Preservation during Development" issued by GLTM Section of DEVB, including provision of Tree Protection Zones (TPZs). Any existing vegetation in landscaped areas and natural terrain not to be affected by the Project should also be carefully preserved. Therefore, these existing landscape elements can maintain their qualities throughout the construction phase.	MTR Corporation
CM2	**Control of Night-time Lighting Glare** Lighting for the construction works at night, if any, should be carefully controlled to prevent light overspill to the nearby VSRs and into the sky.	MTR Corporation
CM3	**Erection of screen hoarding compatible with the surround setting.**	MTR Corporation
CM4	**Management of Construction Activities and Facilities** Construction machinery will be stored in proper covered area for good housekeeping on site. Openings will be decked over wherever feasible to minimise the visual impact to the VSRs who have views overlooking the project site. Bitumen/concrete finish will be temporarily applied to the traffic/construction decks to blend in with the surrounding. Bentonite silos will be with aesthetic painting. The undecked areas would be provided with dust screen/ mesh cover as far as practicable.	MTR Corporation

4.1.9 Hazard to Life

As no hazard to life impact is anticipated, specific mitigation measures are not necessary.

4.2 Operation Phase

4.2.1 Air Quality

As no adverse air quality impact is anticipated during operation phase of the Project, specific mitigation measures are not required.

4.2.2 Noise

4.2.2.1 Airborne Railway Noise

As no airborne railway noise impact is anticipated, specific mitigation measures are not necessary.

4.2.2.2 Groundborne Railway Noise

No adverse groundborne railway noise impact arising from operation of the Project is anticipated. Therefore, no mitigation measure would be required.

4.2.2.3 Fixed Noise

As no adverse fixed noise impact from the proposed ARB is anticipated, specific mitigation measures are not necessary.

4.2.3 Water Quality

As no adverse water quality impact is anticipated, specific mitigation measures are not necessary.

4.2.4 Waste Management

The following measures should be implemented to minimise the amount of waste to be disposed of at landfill and to maximise the recovery of material.

4.2.4.1 General Refuse

Proper storage and collection of general refuse should be provided on site to minimise potential impacts that may arise from improper storage of waste. The general refuse would be regularly collected and disposed of at designated waste collection facilities by a reputable waste collector. Recycling bins would also be provided as far as practicable (subjected to the actual setting in operation phase) to maximise the capture of recyclables from general refuse.

4.2.4.2 Chemical Waste

Used solvents, cleaning fluids and waste lubricating oil may be generated during maintenance activities. To prevent health hazards to operators, all such chemical wastes should be collected and handled carefully.

To minimise potential environmental hazard due to waste handling, localized chemical waste storage areas should be located close to the source of waste generation for temporary storage. Drum-type containers with proper labelling should be used to collect chemical wastes for storage at the designated areas.

The producers should register with EPD as chemical waste producers. Chemical wastes should be stored in appropriate containers and collected by a licensed chemical waste collector. All chemical wastes generated should be dealt with according to the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes under the provisions of the Waste Disposal (Chemical Waste) (General) Regulation. Collection and disposal of chemical waste shall comply with the Waste Disposal Ordinance.

It is recommended that the chemical wastes are disposed at licensed chemical waste treatment facilities, such as the CWTC in Tsing Yi. A licensed collector should be employed for the chemical waste collection.

4.2.5 Ecology

As no ecological impact is anticipated, specific mitigation measures are not necessary.

4.2.6 Fisheries

As no fisheries impact is anticipated, specific mitigation measures are not necessary.

4.2.7 Cultural Heritage

As no cultural heritage impact is anticipated, specific mitigation measures are not necessary.

4.2.8 Landscape and Visual

Landscape and visual mitigation measures during operation phase are shown in **Table 4.2**. The proposed mitigation measures are illustrated on plans (**Figure 4.1a** and **Figure 4.1b)**.

Table 4.2 Landscape and Visual Mitigation Measures during Operation Phase

ID.	Landscape and Visual Mitigation Measures	Funding & Implementation Agency	Maintenance / Management Agency [1]
OM1	**Visual Sensitive Design for the Proposed Ventilation Building** The aboveground structure of the proposed ventilation building shall be visually compatible with the existing surround setting in consistent colour. Greenery shall be incorporated to soften the hard building edges and to complement with the surrounding green setting. Rooftop greening and vertical greenery shall be provided where space permits.	**MTR Corporation**	**MTR Corporation**
OM2	**Reinstatement of Hard and Soft Landscape** All the hard and soft landscape that are disturbed by the construction works and the corresponding temporary traffic arrangement shall be reinstated on like-to-like basis to the satisfaction of the relevant Government Departments.	**MTR Corporation**	**LCSD**
OM3	**Compensatory Tree Planting** Existing trees affected by the proposed construction works should be compensated in accordance with DEVB TC(W) 4/2020.	**MTR Corporation**	**LCSD**

Notes:

[1] The maintenance / management agency is subject to future agreement with government departments.

4.2.9 Hazard to Life

As no hazard to life impact is anticipated, specific mitigation measures are not necessary.

4.3 Environmental Monitoring and Audit

An EM&A programme is recommended to include the monitoring of construction noise and dust on a regular basis. Noise monitoring location shall be set up close to construction NSR, CN1, i.e., New Central Harbourfront Site 3 development (Site 3A) and weekly audits shall be carried out. Construction dust monitoring locations shall also be set up at 4 selected ASRs, close to ASRs A1 (Waterfront area near Central Piers), A4 (Central Barracks Blake Block), A5 (City Gallery) and A7 (New Central Harbourfront Site 3 development) and 1-hr dust monitoring shall be conducted. The monitoring locations proposed in this section are indicative and are subject to further review before commencement of construction works. The monitoring locations shall be relocated to the ASRs which are closet to the major works conducted at the time of monitoring as far as practicable. Site audits should be undertaken during the construction phase of the Project to check that the proposed landscape and visual mitigation measures are properly implemented and maintained. Weekly site inspection /audit shall also be carried out to ensure proper implementation of the proposed mitigation measures by the Contractor.

The proposed mitigation measures to be implemented during construction and operation stages of the project are summarised in **Appendix 4.1**, and applicable items shall be incorporated in the construction contract documents. The Project Proponent will supervise and monitor the implementation of these measures by the Contractor. Details of the proposed EM&A programme are given in **Appendix 4.2**.

4.4 Any Further Implications

Operation of the ARO will follow the Operation and Maintenance (O&M) Manuals to be prepared by MTRCL in accordance with relevant ordinances, regulations and standards. Further implications are not anticipated.

5 Use of Previously Approved EIA Reports

The following approved EIA Reports are referenced in the preparation of this Project Profile:

- Lantau and Airport Railway: Environmental Impact Study. This EIS was submitted to the EPD in 1994, i.e., before the EIAO came into operation on 1 April 1998. The report was made reference to the background of the construction and operation of the whole LAR including the section of overrun tunnel at Hong Kong Station where the overrun tunnels (i.e., the proposed ARO) would be constructed eastwards from the Hong Kong Station at later stages of the Central and Wanchai Reclamation.
- Central Reclamation Phase III (CRIII) (Ref: AEIAR-040/2001). This EIA was approved on 31 August 2001. This report covers the environmental impacts of the construction and operation of the overrun tunnel (i.e., the proposed ARO). The EIA concluded that the Project would be environmentally acceptable with the implementation of the proposed mitigation measures during construction, operation and aftercare phases. A built heritage impact assessment was conducted separately by Antiquities and Monuments Office (AMO) for historical buildings and structures within the project area of the CRIII and appended to the CRIII EIA in Appendix W. Relevant findings of the built heritage impact assessment have been made reference to where appropriate.
- Central-Wan Chai Bypass and Island Eastern Corridor Link (Ref: AEIAR-041/2001). This EIA was approved on 31 August 2001. The report was made reference to the condition of exiting noise sensitive receivers at PLA Headquarters in Chapter 4 of the EIA.
- Shatin to Central Link – Tai Wai to Hung Hom Station (Ref: AEIAR-167/2012). This EIA was approved on 17 February 2012. The Safety Factor adopted for the calculation of groundborne railway noise has been referred to Section 9.4.13 of the approved EIA.
- Shatin to Central Link - Hung Hom to Admiralty Section (Ref: AEIAR-166/2012). This EIA was approved on 17 February 2012. With reference to the approved EIA where cut and cover method was adopted for construction of a tunnel of more than 600 m (Wan Chai Sports ground to Exhibition Station), some decking together with other construction dust mitigation measures are recommended and the mitigated dust impacts at nearby sensitive receivers are assessed to be in compliance with the relevant EIAO-TM requirements. As the nature of work, surrounding environment, and recommended dust mitigation measures of that approved EIA are similar to those of this ARO project, it is anticipated the similarly mitigated dust impact due to the ARO project would comply with the relevant EIAO-TM requirements.
- Tung Chung Line Extension (TUE) (Ref: AEIAR-235/2022). This EIA was approved on 12 July 2022. The train types of TUE are the same as the types of the ARO. The following factors adopted in the calculation of groundborne railway noise for the ARO have been referred to Section 4.7 of TUE EIA.
  - Force Density Level (FDL)
  - Line Source Response (LSR)
  - Trackform Insertion Loss (TIL)
  - Building Coupling Factor (BCF)
  - Conversion To Noise (CTN)

6 Conclusion

The proposed ARO is considered to constitute material changes to the exempted designated project (LAR) under the EIAO. Hence, this Project Profile is submitted under the EIAO to provide sufficient information for direct application of an Environmental Permit.

Potential environmental impacts in terms of air quality, noise, water, waste management, land contamination, ecology, fisheries, hazard to life, landscape and visual and cultural heritage associated with this Project have been examined. Adverse environmental impacts are not anticipated during both construction and operation stages, given that the recommended environmental protection measures and good site practices are properly implemented.

An EM&A programme is also recommended to ensure the proper implementation of control measures and to monitor regularly the environmental impacts on the neighbouring areas throughout the construction period.

In conclusion, the relevant requirements in Annexes 3 to 10 of the EIAO-TM are considered to have been met.

Figures

Office and Retail Uses

Landscape Uses
(Incorporated with Amphitheatre)

New Central Harbourfront
Site 3 Development

Site 3A

Site 3B

維多利亞港
VICTORIA HARBOUR

N

LEGEND:

- Project Site
- Works Site (Major Construction Works)
- Proposed MTR Railway Facilities (Including the Overrun Tunnel and Utilities)
- Proposed Ventilation Building
- Works Area (Construction Site Offices, Site Access, Material Storage, Utilities Diversion and/or Temporary Traffic Management (TTM))

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
DESIGNED	ST
CHECKED	EC
APPROVED	RC
DATE	DEC 2022

MTR

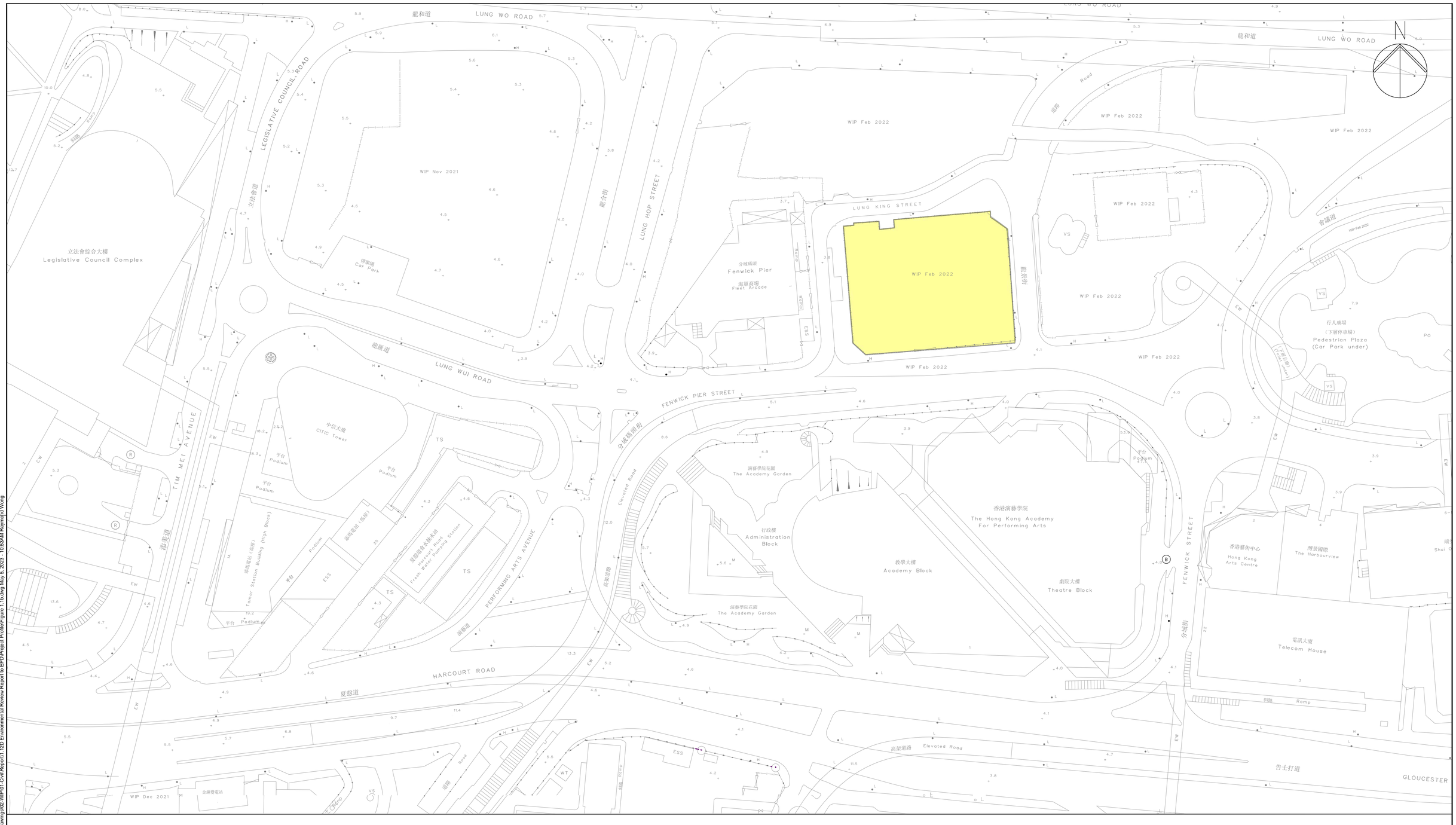
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

CADD REF. Figure 1.1a – Project Location.dwg

TITLE
CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
PROJECT LOCATION

SCALE	DRAWING NO.	REV.
1 : 1500	FIGURE 1.1a	B



LEGEND:

WORKS AREA FOR MATERIAL STORAGE

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

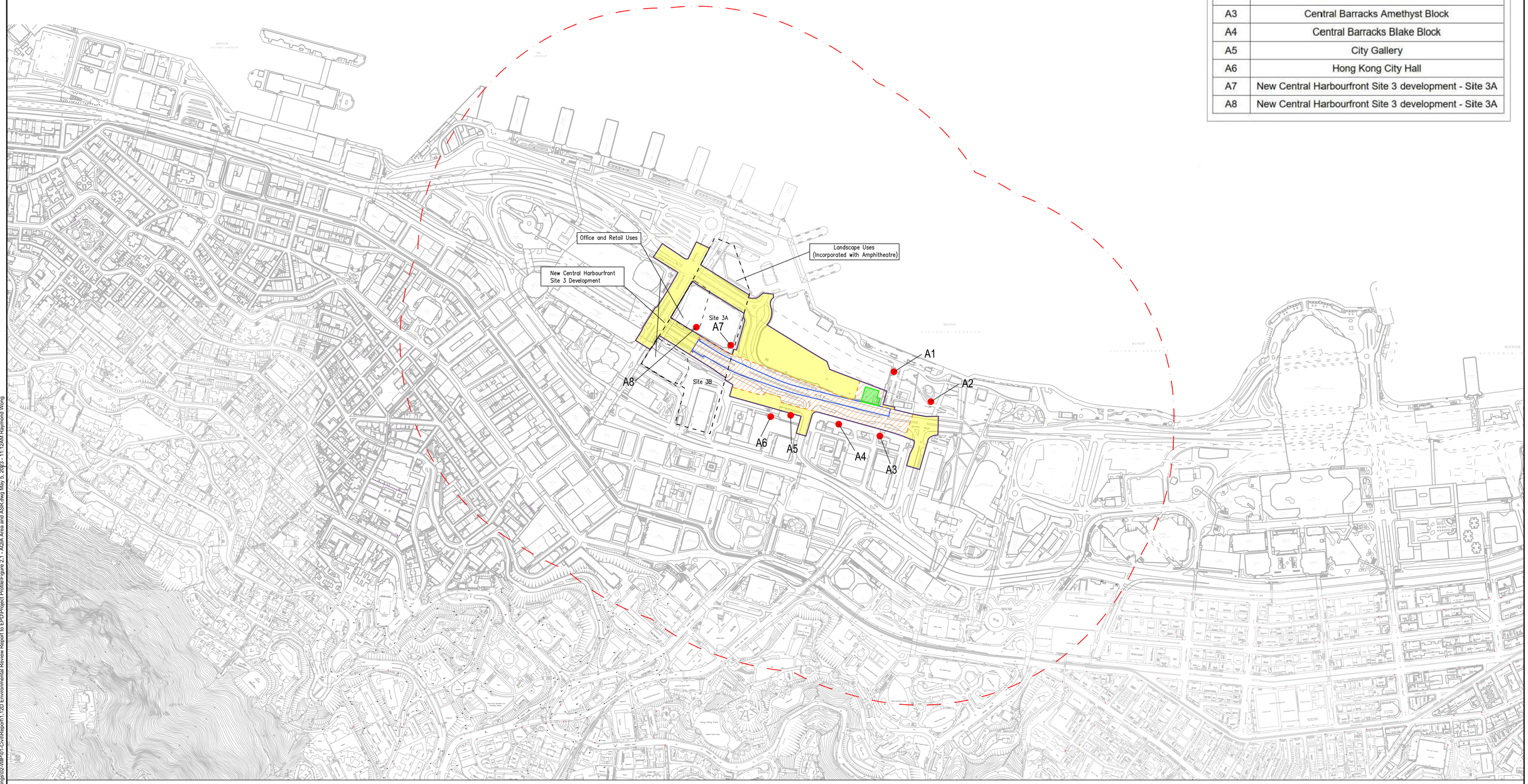
CADD REF. Figure 1.1b

TITLE
CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
TEMPORARY WORKS AREAS

SCALE	DRAWING NO.	REV.
N.T.S.	FIGURE 1.1b	B

F:\426338-Hong Kong\426338 - C1901 - Design Servie for Air\Project Files\01-BIM and Drawings\02-WIP\01-Civil\Report\1. 12D Environmental Review Report to EPD\Project Profile\Figure 1.1b.dwg May 5, 2023 - 10:53AM Raymond Wong

ASR	Description
A1	Waterfront near Central Piers
A2	The Tamar Cultural Plaza
A3	Central Barracks Amethyst Block
A4	Central Barracks Blake Block
A5	City Gallery
A6	Hong Kong City Hall
A7	New Central Harbourfront Site 3 development - Site 3A
A8	New Central Harbourfront Site 3 development - Site 3A



LEGEND:

- Project Site
- Works Site (Major Construction Works)
- 500m Study Area
- Proposed Ventilation Building
- Proposed MTR Railway Facilities (Including the Overrun Tunnel and Utilities)
- Air Sensitive Receiver
- Works Area (Construction Site Offices, Site Access, Material Storage, Utilities Diversion and/or Temporary Traffic Management (TTM))

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
DESIGNED	ST
CHECKED	EC
APPROVED	RC
DATE	DEC 2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

CADD REF. Figure 2.1 – AQIA Area and ASR.dwg

TITLE

CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

AIR QUALITY STUDY AREA AND SENSITIVE RECEIVER

SCALE	DRAWING NO.	REV.
1 : 4000	FIGURE 2.1	B

NSR ID	Description
CN1	New Central Harbourfront Site 3 development - Site 3A

N

Office and Retail Uses

New Central Harbourfront Site 3 Development

CN1

Landscape Uses (Incorporated with Amphitheatre)

Construction Zone B2

Culvert F Diversion

Construction Zone C1

Construction Zone ARB

Construction Zone C2

Site 3A

Site 3B

Construction Zone A

Construction Zone B1

City Gallery

Hong Kong City Hall

Central Barracks Amethyst Block

Central Barracks Blake Block

LEGEND:

- Project Site
- Works Site (Major Construction Works)
- 300m Study Area
- Representative NSRs
- Construction Zone A
- Construction Zone B1
- Construction Zone B2
- Construction Zone C1
- Construction Zone C2
- Construction Zone ARB
- Works Area (Culvert F Diversion)

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
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CHECKED	EC
APPROVED	RC
DATE	DEC 2022

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
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TITLE

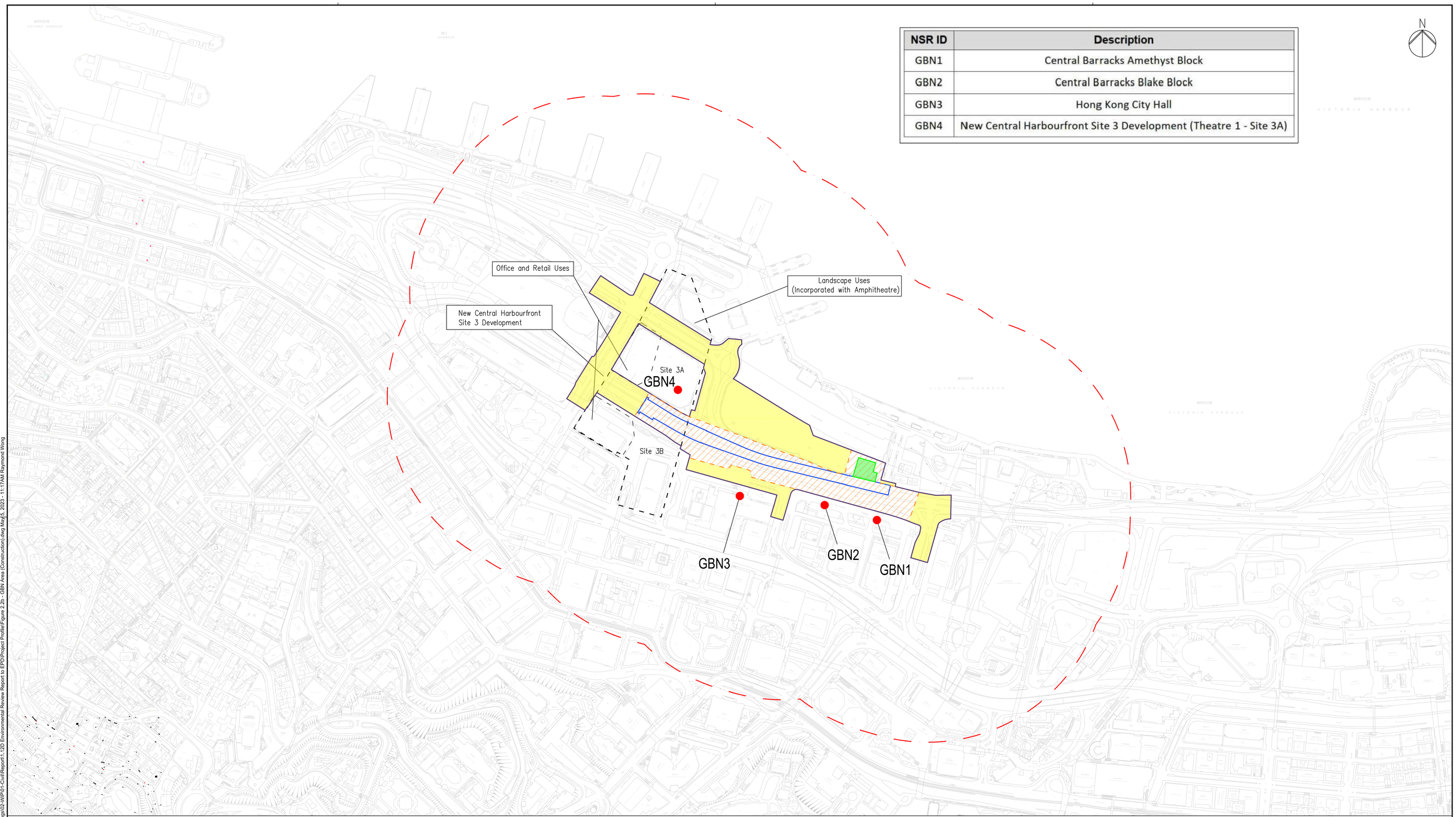
CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

NOISE STUDY AREA AND
SENSITIVE RECEIVERS (FOR AIRBORNE CONSTRUCTION NOISE)

SCALE	DRAWING NO.	REV.
1 : 3000	FIGURE 2.2a	B

F:\426338-Hong Kong\426338 - C1901 - Design Servie for Air\Project Files\01-BIM and Drawings\02-WIP\01-Civil\Report\1.12D Environmental Review Report to EPD\Project Profile\Figure 2.2a - CNA Area and NSR_r.dwg May 5,2023 - 11:14AM Raymond Wong

NSR ID	Description
GBN1	Central Barracks Amethyst Block
GBN2	Central Barracks Blake Block
GBN3	Hong Kong City Hall
GBN4	New Central Harbourfront Site 3 Development (Theatre 1 - Site 3A)



LEGEND:

- Project Site
- Works Site (Major Construction Works)
- 300m Study Area
- Proposed Ventilation Building
- Proposed MTR Railway Facilities (Including the Overrun Tunnel and Utilities)
- Noise Sensitive Receiver
- Works Area (Construction Site Offices, Site Access, Material Storage, Utilities Diversion and/or Temporary Traffic Management (TTM))

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
DESIGNED	ST
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APPROVED	RC
DATE	DEC 2022

MTR

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

CADD REF. FIGURE 2.2b

TITLE

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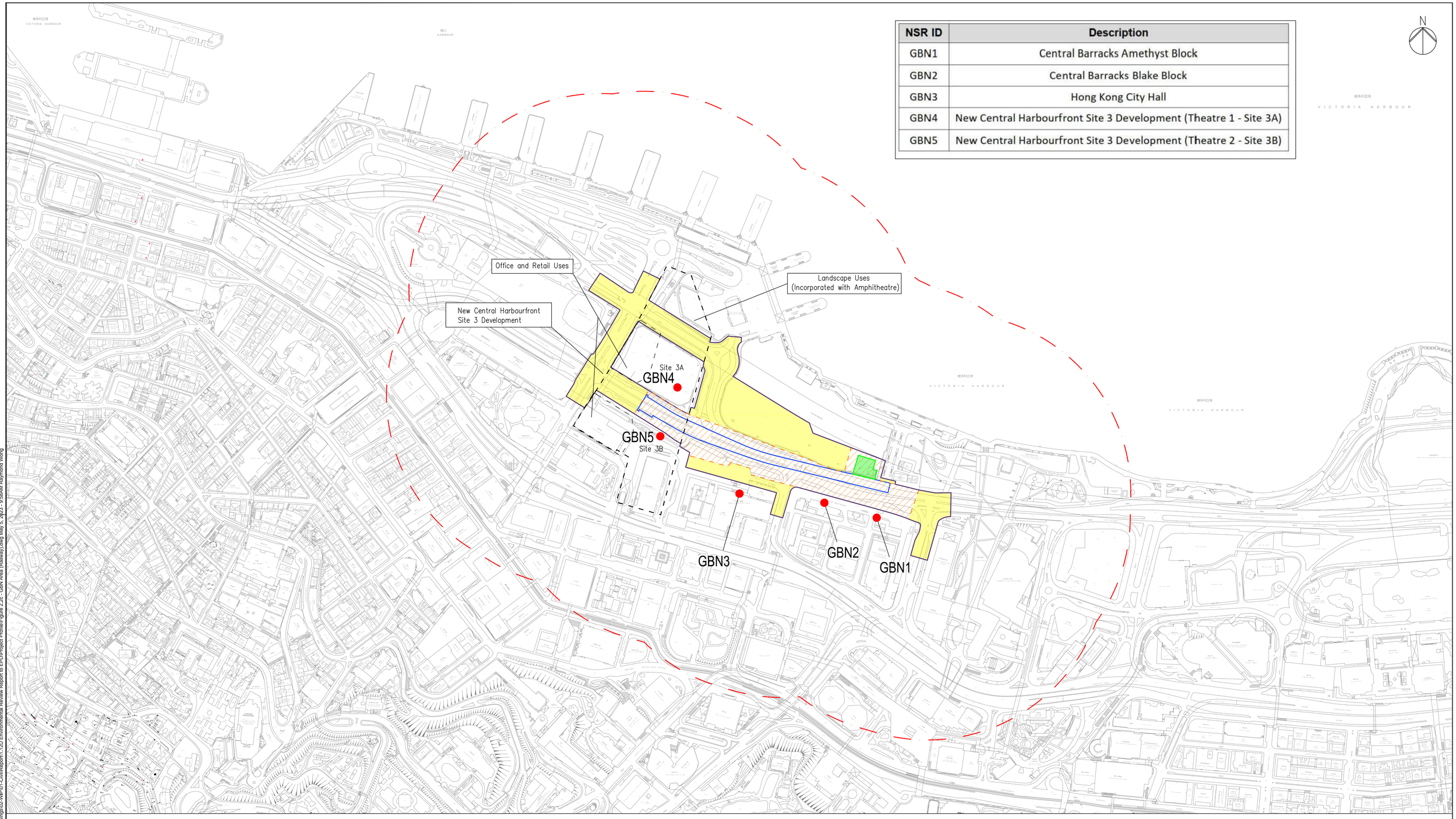
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

NOISE STUDY AREA AND
SENSITIVE RECEIVERS (FOR GROUNDBORNE CONSTRUCTION NOISE)

SCALE	DRAWING NO.	REV.
1 : 3000	FIGURE 2.2b	B

F:\426338-Hong Kong\426338 - C1901 - Design Servie for Air\Project Files\01-BIM and Drawings\02-WIP\01-Civil\Report\1.12D Environmental Review Report to EPD\Project Profile\Figure 2.2b - GBN Area (Construction).dwg May 5, 2023 - 11:17AM Raymond Wong

NSR ID	Description
GBN1	Central Barracks Amethyst Block
GBN2	Central Barracks Blake Block
GBN3	Hong Kong City Hall
GBN4	New Central Harbourfront Site 3 Development (Theatre 1 - Site 3A)
GBN5	New Central Harbourfront Site 3 Development (Theatre 2 - Site 3B)



LEGEND:

- Project Site
- Works Site (Major Construction Works)
- 300m Study Area
- Proposed Ventilation Building
- Proposed MTR Railway Facilities (Including the Overrun Tunnel and Utilities)
- Noise Sensitive Receiver
- Works Area (Construction Site Offices, Site Access, Material Storage, Utilities Diversion and/or Temporary Traffic Management (TTM))

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
DESIGNED	ST
CHECKED	EC
APPROVED	RC
DATE	DEC 2022

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

CADD REF.
Figure 2.2c – GBN Area (Railway).dwg

TITLE
CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

NOISE STUDY AREA AND
SENSITIVE RECEIVERS (FOR GROUNDBORNE RAILWAY NOISE)

SCALE	DRAWING NO.	REV.
1 : 3000	FIGURE 2.2c	B

F:\426338-Hong Kong\426338 - C1901 - Design Servie for Air\Project Files\01-BIM and Drawings\02-WIP\01-Civil\Report\1.12D Environmental Review Report to EPD\Project Profile\Figure 2.2c - GBN Area (Railway).dwg May 5, 2023 - 9:58AM Raymond Wong

Cooling Water Intakes ID	Description
C1	MTR New South Intake
C2	Princes's Building Group
C3	HSBC & AIA Tower
C4	Queensway Government Offices

N

C1

C2

C3

C4

Office and Retail Uses

Landscape Uses
(Incorporated with Amphitheatre)

New Central Harbourfront
Site 3 Development

Site 3A

Site 3B

LEGEND:

- Project Site
- Works Site (Major Construction Works)
- 500m Study Area
- Proposed Ventilation Building
- Proposed MTR Railway Facilities (Including the Overrun Tunnel and Utilities)
- Cooling Water Intakes
- Works Area (Construction Site Offices, Site Access, Material Storage, Utilities Diversion and/or Temporary Traffic Management (TTM))

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
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CHECKED	EC
APPROVED	RC
DATE	DEC 2022

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

CADD REF. Figure 2.3 – WSR.dwg

TITLE

CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

INDICATIVE LOCATIONS OF COOLING WATER INTAKES

SCALE	DRAWING NO.	REV.
1 : 4000	FIGURE 2.3	B

F:\426338-Hong Kong\426338 - C1901 - Design Servie for Air\Project Files\01-BIM and Drawings\02-WIP\01-Civil\Report\1.12D Environmental Review Report to EPD\Project Profile\Figure 2.3 - WSR.dwg May 5, 2023 - 10:11AM Raymond Wong

ID	Name / Address of the Identified Declared Monument or Built Heritage
H1	Hong Kong City Hall, Edinburgh Place, Central
H2	The Cenotaph, Central
H3	Old Supreme Court, 8 Jackson Road, Central

ID	Name / Address of Pre-1969 Buildings
B1	St. George's Building, Central
B2	Madarin Oriental Hong Kong, Central
B3	Prince's Building, Central
B4	Grand Building, Central
B5	On Lok Yuen Building, Central

Office and Retail Uses

Landscape Uses
(Incorporated with Amphitheatre)

New Central Harbourfront
Site 3 Development

Site 3A

Site 3B
(to be completed by end of 2032)

Site 3B

B1

B2

B3

B4

B5

H1

H2

H3

VICTORIA HARBOUR

0 25 50 75 100 125 m

LEGEND:

- Project Site
- Works Site (Major Construction Works)
- 300m Study Area
- Proposed Ventilation Building
- The Identified Pre-1969 Buildings
- The Identified Declared Monuments or Built Heritage
- Proposed MTR Railway Facilities (Including the Overrun Tunnel and Utilities)
- Works Area (Construction Site Offices, Site Access, Material Storage, Utilities Diversion and/or Temporary Traffic Management (TTM))

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
DESIGNED	ST
CHECKED	EC
APPROVED	RC
DATE	DEC 2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

CADD REF.
Figure 2.4 – Cultural Heritage.dwg

TITLE
CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

LOCATIONS OF DECLARED MONUMENTS, BUILT HERITAGE AND PRE-1969 BUILDINGS

SCALE –
DRAWING NO. FIGURE 2.4
REV. B

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REV	DESCRIPTION	BY	DATE	APPROVED
P1	PRELIMINARY	JF	SEP 22	RL

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
35/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

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TITLE
CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE RESOURCE PLAN

SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 2.5	—

W:\HKS501\Project\2022\134226-SUBMISSION\CG-LI\VA\Figure 1_Landscape Study Area\Landscape Study Area.dwg Sep 6, 2022 - 7:14PM Joyce Fong

REV	DESCRIPTION	BY	DATE	APPROVED
P1	PRELIMINARY	JF	SEP 22	RL
P2	PRELIMINARY	JF	OCT 22	RL

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
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Hong Kong
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F +852 2827 1823
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TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE CHARACTER AREA PLAN

SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 2.6	P2

W:\HKSS01\Project\2022\13422\C-SUBMISSION\CG-LV\AF\Figure 1_Landscape Study Area\Landscape Study Area.dwg Sep 8, 2022 - 7:14PM Joyce Fong

VSR ID.	VSR
T1	Travellers on Lung Wo Road
T2	Travellers across Lung Wo Road on Tamar Park's landscape deck
R1	Visitors at Hong Kong Observation Wheel
R2	Visitors on the landscape deck in Site 3
R3	Visitors in the Tamar Culture Plaza
O1	Workers at Site 3 building
O2	Workers at City Gallery
O3	Workers at Central Barracks
O4	Workers at Chinese People's Liberation Army Forces Hong Kong Building
O5	Workers at Legislative Council Complex

REV	DESCRIPTION	BY	DATE	APPROVED
P1	PRELIMINARY	JF	SEP 22	RL
P2	PRELIMINARY	JF	OCT 22	RL

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
35/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
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TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
VISUAL SENSITIVE RECEIVER PLAN

SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 2.7	P2

W:\HKS501\Project\402021\34220-SUBMISSION\CG-LVIA\0_CAD\Visual Sensitive Receiver Plan.dwg Sep 21, 2022 - 6:50PM Joyce Fong

PROJECT SITE BOUNDARY

LOT BOUNDARY OF SITE 3 OF IL9088

VISUAL ENVELOPE

PROPOSED MTR RAILWAY FACILITIES

WORKS SITE
(MAJOR CONSTRUCTION WORKS)

WORKS AREA
(CONSTRUCTION SITE OFFICES,
SITE ACCESS, MATERIAL STORAGE,
UTILITIES DIVERSION AND/OR TEMPORARY
TRAFFIC MANAGEMENT)

WORKS SITE
VENTILATION BUILDING

VIEWPOINT FOR PHOTOMONTAGE

VP1

VP2

VP3

VP4

REV	DESCRIPTION	BY	DATE	APPROVED
P1	PRELIMINARY	JF	SEP 22	RL
P2	PRELIMINARY	JF	OCT 22	RL

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

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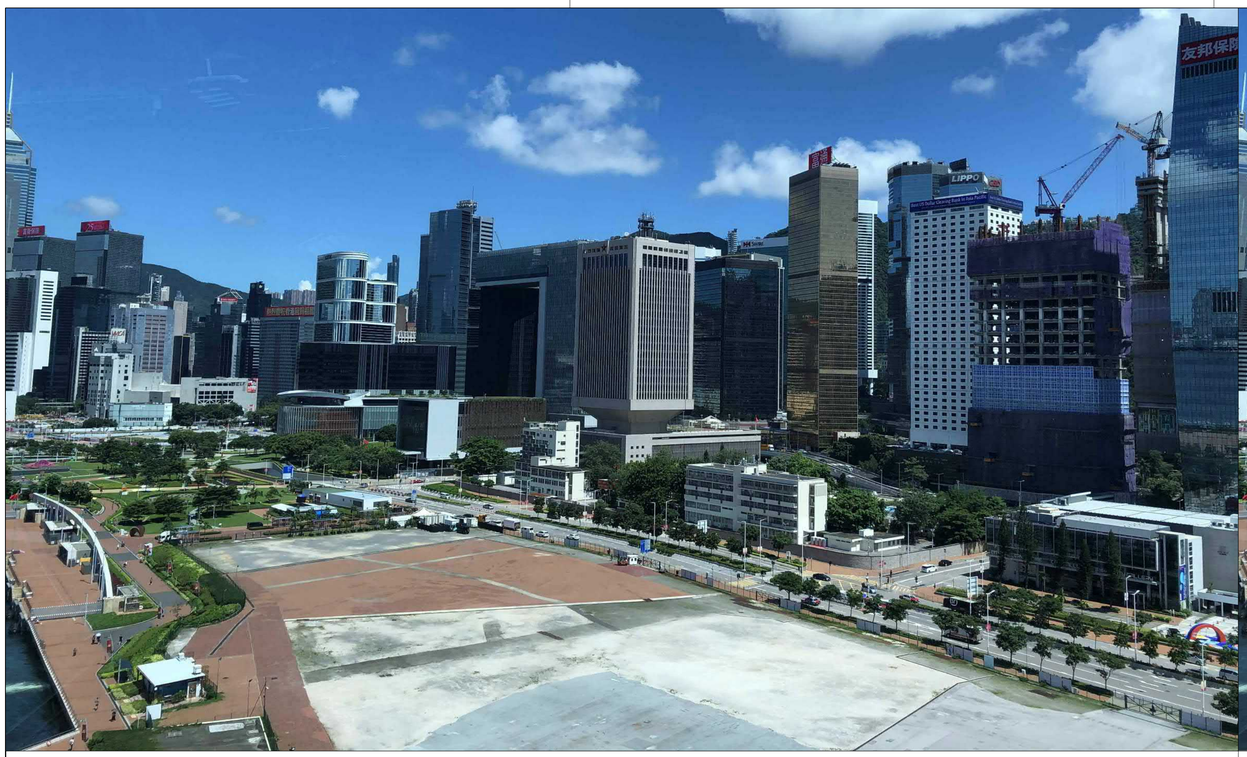
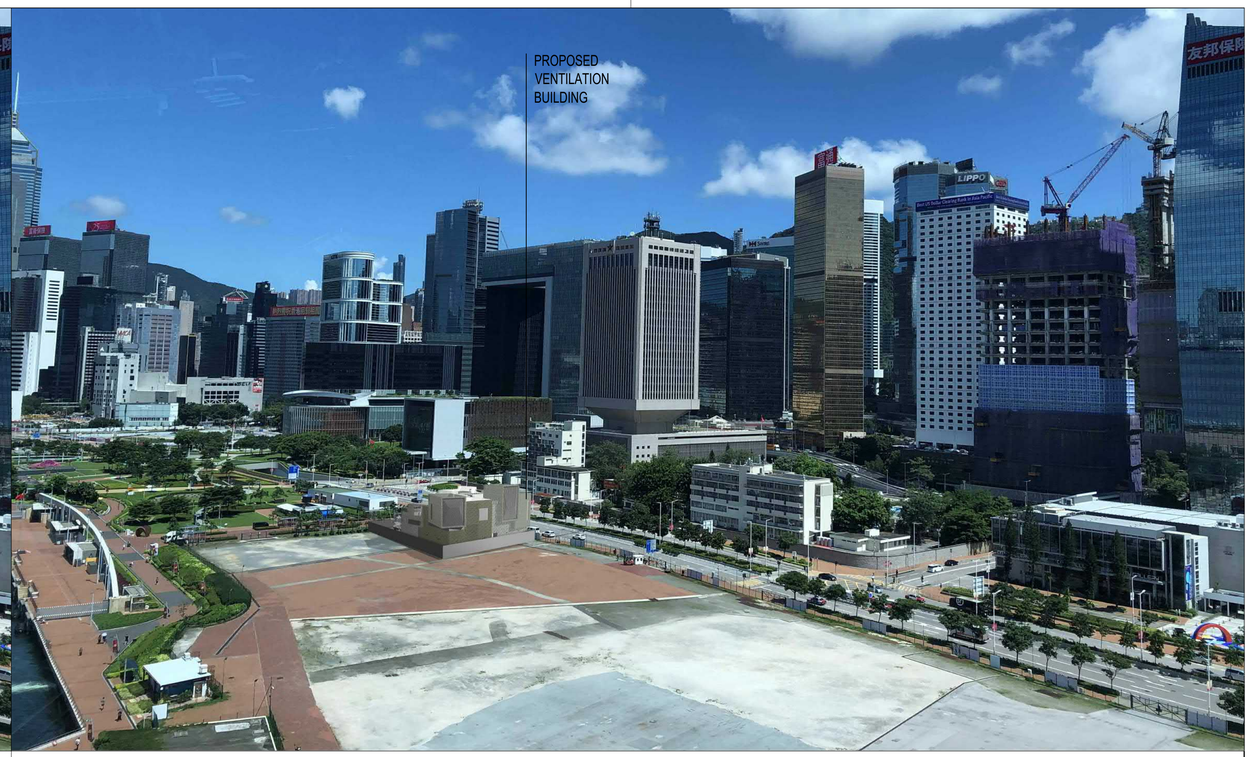
CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
VIEWPOINT LOCATION PLAN

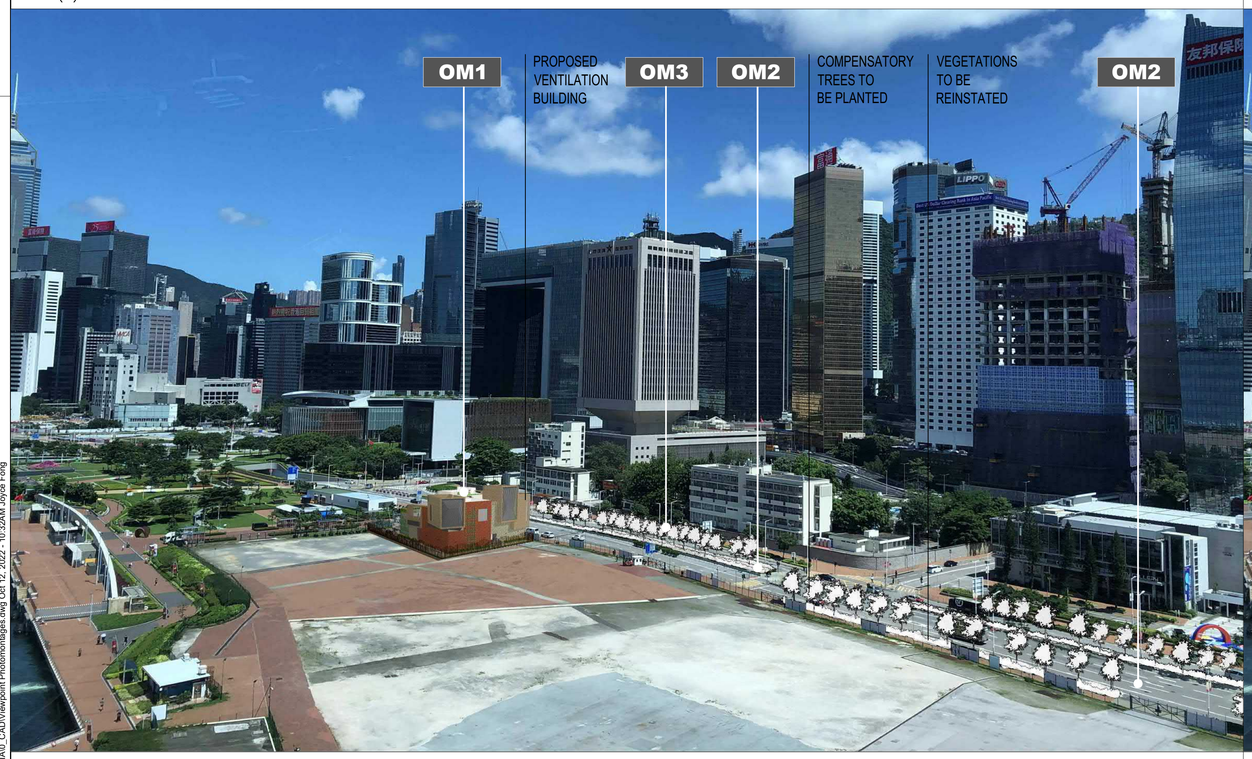
SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 3.1	P2



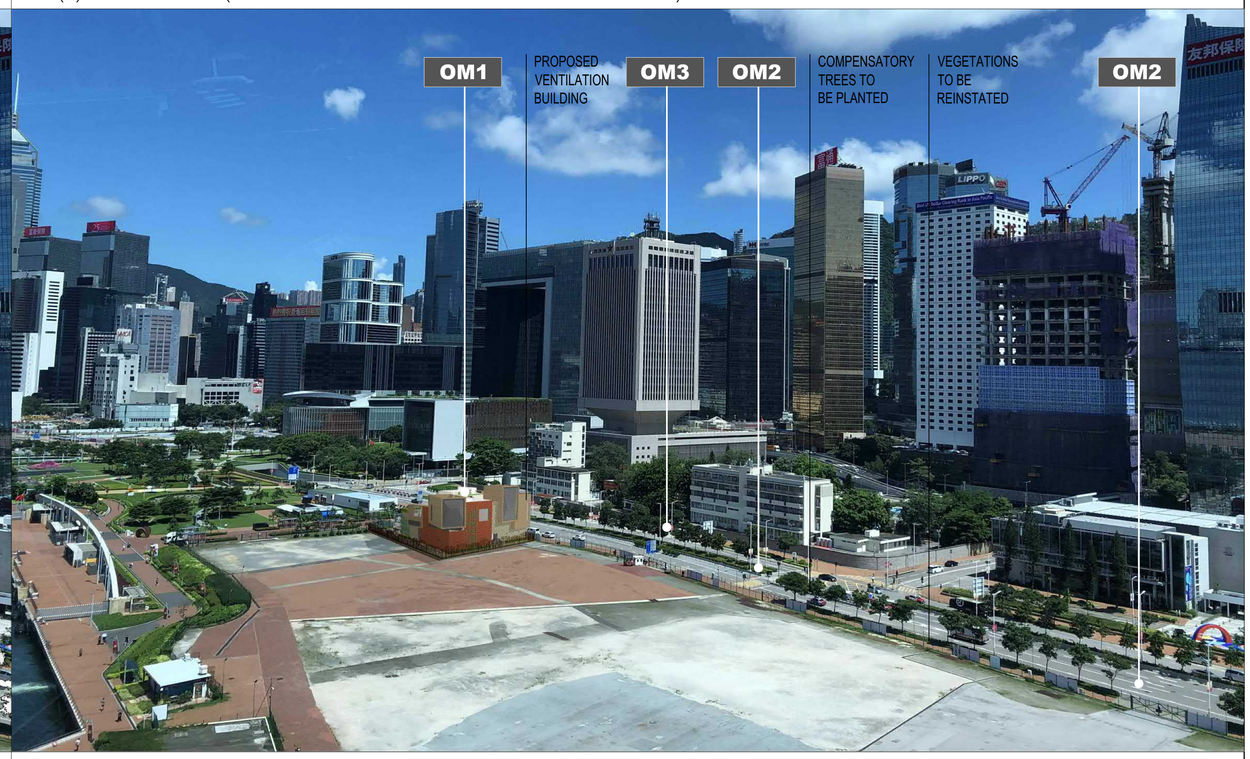
(1) VP1 – EXISTING CONDITION



(2) VP1 – DAY 1 (OPERATIONAL PHASE WITHOUT MITIGATION MEASURE)



(3) VP1 – DAY 1 (OPERATIONAL PHASE WITH MITIGATION MEASURES)



(4) VP1 – YEAR 10 (OPERATIONAL PHASE WITH MITIGATION MEASURES)

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	26/AUG/2022

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
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F +852 2827 1823
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TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
PHOTOMONTAGE
VP 1
HONG KONG OBSERVATION WHEEL

SCALE	DRAWING NO.	REV.
–	FIGURE 3.2a	–

(1) VP2 – EXISTING CONDITION

(2) VP2 – DAY 1 (OPERATIONAL PHASE WITHOUT MITIGATION MEASURE)

(3) VP2 – DAY 1 (OPERATIONAL PHASE WITH MITIGATION MEASURES)

(4) VP2 – YEAR 10 (OPERATIONAL PHASE WITH MITIGATION MEASURES)

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	26/AUG/2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Keun Tong, Kowloon
Hong Kong
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F +852 2827 1823
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TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
PHOTOMONTAGE
VP 2
LANDSCAPE DECK IN SITE 3

SCALE	DRAWING NO.	REV.
–	FIGURE 3.2b	–

(1) VP3 – EXISTING CONDITION

(2) VP3 – DAY 1 (OPERATIONAL PHASE WITHOUT MITIGATION MEASURE)

(3) VP3 – DAY 1 (OPERATIONAL PHASE WITH MITIGATION MEASURES)

(4) VP3 – YEAR 10 (OPERATIONAL PHASE WITH MITIGATION MEASURES)

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	26/AUG/2022

MTR

AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL (ARO)

ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
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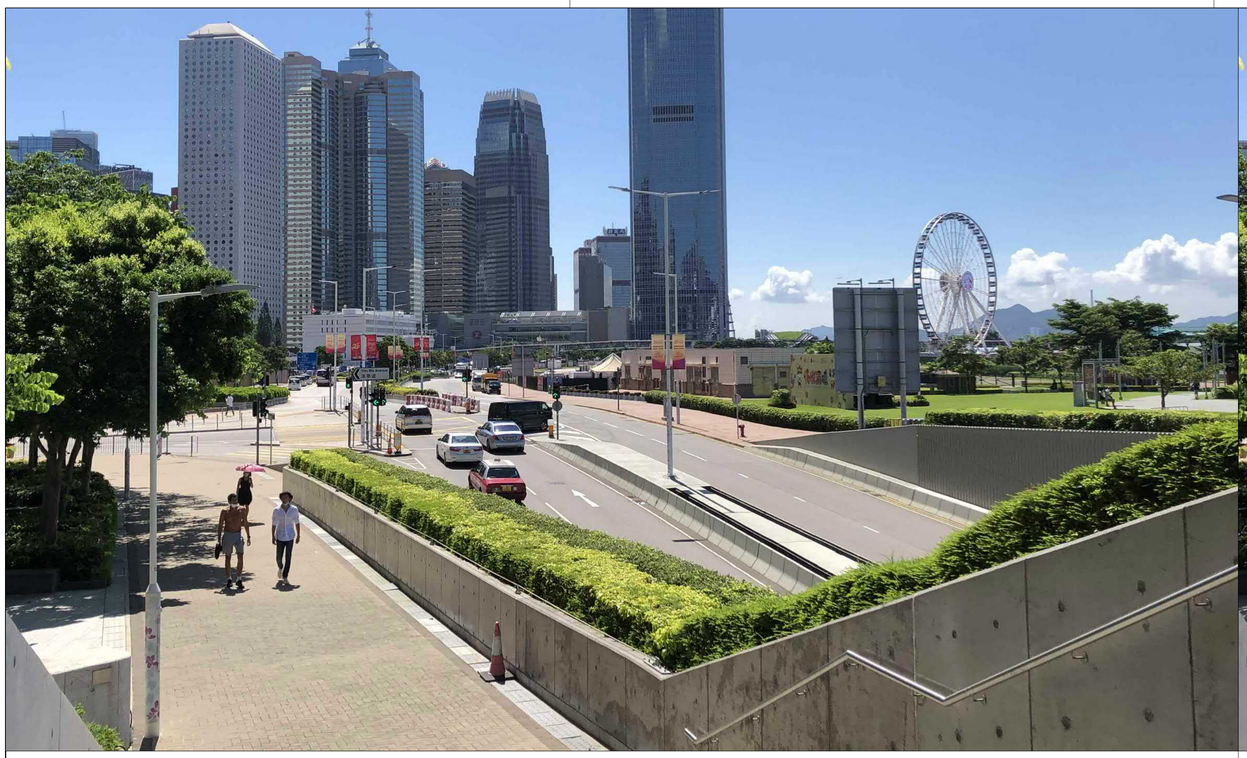
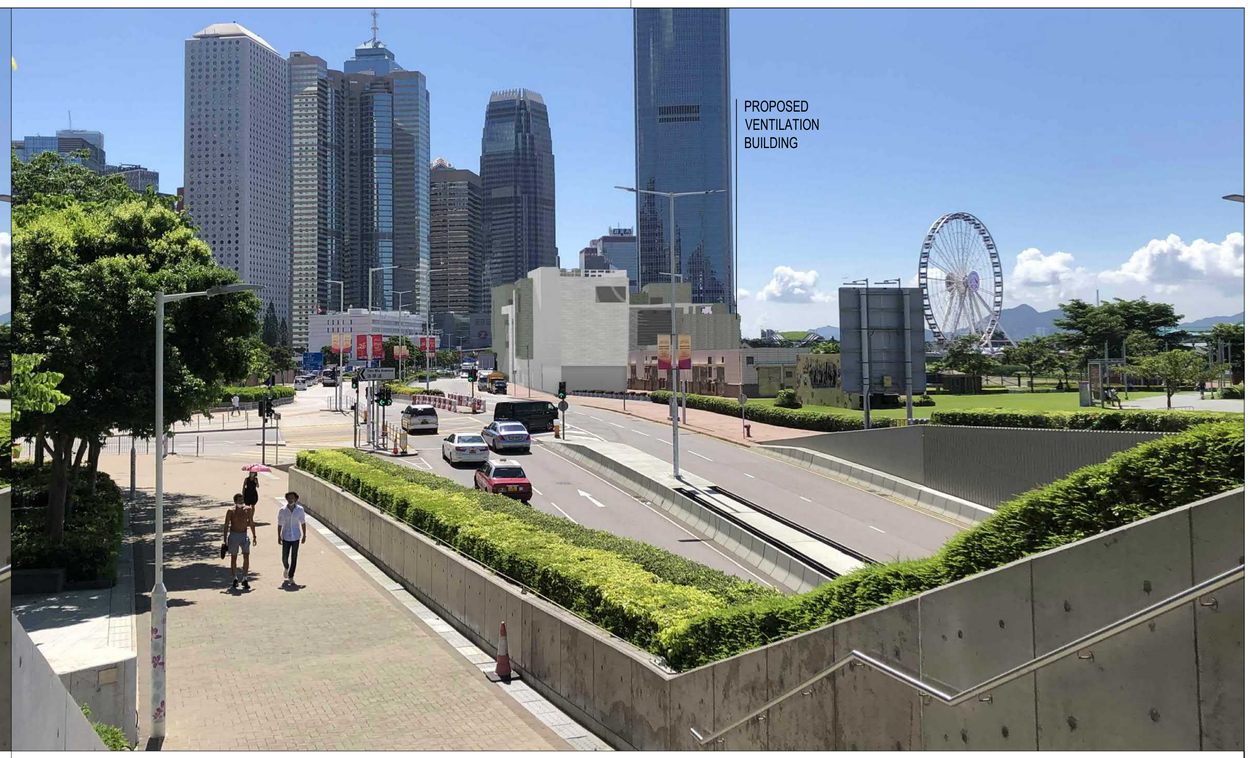
TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
PHOTOMONTAGE
VP 3
PEDESTRIAN WALKWAY ON LUNG WO ROAD

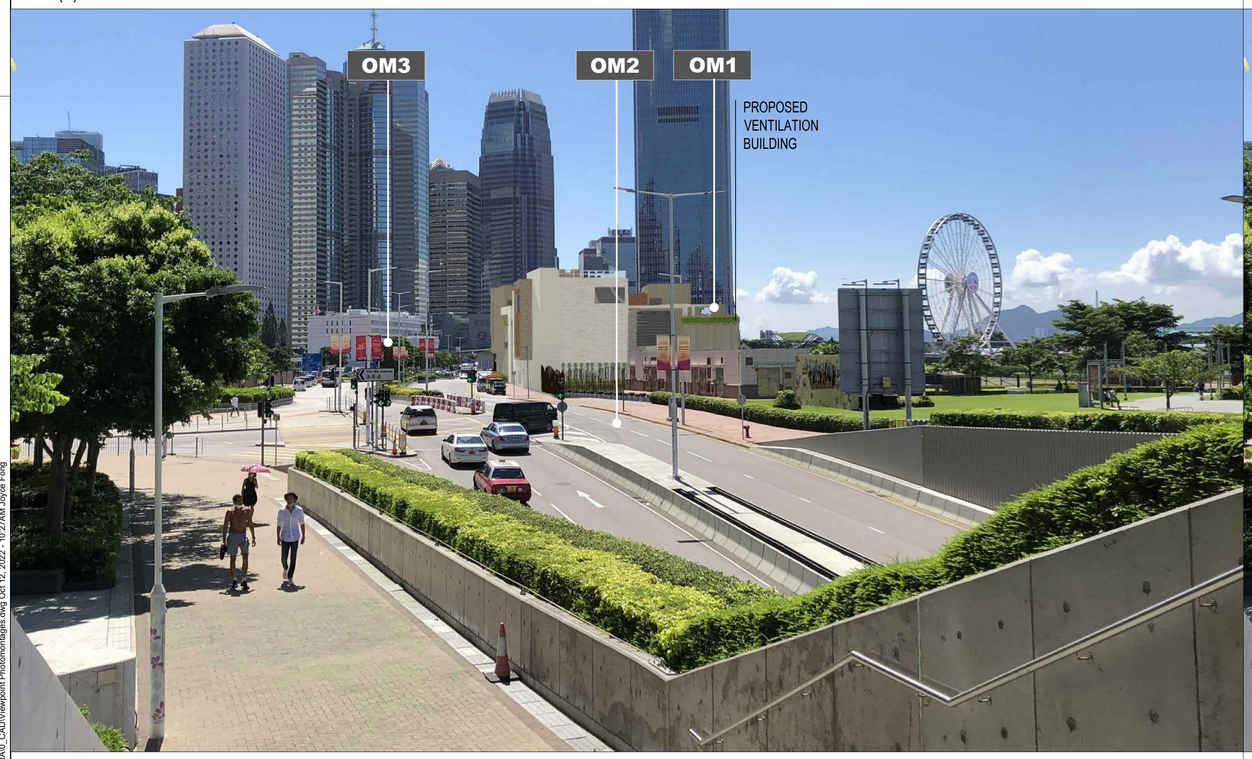
SCALE	DRAWING NO.	REV.
–	FIGURE 3.2c	–



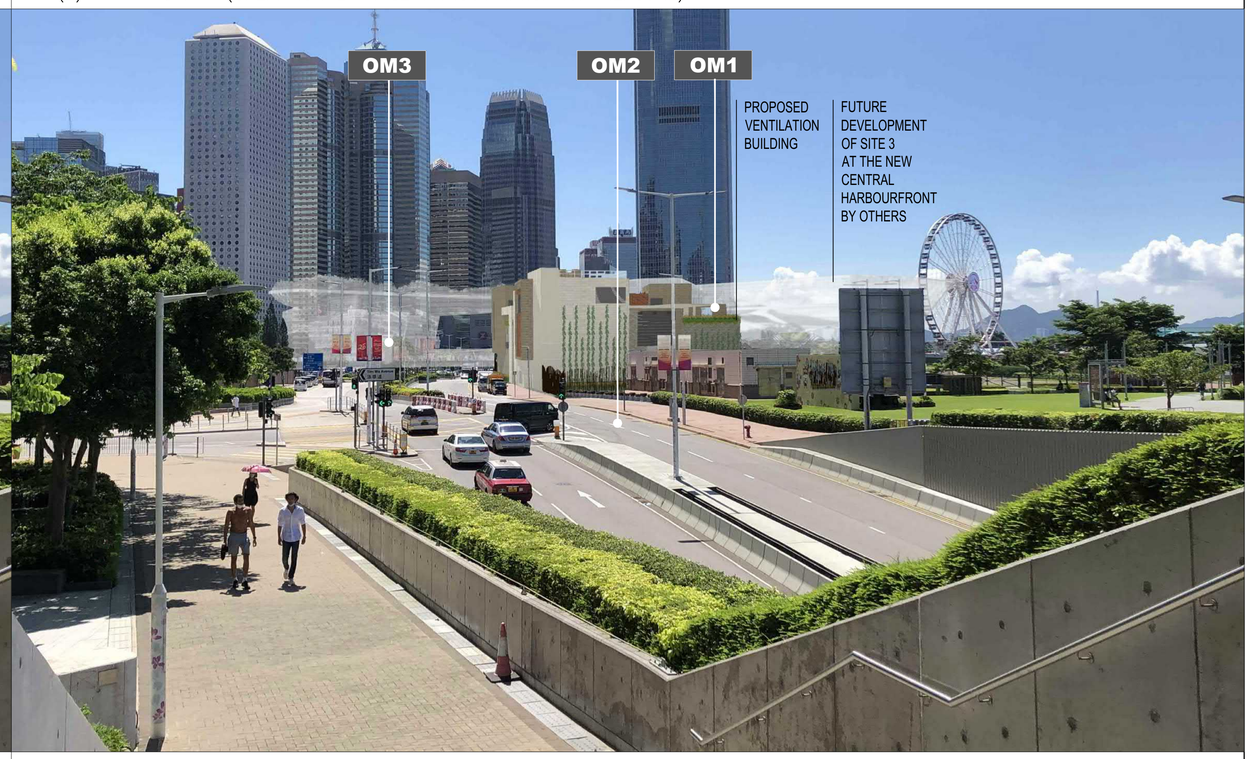
(1) VP4 – EXISTING CONDITION



(2) VP4 – DAY 1 (OPERATIONAL PHASE WITHOUT MITIGATION MEASURE)



(3) VP4 – DAY 1 (OPERATIONAL PHASE WITH MITIGATION MEASURES)



(4) VP4 – YEAR 10 (OPERATIONAL PHASE WITH MITIGATION MEASURES)

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	26/AUG/2022

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MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
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TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
PHOTOMONTAGE
VP 4
LANDSCAPE DECK IN TAMAR PARK

SCALE	DRAWING NO.	REV.
–	FIGURE 3.2d	–

PROJECT SITE BOUNDARY

LOT BOUNDARY OF SITE 3 OF IL9088

WORKS SITE (MAJOR CONSTRUCTION WORKS)

PROPOSED MTR RAILWAY FACILITIES

PROPOSED PLANTING AREA

PRESERVED PLANTING AREA

REINSTATED PAVEMENT (ROADS)

REINSTATED PAVEMENT (PATHWAYS)

PROPOSED COMPENSATORY TREES

TREES TO BE RETAINED

FIGURE 4.1B

REMARKS:

1. THE DRAWING DOES NOT INDICATE PRECISE NUMBER AND LOCATIONS OF RETAINED TREES AND COMPENSATORY TREES.
2. THE PRECISE NUMBER OF TREES TO BE RETAINED, TRANSPLANTED, REMOVED AND COMPENSATED SHALL BE DETERMINED AND AGREED SEPARATELY WITH GOVERNMENT DURING THE TREE PRESERVATION AND REMOVAL APPLICATION PROCESS UNDER DEVB TC(W) NO. 4/2020.
3. LANDSACPE FEATURES AND FORMS OF STRUCTURES SHOWN IN THE DRAWING ARE INDICATIVE ONLY

REV	DESCRIPTION	BY	DATE	APPROVED
P1	PRELIMINARY	JF	SEP 22	RL
P2	PRELIMINARY	JF	OCT 22	RL

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

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MOTT MACDONALD
35F Manulife Place
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Hong Kong
T +852 2828 5757
F +852 2827 1823
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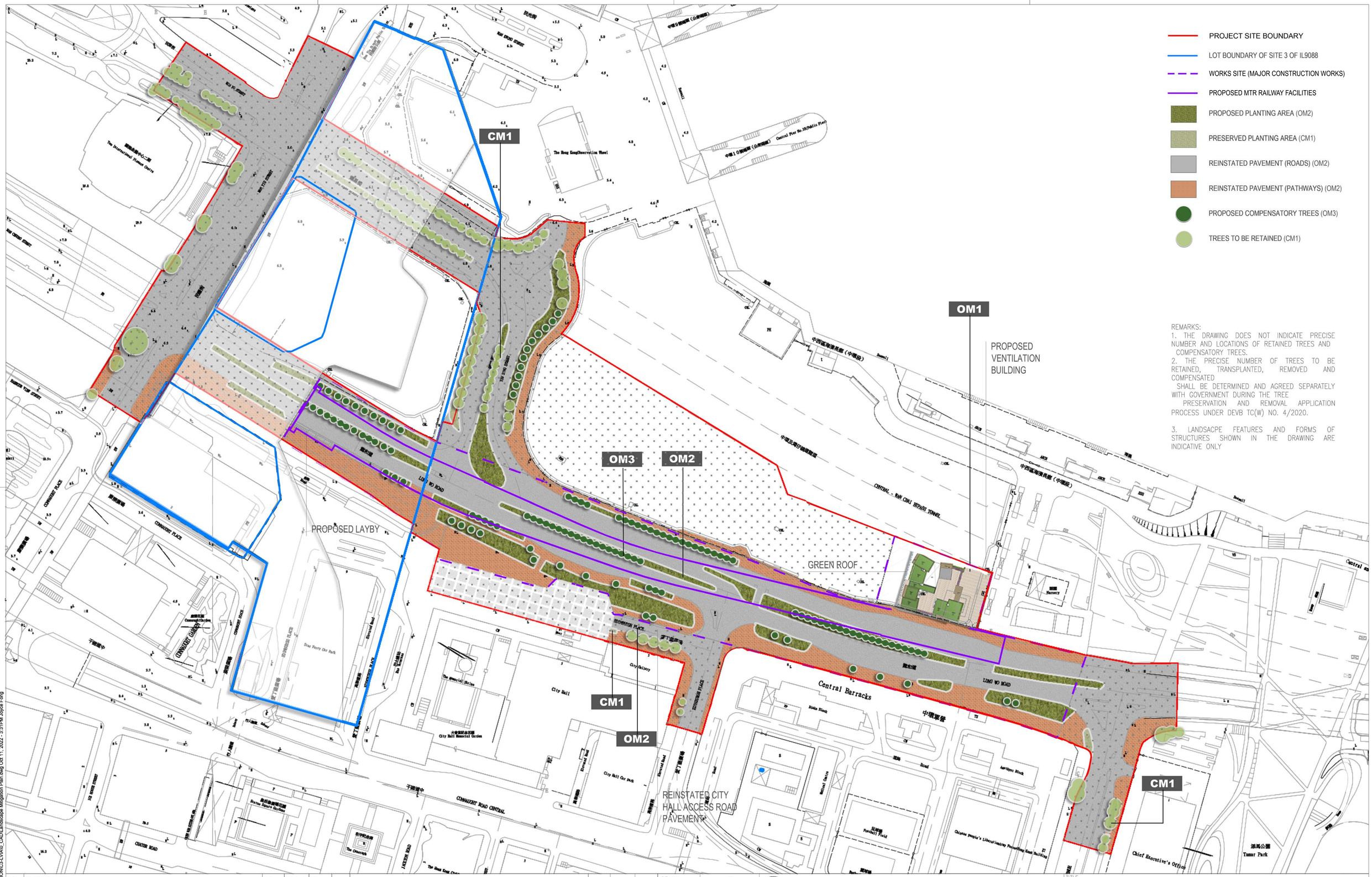
TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE MITIGATION PLAN
(SHEET 1 OF 2)

SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 4.1A	P2



REV	DESCRIPTION	BY	DATE	APPROVED
P1	PRELIMINARY	JF	SEP 22	RL
P2	PRELIMINARY	JF	OCT 22	RL

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

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ORIGINATOR
MOTT MACDONALD
3/F Manulife Place
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Hong Kong
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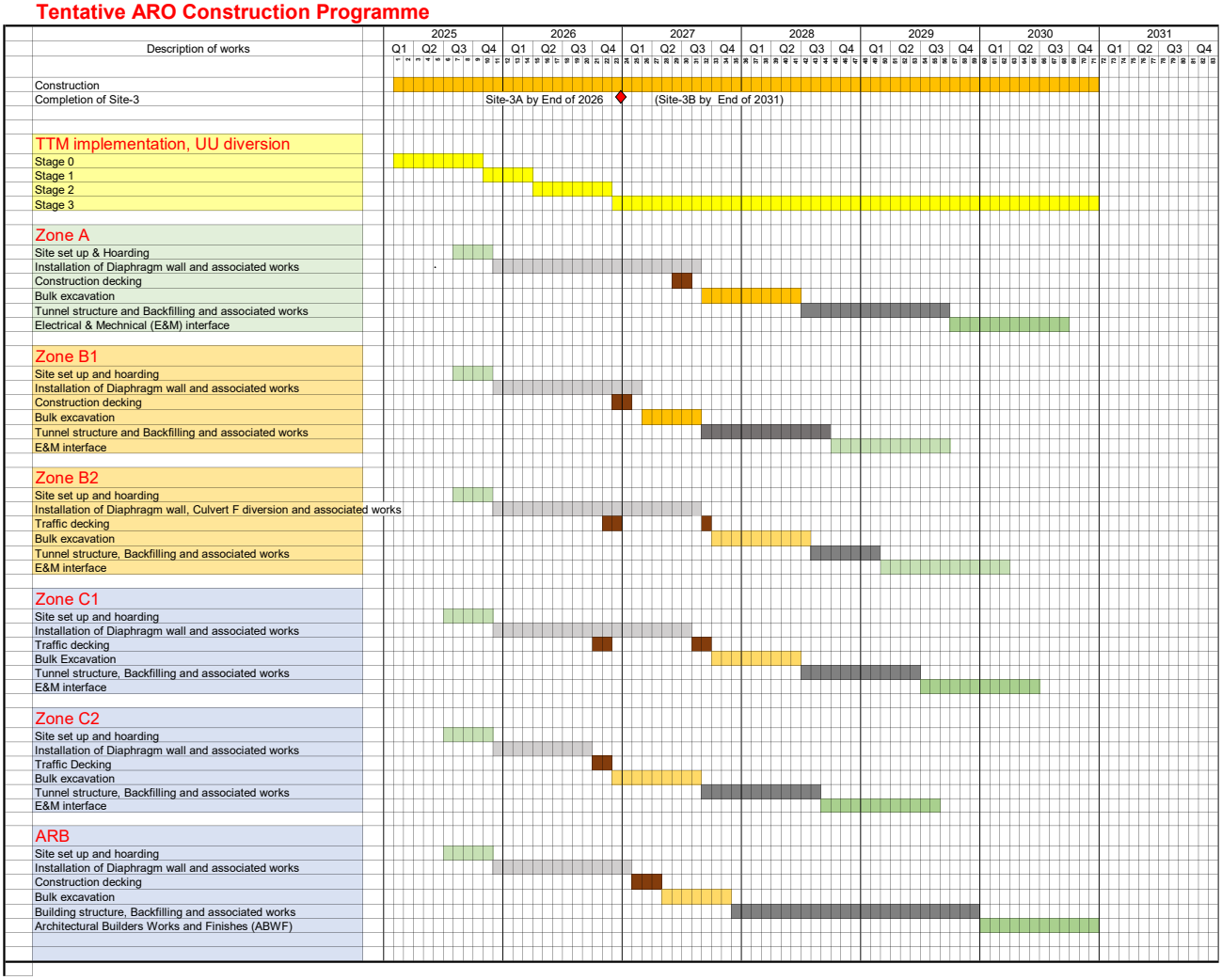
CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE MITIGATION PLAN
(SHEET 2 OF 2)

SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 4.1b	P2

W:\HKSS01\Project\2022\13422C-SUBMISSION\C03-LV\A0_CAD\Landscape Mitigation Plan.dwg Oct 11, 2022 - 3:31PM Joyce Fong

Appendix 1.1 – Tentative Construction Programme of the Project and Locations of Working Zones

Tentative ARO Construction Programme



LEGEND:

- Project Site
- Works Site (Major Construction Works)
- Zone A
- Zone B1
- Zone B2
- Zone C1
- Zone C2
- Zone ARB

N

Office and Retail Uses

New Central Harbourfront Site 3 Development

Landscape Uses (Incorporated with Amphitheatre)

Site 3A

Site 3B

Zone A

Zone B1

Zone B2

Zone C1

Zone ARB

Zone C2

VICTORIA HARBOUR

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	AC/MW
DESIGNED	ST
CHECKED	EC
APPROVED	RC
DATE	DEC 2022

MTR

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MOTT MACDONALD
3/F Manulife Place
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Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
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TITLE

CONSULTANCY AGREEMENT NO. C1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

CONSTRUCTION PROGRAM_ZONE

SCALE	DRAWING NO.	REV.
1 : 1500	FIGURE –	B

Appendix 2.1 – Aerial Image of the LVIA Study Area and Site Photos for the LRs and LCAs

SITE BOUNDARY

LANDSCAPE IMPACT STUDY AREA
100M OFFSET FROM SITE BOUNDARY

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
DESIGNED	
CHECKED	
APPROVED	
DATE	1/SEP/2022

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MOTT MACDONALD
3/F Manulife Place
348 Kwun Tong Road
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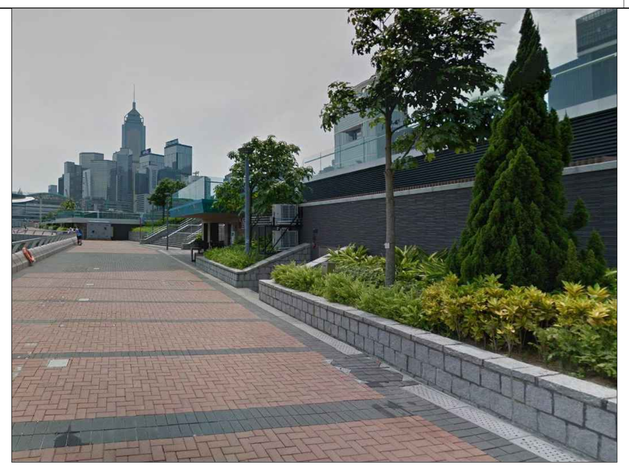
TITLE
CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE STUDY AREA

SCALE	DRAWING NO.	REV.
1 : 2500 (A1)	FIGURE 1	P2

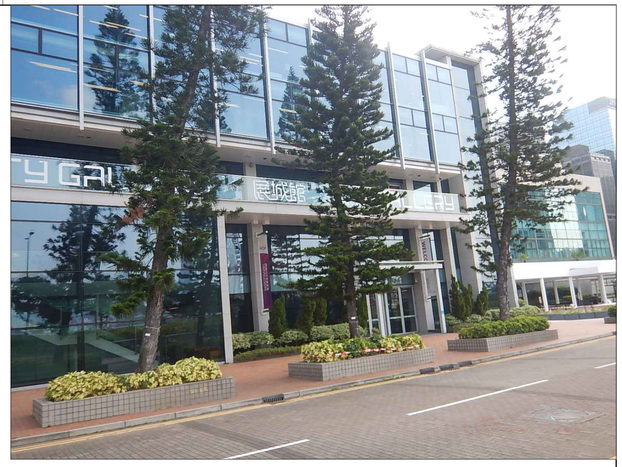
P:\20221\34227C-SUBMISSION\C3-LVIA\Figure 1_Landscape Study Area\Landscape Study Area.dwg Dec 29, 2022 - 1:43pm Theodora Ho

LR 1 – COASTAL WATER

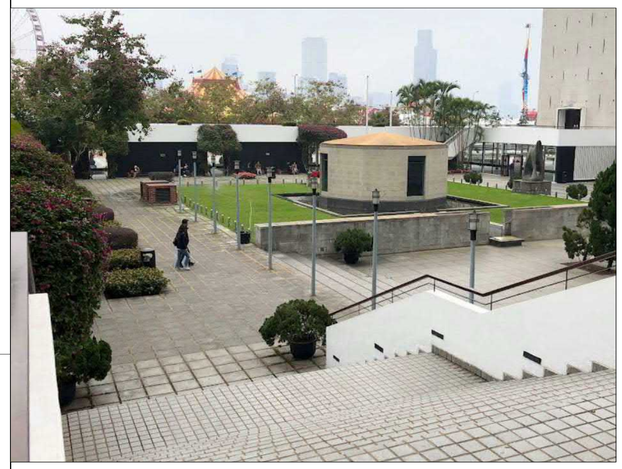
LR 2.1 – AMENITY LANDSCAPE AREA IN TAMAR PARK



LR 2.2 – AMENITY LANDSCAPE AREA IN HARBOURFRONT PROMENADE

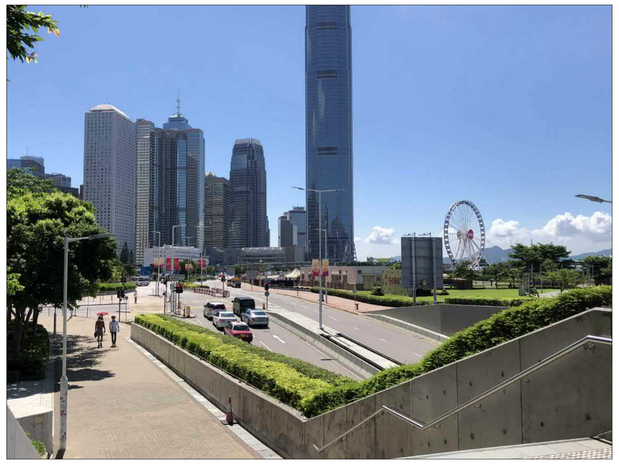


LR 2.3 – AMENITY LANDSCAPE AREA IN CITY GALLERY

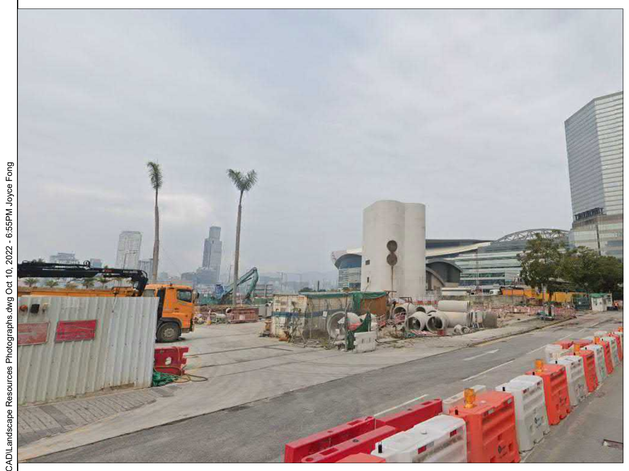


LR 2.4 – AMENITY LANDSCAPE AREA IN CITY HALL MEMORIAL GARDEN

LR 3 – ROADSIDE INFRASTRUCTURE LANDSCAPE



LR 4 – URBAN LANDSCAPE GREENERY



LR 5 – VEGETATION IN CONSTRUCTION WORKS SITE ON LUNG KING ROAD

REV.	DESCRIPTION	BY	DATE	APPROVED	REV.	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
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APPROVED	
DATE	31/AUG/2022

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MOTT MACDONALD
3/F Manulife Place
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Hong Kong
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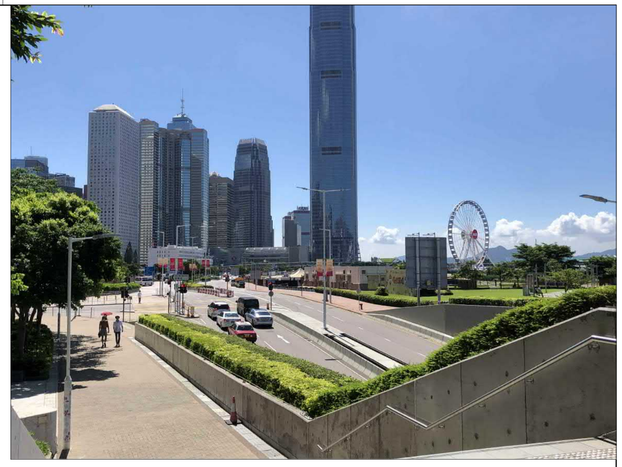
CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE RESOURCES PHOTOGRAPHS

SCALE	DRAWING NO.	REV.
–	FIGURE 2.5.1	–

LCA 1 – HARBOURFRONT LANDSCAPE

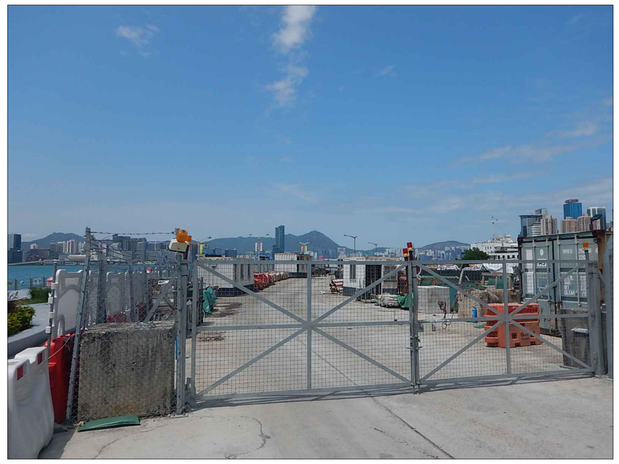
LCA 2 – URBAN PARK LANDSCAPE

LCA 3 – CONSTRUCTION WORKS AREA LANDSCAPE



LCA 4 – TRANSPORTATION CORRIDOR LANDSCAPE

LCA 5 – COMMERCIAL URBAN LANDSCAPE



LCA 6 – MISCELLANEOUS URBAN FRINGE LANDSCAPE

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	JF
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DATE	31/AUG/2022

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Kwun Tong, Kowloon
Hong Kong
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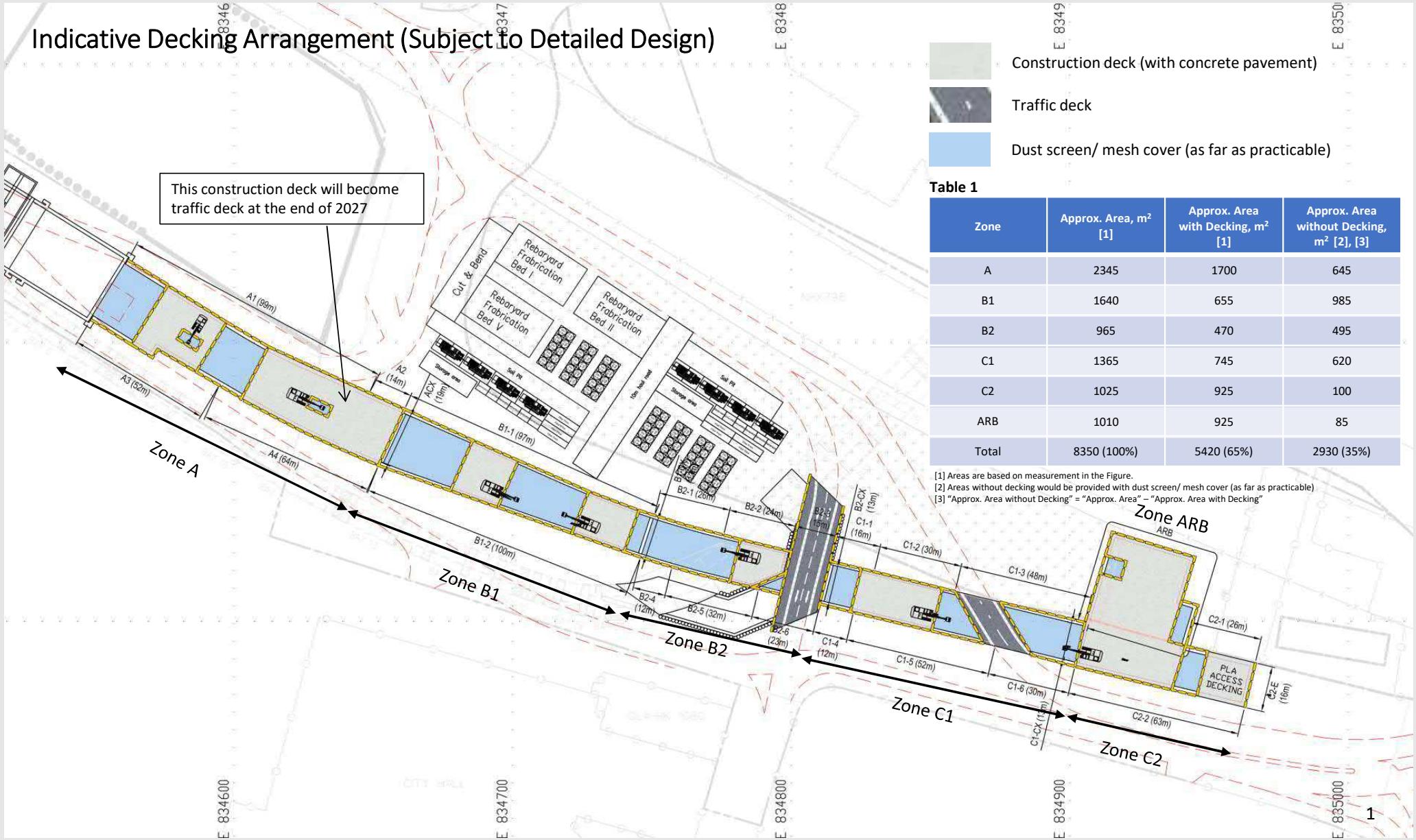
TITLE

CONSULTANCY AGREEMENT NO.1901
AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL
LANDSCAPE CHARACTER AREA PHOTOGRAPHS

SCALE	DRAWING NO.	REV.
–	FIGURE 2.6.1	–

Appendix 3.1 – Indicative Decking Arrangement

Indicative Decking Arrangement (Subject to Detailed Design)



Construction deck (with concrete pavement)

Traffic deck

Dust screen/ mesh cover (as far as practicable)

Table 1

Zone	Approx. Area, m² [1]	Approx. Area with Decking, m² [1]	Approx. Area without Decking, m² [2], [3]
A	2345	1700	645
B1	1640	655	985
B2	965	470	495
C1	1365	745	620
C2	1025	925	100
ARB	1010	925	85
Total	8350 (100%)	5420 (65%)	2930 (35%)

[1] Areas are based on measurement in the Figure.
[2] Areas without decking would be provided with dust screen/ mesh cover (as far as practicable)
[3] "Approx. Area without Decking" = "Approx. Area" – "Approx. Area with Decking"

Indicative Decking Arrangement (Subject to Detailed Design)

Decking and Bulk Excavation Programme (extracted from Appendix 1.1)

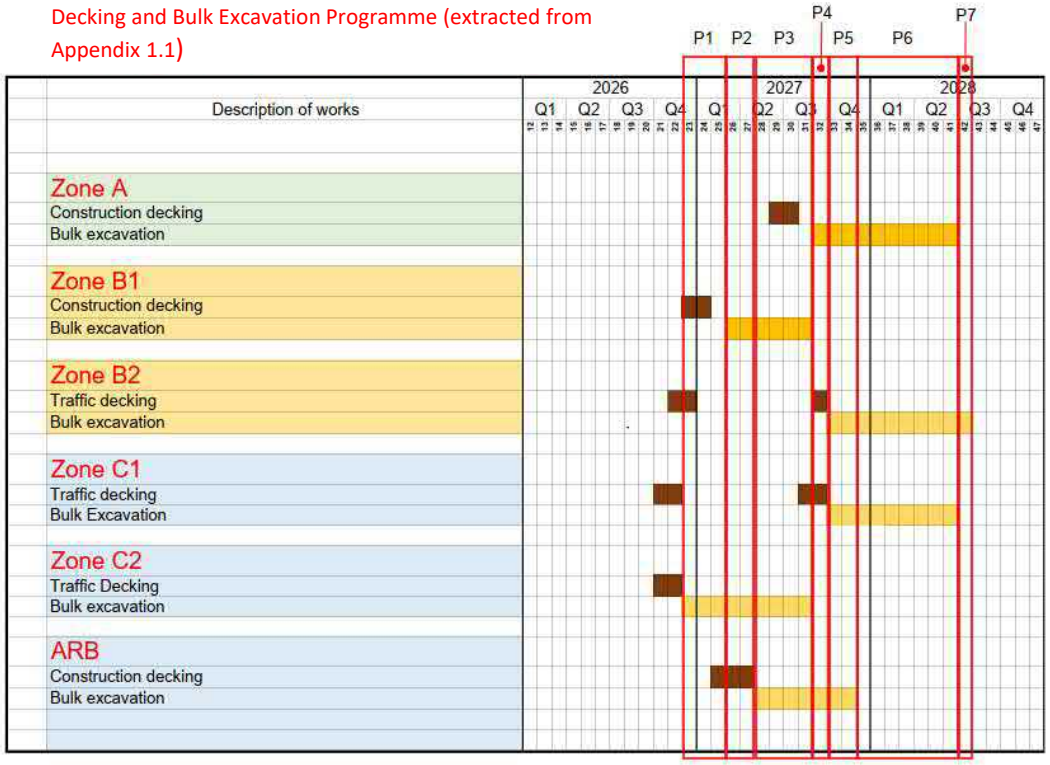
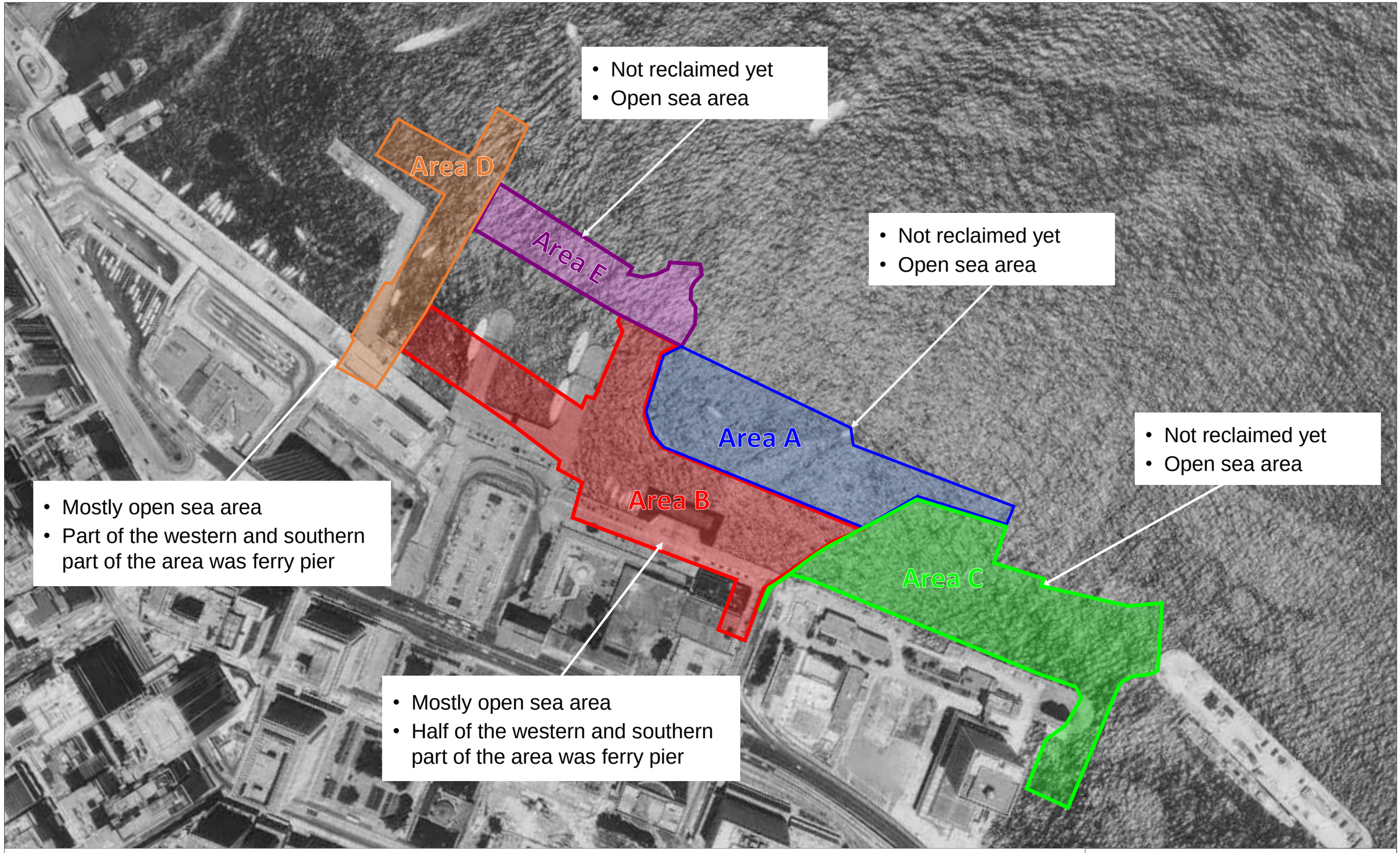


Table 2

Period	Excavation Duration	Zones	Approx. area with excavation not under decking, m^2 [1]	Approx. area with excavation under decking or without any excavation in-progress, m^2 [2], [3]	Approx. % of area with excavation not under decking [4]	Approx. % of area with excavation under decking or without any excavation in-progress [4]
P1	Q4 2026 - Q1 2027	C2	100	8250	1%	99%
P2	Q1 2027 - Q2 2027	B1, C2	1085	7265	13%	87%
P3	Q2 2027 – Q3 2027	B1, C2, ARB	1170	7180	14%	86%
P4	Q3 2027	A, ARB	730	7620	9%	91%
P5	Q4 2027	A, B2, C1, ARB	1845	6505	22%	78%
P6	Q4 2027 – Q2 2028	A, B2, C1	1760	6590	21%	79%
P7	Q3 2028	B2	495	7855	6%	94%

[1] "Approx. area with excavation not under decking" is calculated as the total of "Approx. Area without Decking" in Table 1 for the corresponding Zone(s) during the specific Period. For example, during Period P2, "Approx. area with excavation not under decking" = "Approx. Area without Decking" for Zone B1 + "Approx. Area without Decking" for Zone C2 = 985m^2 + 100m^2 = 1085m^2
[2] Areas without any excavation in progress refer to areas of the Zones where no excavation would be in progress as shown in the Programme next to this Table 2. For example, during period P2, there would be no excavation in Zones A, B2, C1 and ARB.
[3] "Approx. area with excavation under decking or without any excavation in-progress" = Total major area requiring excavation for the tunnel, culvert F diversion and ventilation building (i.e., 8350m^2) – "Approx. area with excavation not under decking"
[4] % of area refers to % of total major area requiring excavation for the tunnel, culvert F diversion and ventilation building (8350m^2)

Appendix 3.2 – Selected Aerial Photos for Past Land Uses



LEGEND

BOUNDARY OF PROJECT SITE - AREA A

BOUNDARY OF PROJECT SITE - AREA B

BOUNDARY OF PROJECT SITE - AREA C

BOUNDARY OF PROJECT SITE - AREA D

BOUNDARY OF PROJECT SITE - AREA E

YEAR: 1979

REF NO.: 26524
SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

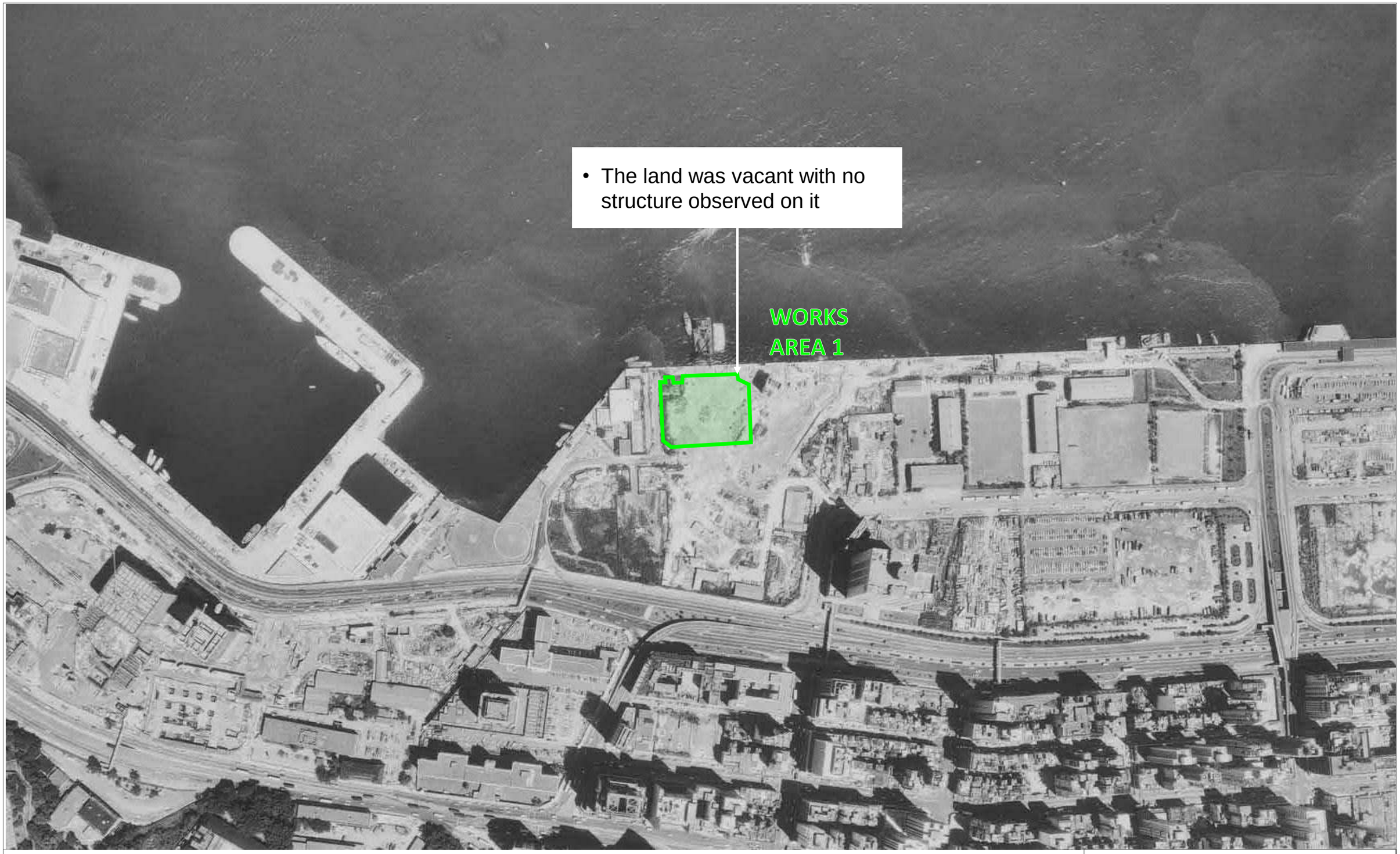
MOTT MACDONALD

CADD REF. --

PROJECT TITLE
CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE
HISTORICAL AERIAL PHOTO FOR PROJECT SITE
YEAR 1979

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 1979 - 1	--



LEGEND

BOUNDARY OF WORKS AREA 1

YEAR: 1979

REF NO.: 26855

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED
REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

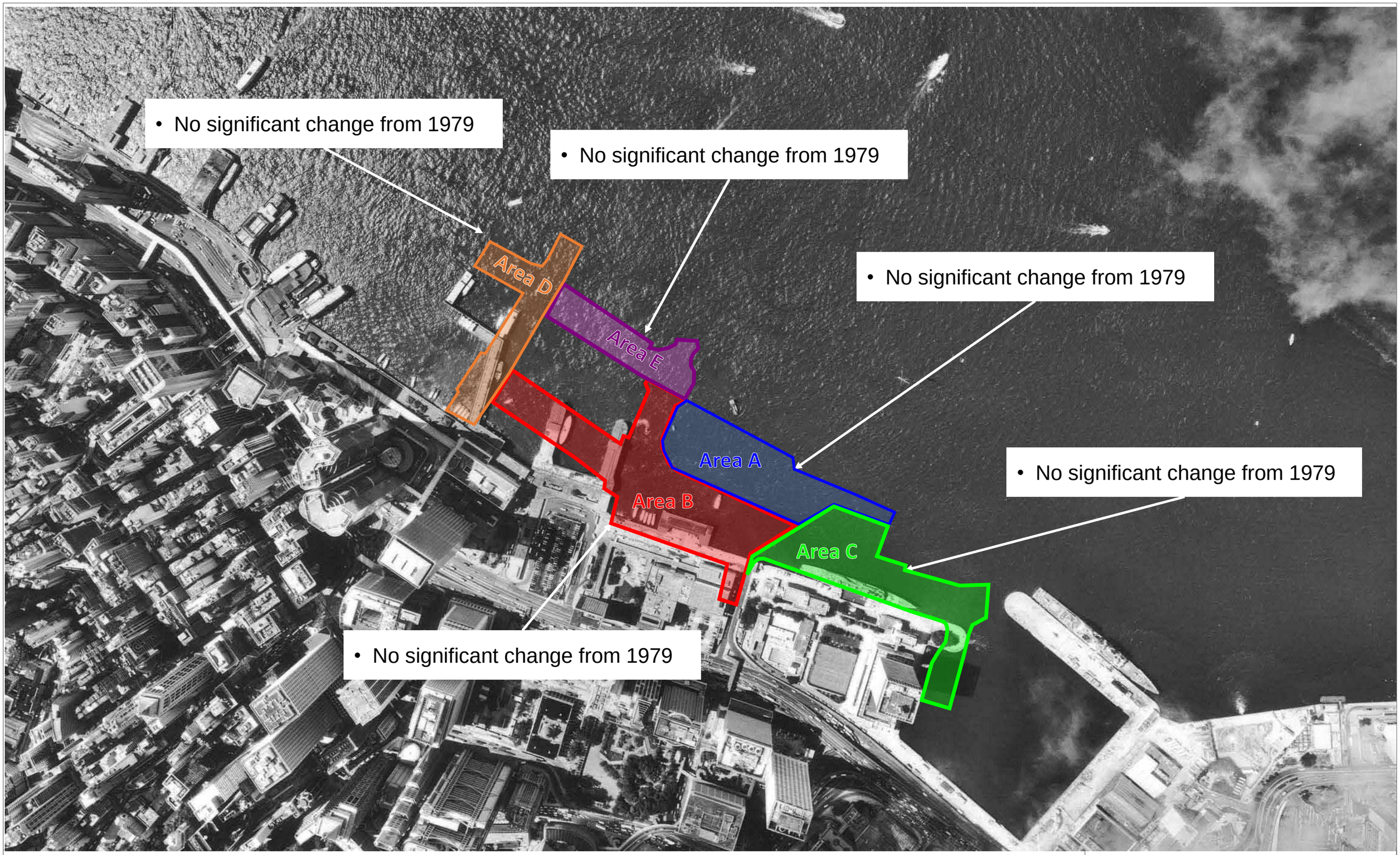
MOTT MACDONALD

CADD REF. --

PROJECT TITLE
CONSULTANCYAGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE
HISTORICAL AERIAL PHOTO FOR WORKS AREA 1
YEAR 1979

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 1979 - 2	--



LEGEND

BOUNDARY OF PROJECT SITE - AREA A

BOUNDARY OF PROJECT SITE - AREA B

BOUNDARY OF PROJECT SITE - AREA C

BOUNDARY OF PROJECT SITE - AREA D

BOUNDARY OF PROJECT SITE - AREA E

YEAR: 1993

REF NO.: A35231

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

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CADD REF. --

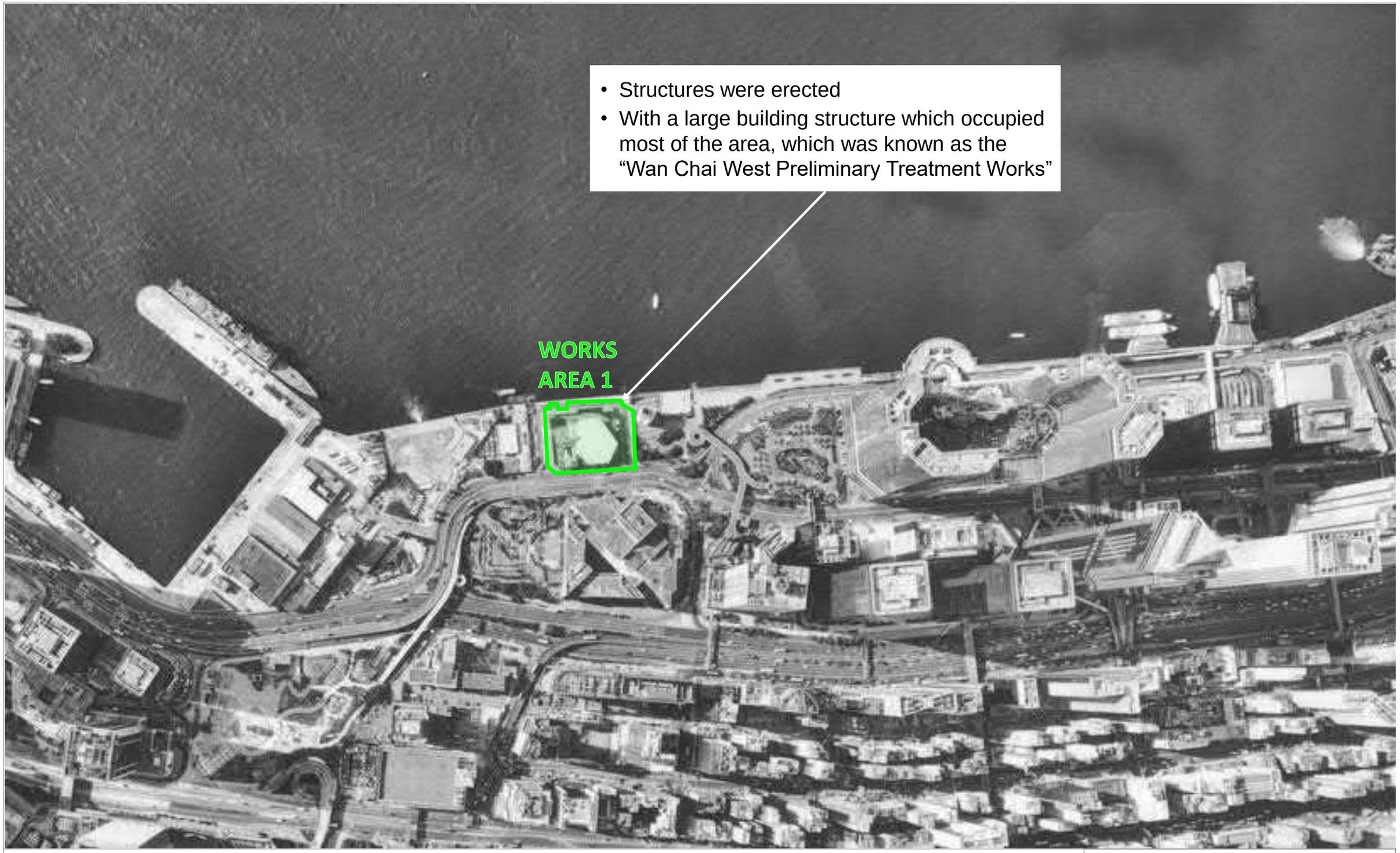
PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR PROJECT SITE
YEAR 1993

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 1993 - 1	--



LEGEND

BOUNDARY OF WORKS AREA 1

YEAR: 1993

REF NO.: A35386

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

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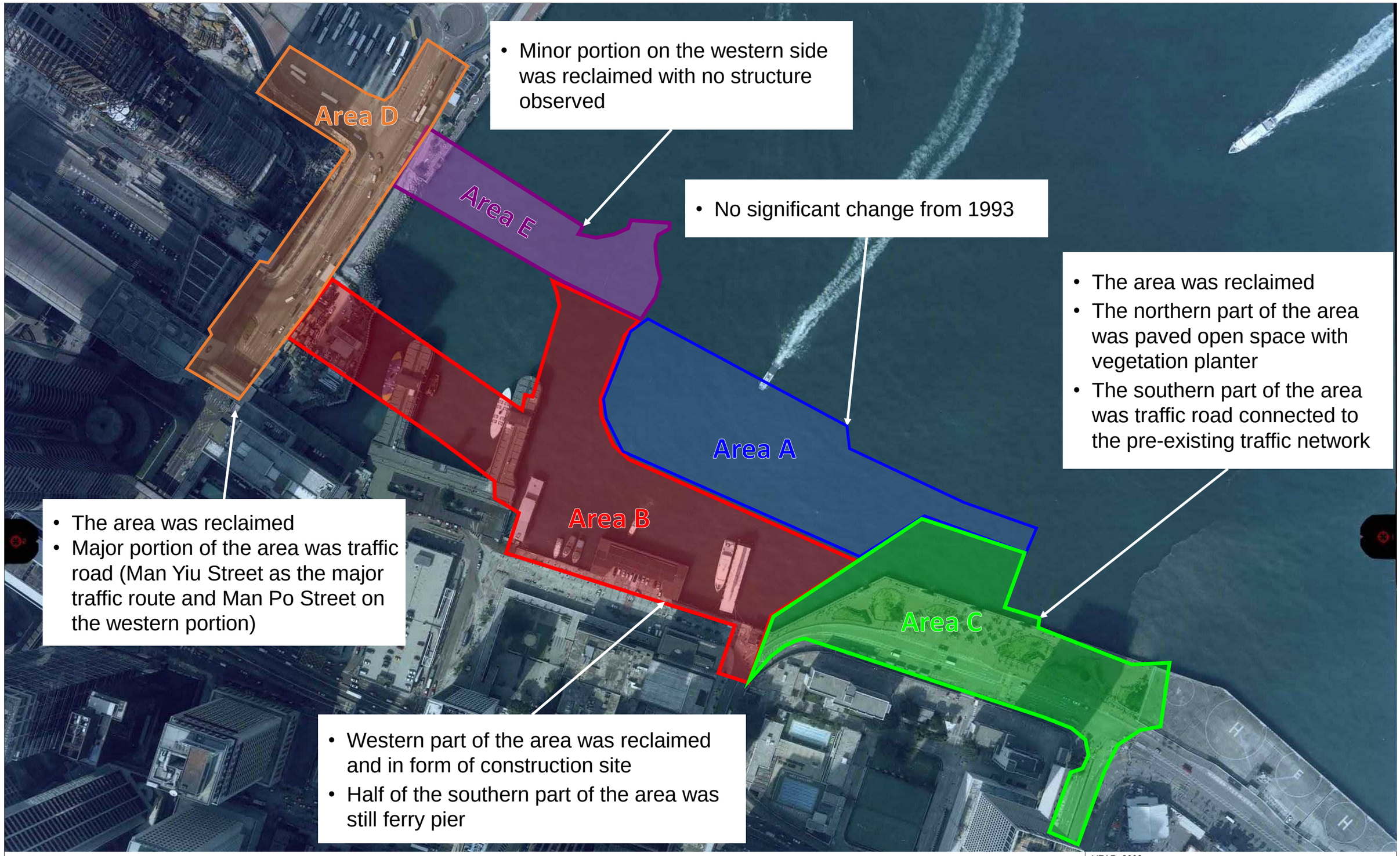
PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR WORKS AREA 1
YEAR 1993

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 1993 - 2	--



LEGEND

BOUNDARY OF PROJECT SITE - AREA A

BOUNDARY OF PROJECT SITE - AREA B

BOUNDARY OF PROJECT SITE - AREA C

BOUNDARY OF PROJECT SITE - AREA D

BOUNDARY OF PROJECT SITE - AREA E

YEAR: 2002

REF NO.: CW38157

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

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PROJECT TITLE

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DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR PROJECT SITE
YEAR 2002

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2002 - 1	--

LEGEND

BOUNDARY OF WORKS AREA 1

YEAR: 2002

REF NO.: CW38189

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

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ORIGINATOR

MOTT MACDONALD

3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

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PROJECT TITLE

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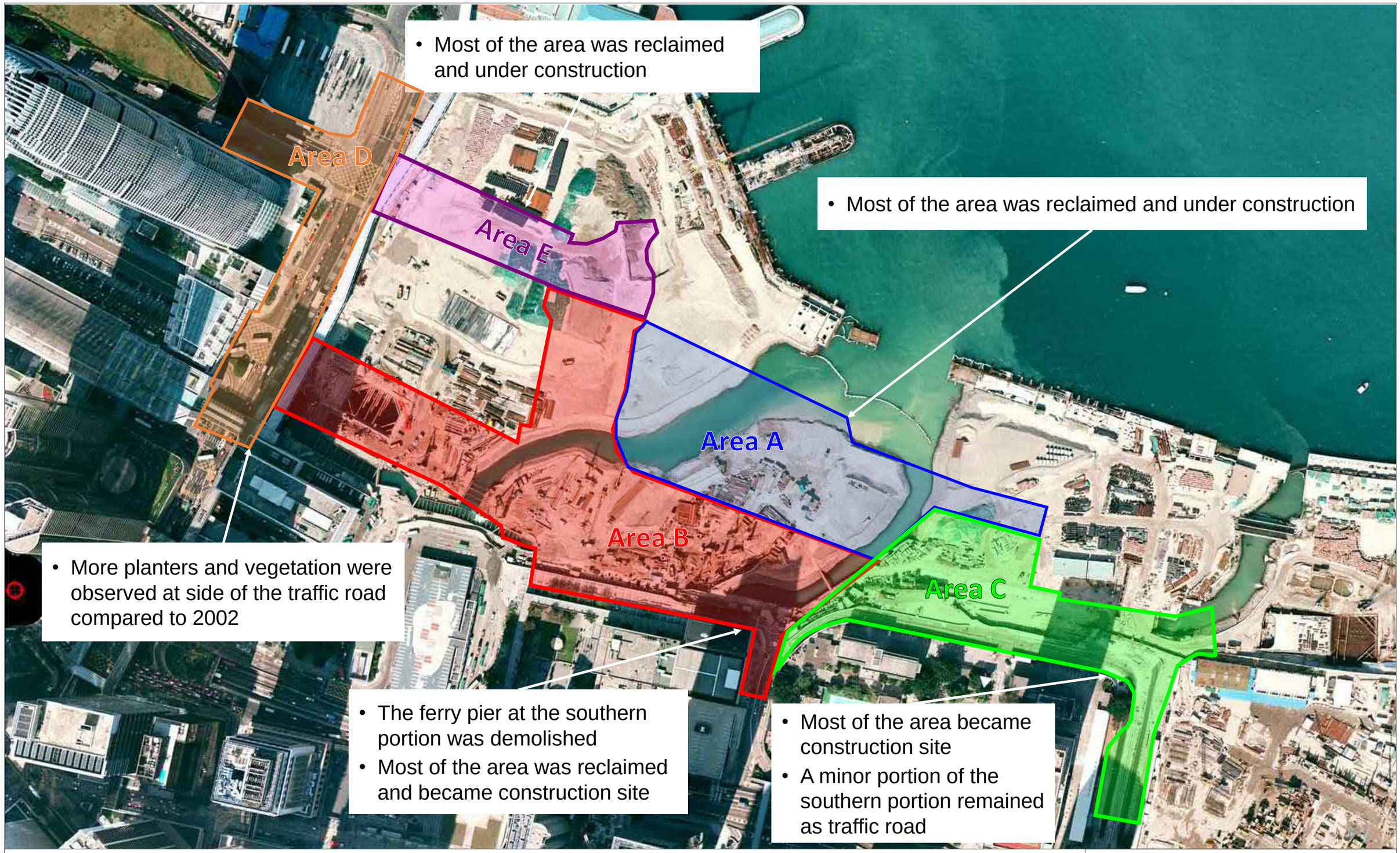
DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR WORKS AREA 1
YEAR 2002

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2002 - 2	--



LEGEND

BOUNDARY OF PROJECT SITE - AREA A

BOUNDARY OF PROJECT SITE - AREA B

BOUNDARY OF PROJECT SITE - AREA C

BOUNDARY OF PROJECT SITE - AREA D

BOUNDARY OF PROJECT SITE - AREA E

YEAR: 2008

REF NO.: CS19798

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

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ORIGINATOR

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PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR PROJECT SITE
YEAR 2008

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2008 - 1	--

LEGEND

BOUNDARY OF WORKS AREA 1

YEAR: 2008

REF NO.: CS19797

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

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ORIGINATOR

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

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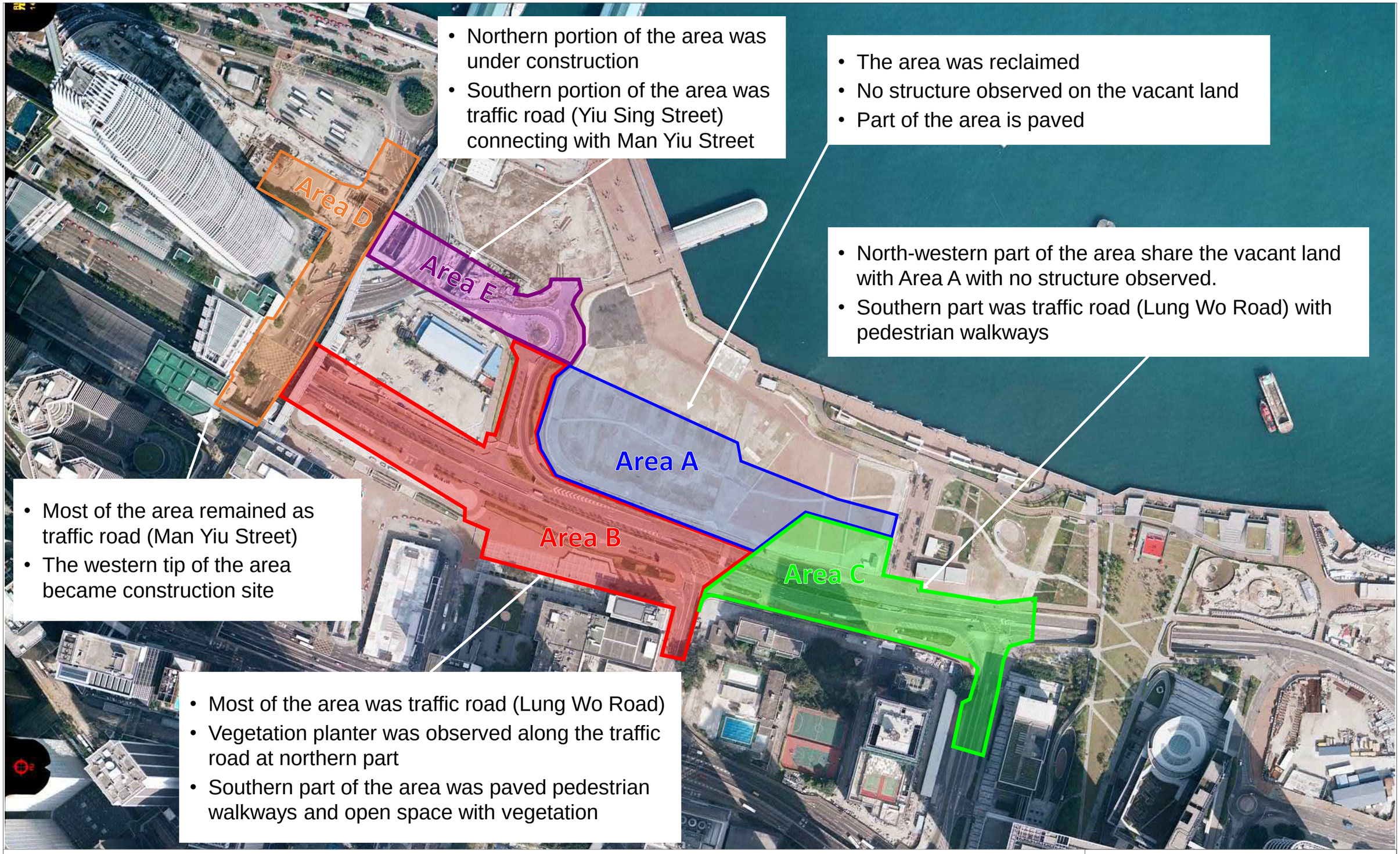
PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR WORKS AREA 1
YEAR 2008

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2008 - 2	--



- Northern portion of the area was under construction
- Southern portion of the area was traffic road (Yiu Sing Street) connecting with Man Yiu Street

- The area was reclaimed
- No structure observed on the vacant land
- Part of the area is paved

- North-western part of the area share the vacant land with Area A with no structure observed.
- Southern part was traffic road (Lung Wo Road) with pedestrian walkways

- Most of the area remained as traffic road (Man Yiu Street)
- The western tip of the area became construction site

- Most of the area was traffic road (Lung Wo Road)
- Vegetation planter was observed along the traffic road at northern part
- Southern part of the area was paved pedestrian walkways and open space with vegetation

LEGEND

BOUNDARY OF PROJECT SITE - AREA A

BOUNDARY OF PROJECT SITE - AREA B

BOUNDARY OF PROJECT SITE - AREA C

BOUNDARY OF PROJECT SITE - AREA D

BOUNDARY OF PROJECT SITE - AREA E

YEAR: 2014

REF NO.: CS47219

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

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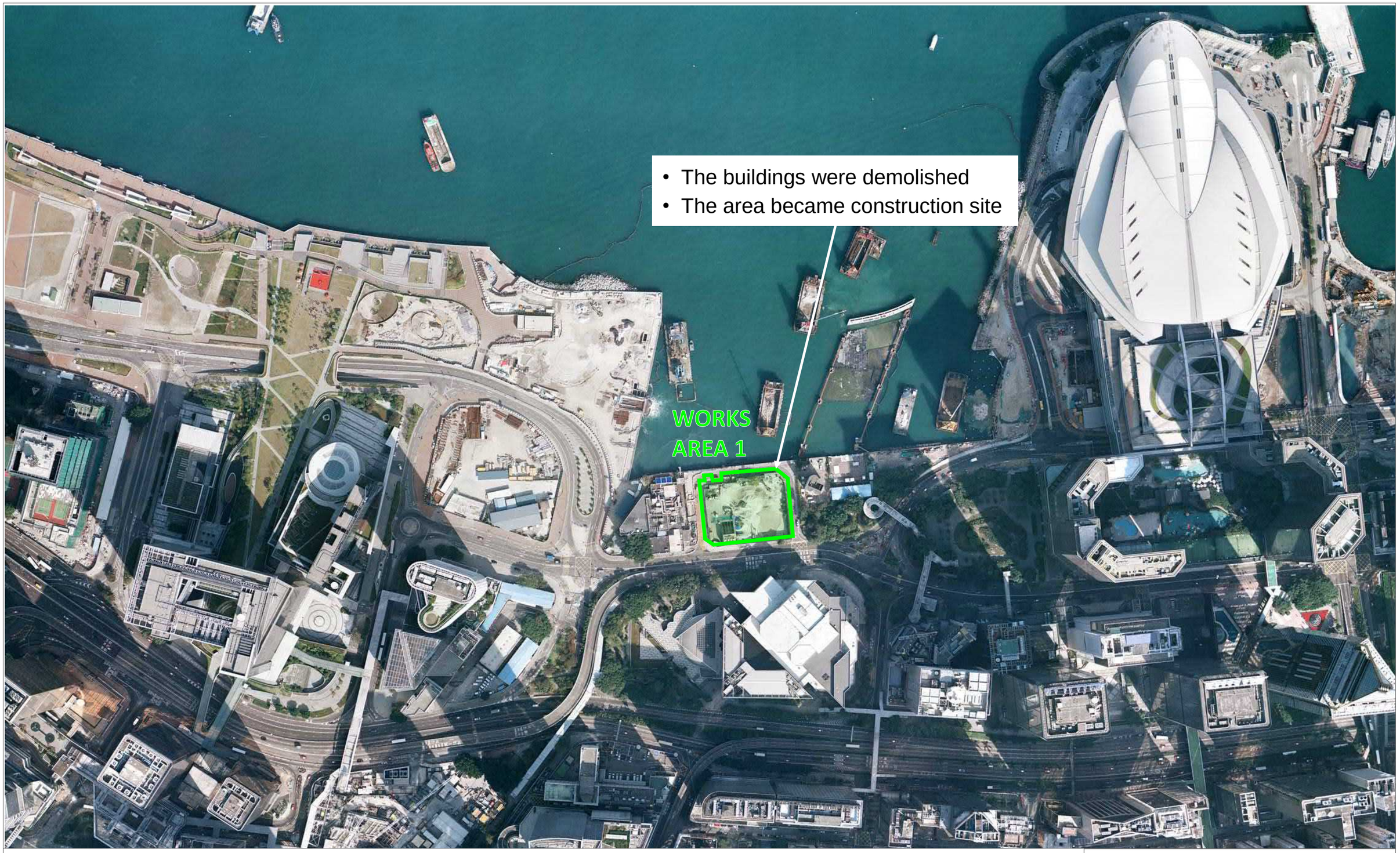
PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR PROJECT SITE
YEAR 2014

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2014 - 1	--



LEGEND

BOUNDARY OF WORKS AREA 1

YEAR: 2014

REF NO.: CS47220

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2827 1823
W mottmac.com

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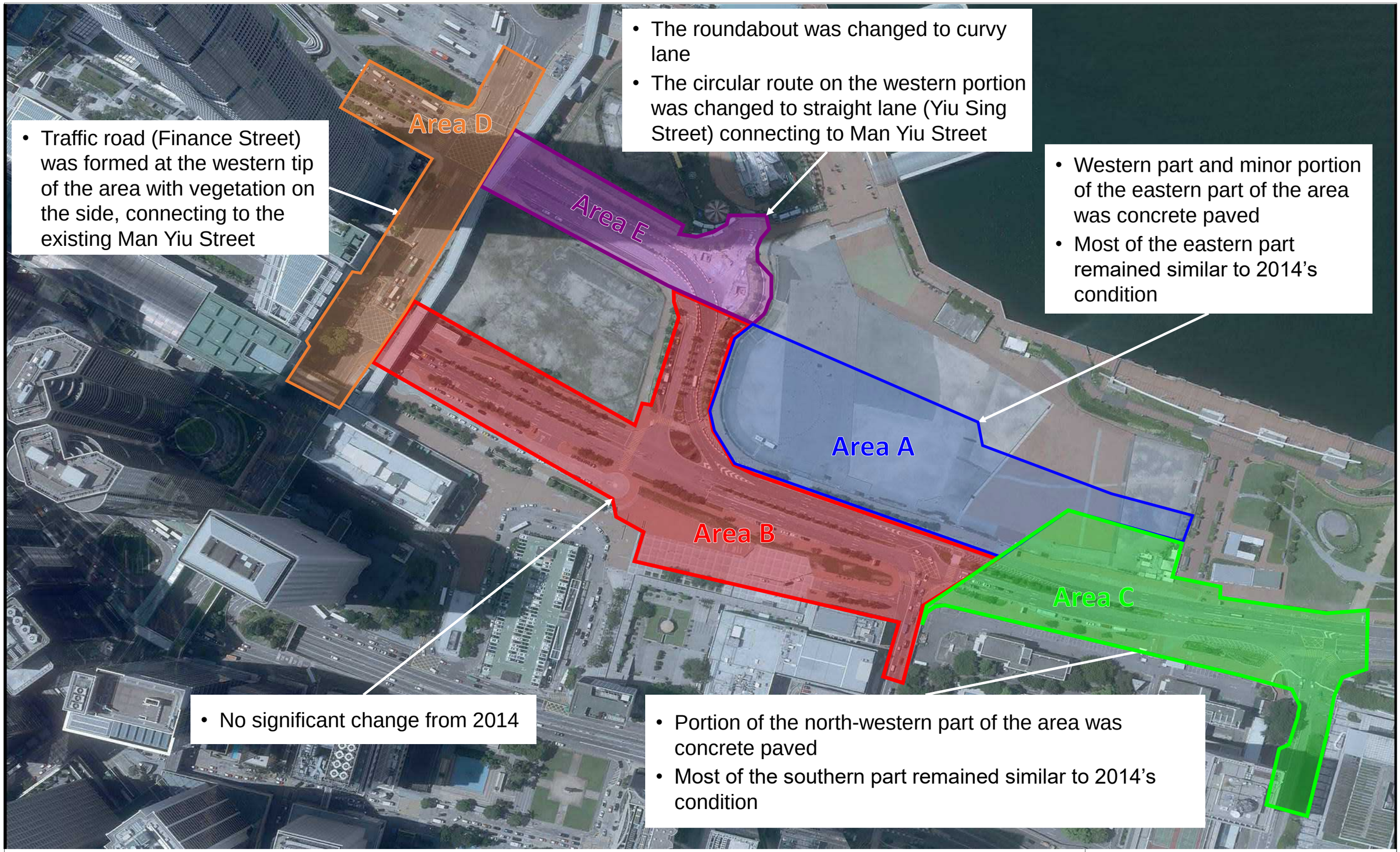
PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR WORKS AREA 1
YEAR 2014

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2014 - 2	--



- Traffic road (Finance Street) was formed at the western tip of the area with vegetation on the side, connecting to the existing Man Yiu Street

- The roundabout was changed to curvy lane
- The circular route on the western portion was changed to straight lane (Yiu Sing Street) connecting to Man Yiu Street

- Western part and minor portion of the eastern part of the area was concrete paved
- Most of the eastern part remained similar to 2014's condition

- No significant change from 2014

- Portion of the north-western part of the area was concrete paved
- Most of the southern part remained similar to 2014's condition

LEGEND

BOUNDARY OF PROJECT SITE - AREA A

BOUNDARY OF PROJECT SITE - AREA B

BOUNDARY OF PROJECT SITE - AREA C

BOUNDARY OF PROJECT SITE - AREA D

BOUNDARY OF PROJECT SITE - AREA E

YEAR: 2020

REF NO.: E100162C

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD

CADD REF. --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

HISTORICAL AERIAL PHOTO FOR PROJECT SITE
YEAR 2020

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2020 - 1	--

LEGEND

BOUNDARY OF WORKS AREA 1

YEAR: 2020

REF NO.: E086423C

SOURCE:SURVEY AND MAPPING OFFICE, LANDS DEPARTMENT

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	HC
DESIGNED	HC
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD

CADD REF. --

PROJECT TITLE
CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE
HISTORICAL AERIAL PHOTO FOR WORKS AREA 1
YEAR 2020

SCALE	DRAWING NO.	REV.
--	Appendix 3.2 – 2020 - 2	--

Appendix 3.3 – Site Reconnaissance Survey Detail of Project Site and Works Area

Photo 1A-01

Photo 1A-02

Photo 1A-06

Photo 1A-03

Photo 1A-05

Photo 1A-04

Area A


Photo 1A-01


Photo 1A-02


Photo 1A-06


Photo 1A-03


Photo 1A-05


Photo 1A-04

LEGEND

PROJECT SITE

AREA A

REV.	DESCRIPTION	BY	DATE	APPROVED
REV.	DESCRIPTION	BY	DATE	APPROVED

DRAWN	DC
DESIGNED	--
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD

CADD REF. --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

SITE RECONNAISSANCE SURVEY DETAIL OF PROJECT SITE – AREA A

SCALE	DRAWING NO.	REV.
--	APPENDIX 3.3	A


Photo 1B-01


Photo 1B-02


Photo 1B-03


Photo 1B-04

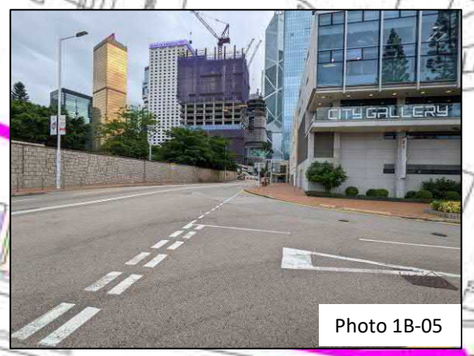


Photo 1B-05


Photo 1B-09

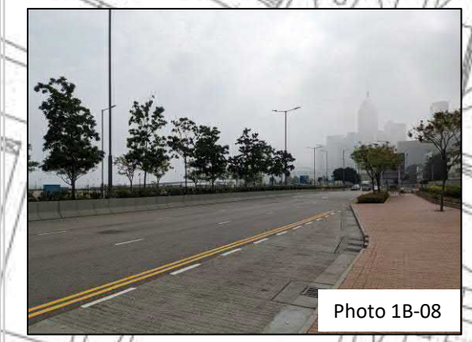


Photo 1B-08


Photo 1B-07


Photo 1B-06

Photo 1B-01

Photo 1B-02

Photo 1B-03

Photo 1B-04

Photo 1B-09

Area B

Photo 1B-08

Photo 1B-07

Photo 1B-05

Photo 1B-06

LEGEND

PROJECT SITE

AREA B

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	DC
DESIGNED	--
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD

CADD REF. --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

SITE RECONNAISSANCE SURVEY DETAIL OF PROJECT SITE – AREA B

SCALE	DRAWING NO.	REV.
--	APPENDIX 3.3	A

Photo 1C-01


Photo 1C-02


Photo 1C-03


Photo 1C-04


Photo 1C-09


Photo 1C-08


Photo 1C-07

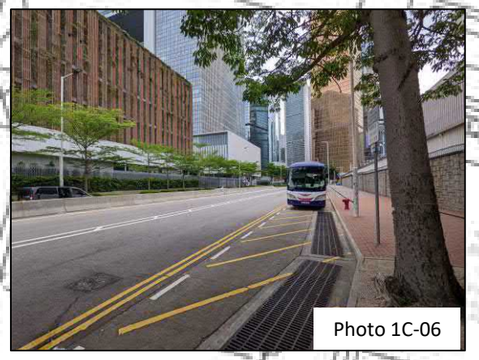


Photo 1C-06


Photo 1C-05

Area C

Photo 1C-01

Photo 1C-02

Photo 1C-03

Photo 1C-04

Photo 1C-05

Photo 1C-06

Photo 1C-07

Photo 1C-08

Photo 1C-09

LEGEND

PROJECT SITE

AREA C

REV.	DESCRIPTION	BY	DATE	APPROVED	REV.	DESCRIPTION	BY	DATE	APPROVED

DRAWN	DC
DESIGNED	--
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

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CADD REF. --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

SITE RECONNAISSANCE SURVEY DETAIL OF PROJECT SITE – AREA C

SCALE	DRAWING NO.	REV.
--	APPENDIX 3.3	A


Photo 1D-01


Photo 1D-02


Photo 1D-03

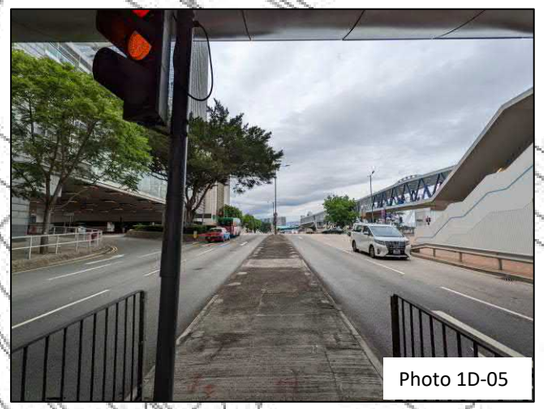


Photo 1D-05

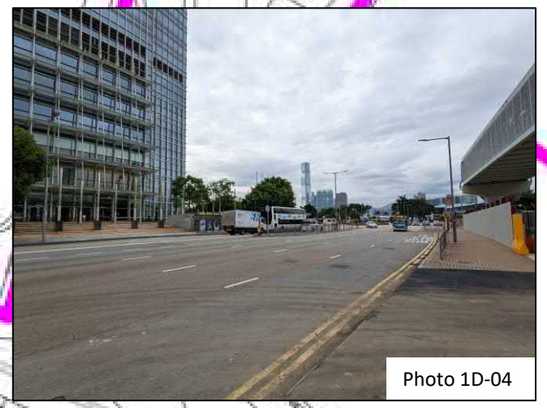


Photo 1D-04

Photo 1D-01

Photo 1D-02

Photo 1D-03

Photo 1D-04

Photo 1D-05

Area D

LEGEND

PROJECT SITE

AREA D

REV.	DESCRIPTION	BY	DATE	APPROVED
REV.	DESCRIPTION	BY	DATE	APPROVED

DRAWN	DC
DESIGNED	--
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR MOTT MACDONALD

CADD REF. --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

SITE RECONNAISSANCE SURVEY DETAIL OF PROJECT SITE – AREA D

SCALE	DRAWING NO.	REV.
--	APPENDIX 3.3	A

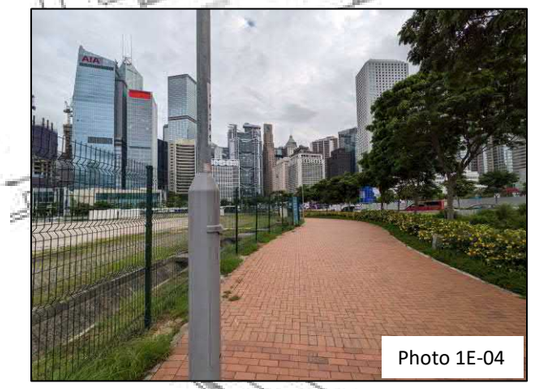


Photo 1E-01

Photo 1E-02

Photo 1E-03

Area E

Photo 1E-04

LEGEND

PROJECT SITE

AREA E

REV.	DESCRIPTION	BY	DATE	APPROVED	REV.	DESCRIPTION	BY	DATE	APPROVED

DRAWN	DC
DESIGNED	--
CHECKED	LL
APPROVED	TC
DATE	MAY 2023

MTR

ORIGINATOR

MOTT MACDONALD

CADD REF. --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

SITE RECONNAISSANCE SURVEY DETAIL OF PROJECT SITE – AREA E

SCALE	DRAWING NO.	REV.
--	APPENDIX 3.3	A

LEGEND

WORKS AREA 1

REV.	DESCRIPTION	BY	DATE	APPROVED
REV.	DESCRIPTION	BY	DATE	APPROVED

DRAWN	DC
DESIGNED	--
CHECKED	LL
APPROVED	TC
DATE	APR 2022

MTR

ORIGINATOR: MOTT MACDONALD

CADD REF.: --

PROJECT TITLE

CONSULTANCY AGREEMENT C1901
DESIGN CONSULTANCY FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL

DRAWING TITLE

SITE RECONNAISSANCE SURVEY DETAIL OF WORKS AREA 1

SCALE	DRAWING NO.	REV.
--	APPENDIX 3.3	A

Appendix 3.4 – Significance of Landscape and Visual Impact during Construction and Operation Phases with Mitigation Measures

Significance of Landscape Impact during Construction and Operation Phases with Mitigation Measures

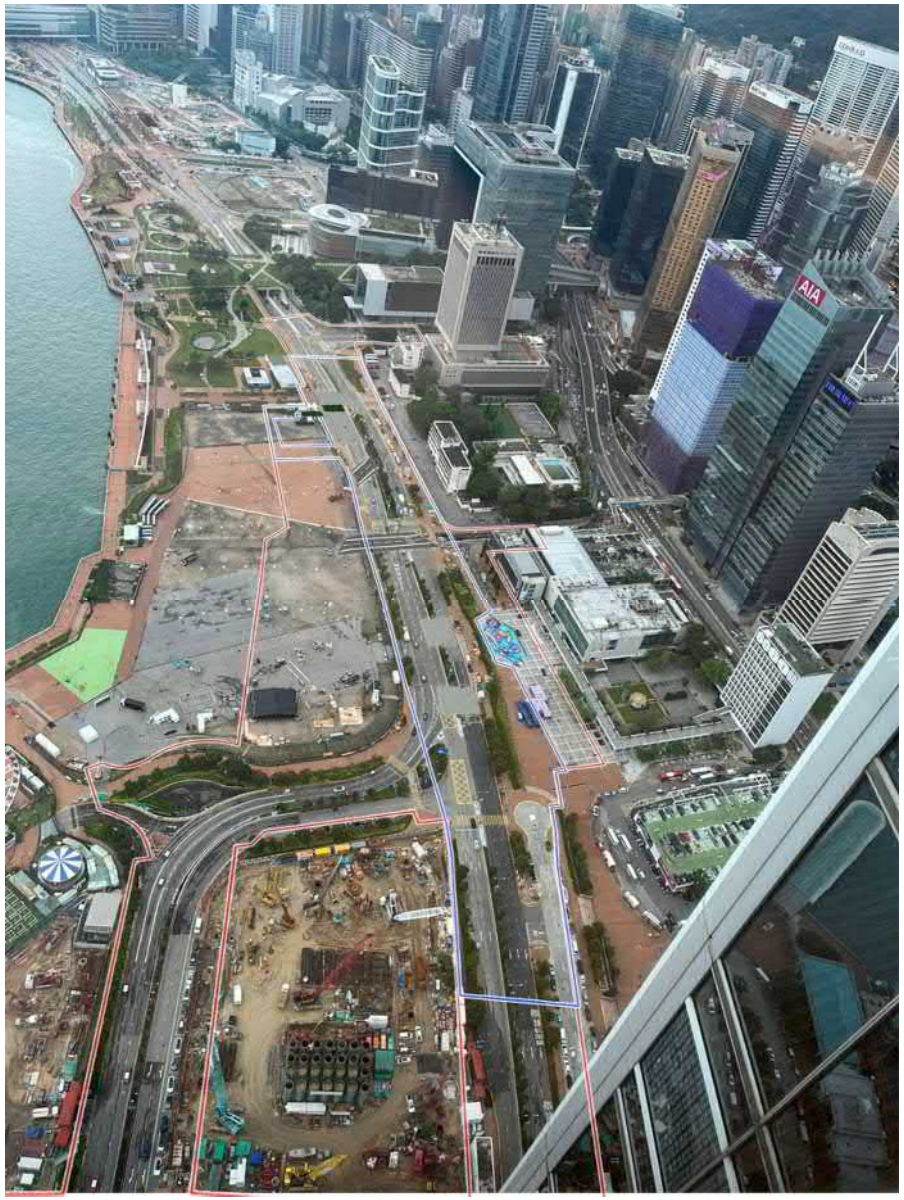
LR ID.	LR	Sensitivity to Change (Low / Medium / High)		Magnitude of Change (Large/ Intermediate/ Small/ Negligible)		Impact Significance before Mitigation (Insubstantial / Slight / Moderate / Substantial)		Recommended Mitigation Measures	Residual Impact Significance after Mitigation (None / Insubstantial / Slight / Moderate / Substantial)		
		Construction	Operation	Construction	Operation	Construction	Operation		Construction	Operation (Day 1)	Operation (Year 10)
Landscape Resources (LRs)											
LR1	**Coastal Water**	Medium	Medium	None	None	None	None	-	None	None	None
LR2.1	**Amenity Landscape Area in Tamar Park**	Medium	Medium	None	None	None	None	-	None	None	None
LR2.2	**Amenity Landscape Area in Harbourfront Promenade**	Medium	Medium	None	None	None	None	-	None	None	None
LR2.3	**Amenity Landscape Area in City Gallery**	Medium	Medium	Intermediate	Intermediate	Moderate	Moderate	CM1, OM2, OM3	Moderate	Slight	Insubstantial
LR2.4	**Amenity Landscape Area in City Hall Memorial Garden**	High	High	None	None	None	None	-	None	None	None
LR3	**Roadside Infrastructure Landscape**	Low	Low	Large	Large	Moderate	Moderate	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Moderate	Slight	Insubstantial
LR4	**Urban Landscape Greenery**	Low	Low	None	None	None	None	-	None	None	None
LR5	**Vegetation in Construction Site on Lung King Street**	Low	Low	None	None	None	None	-	None	None	None
Landscape Character Areas (LCAs)											
LCA1	**Harbourfront Landscape**	Medium	Medium	None	None	None	None	-	None	None	None
LCA2	**Urban Park Landscape**	Medium	Medium	None	None	None	None	-	None	None	None
LCA3	**Construction Works Areas Landscape**	Low	Low	None	None	None	None	-	None	None	None
LCA4	**Transportation Corridor Landscape**	Low	Low	Large	Large	Moderate	Moderate	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Moderate	Slight	Insubstantial
LCA5	**Commercial / Institutional Urban Landscape**	Low	Low	None	None	None	None	-	None	None	None
LCA6	**Miscellaneous Urban Fringe Landscape**	Low	Low	Small	Small	Insubstantial	Insubstantial	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Insubstantial	Insubstantial	Insubstantial

Significance of Visual Impact during Construction and Operation Phases with Mitigation Measures

VSR ID.	VSR	Sensitivity to Change (Low / Medium / High)		Magnitude of Change (Large/ Intermediate/ Small/ Negligible)		Impact of Significance before Mitigation (Insubstantial / Slight / Moderate / Substantial)		Recommended Mitigation Measures	Residual Impact Significance after Mitigation (Insubstantial / Slight / Moderate / Substantial)		
		Construction	Operation	Construction	Operation	Construction	Operation		Construction	Operation (Day 1)	Operation (Year 10)
T1	Travellers on Lung Wo Road	Medium	Medium	Intermediate	Small	Moderate	Slight	CM1, CM2, CM3, OM1, OM2, OM3	Moderate	Slight	Insubstantial
T2	Travellers across Lung Wo Road on Tamar Park's landscape deck	Medium	Medium	Intermediate	Small	Moderate	Slight	CM1, CM2, CM3, OM1, OM2, OM3	Moderate	Slight	Insubstantial
R1	Visitors at Hong Kong Observation Wheel	High	High	Large	Small	Substantial	Moderate	CM1, CM2, CM3, OM1, OM2, OM3	Moderate	Slight	Insubstantial
R2	Visitors on the landscape deck in Site 3	N/A*	High	N/A*	Small	N/A*	Moderate	CM1, CM2, CM3, CM4, OM1, OM2, OM3	N/A*	N/A*	Insubstantial
R3	Visitors in the Tamar Culture Plaza	Medium	Medium	Small	Small	Slight	Slight	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Slight	Insubstantial	Insubstantial
O1	Workers at Site 3 building	N/A*	Medium	N/A*	Small	N/A*	Slight	CM1, CM2, CM3, CM4, OM1, OM2, OM3	N/A*	N/A*	Insubstantial
O2	Workers at City Gallery	Low	Low	Small	Small	Slight	Slight	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Slight	Insubstantial	Insubstantial
O3	Workers at Central Barracks	Medium	Medium	Intermediate	Intermediate	Moderate	Moderate	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Moderate	Slight	Insubstantial
O4	Workers at Chinese People's Liberation Army Forces Hong Kong Building	Medium	Medium	Small	Small	Slight	Slight	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Slight	Slight	Insubstantial
O5	Workers at Legislative Council Complex	Low	Low	Small	Small	Insubstantial	Insubstantial	CM1, CM2, CM3, CM4, OM1, OM2, OM3	Insubstantial	Insubstantial	Insubstantial

* The VSR is from a concurrent project, which no individuals would expect to be affected during the construction of the Project.

Appendix 3.5 – Visual Images Illustrating Decking Arrangements during Construction Phase



P1 (Q4 2026 – Q1 2027) – Excavated Zone C2

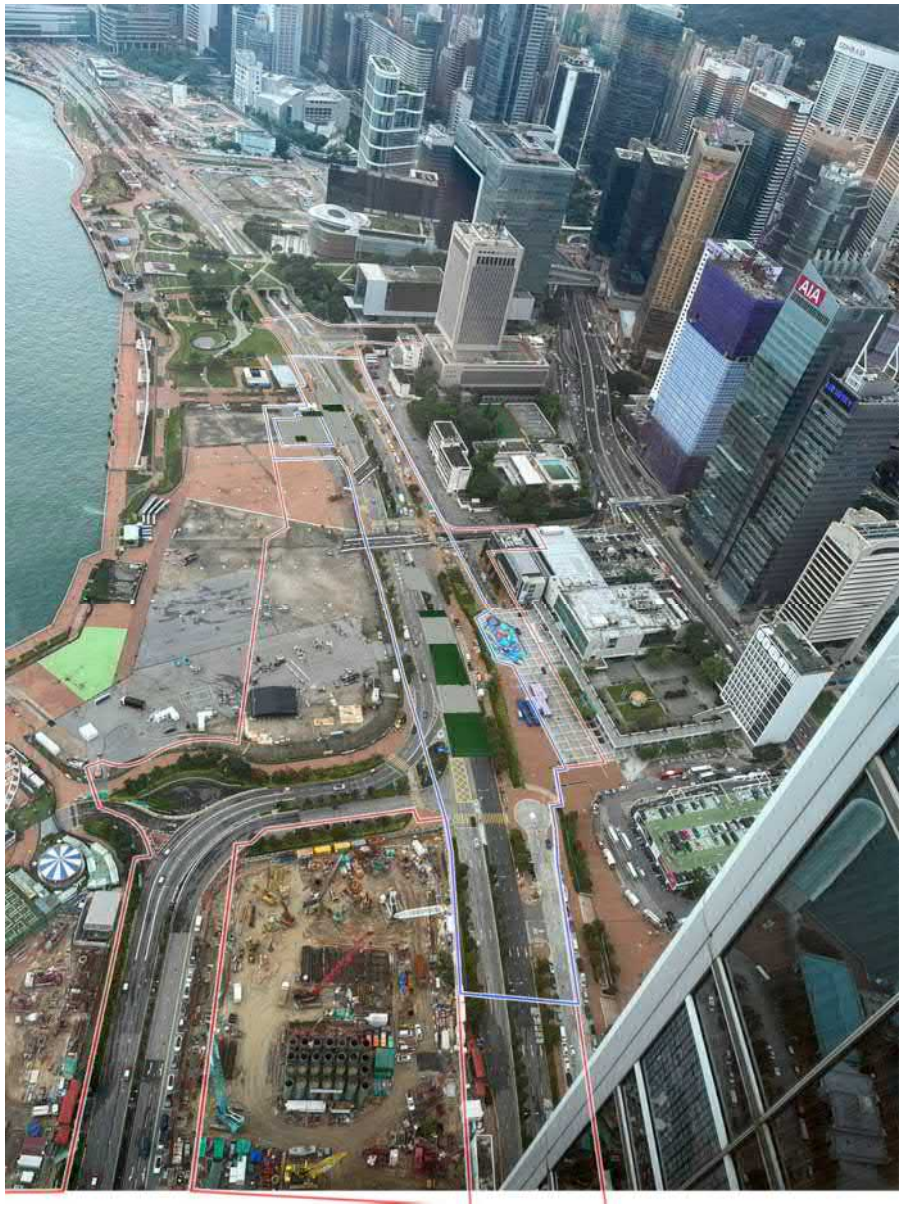
Works Site

Works Area

Dust screen / mesh cover (as far as practicable)

Construction deck (with concrete pavement)

Traffic deck



P3 (Q2 2027 – Q3 2027) – Excavated Zones B1, C2, ARB

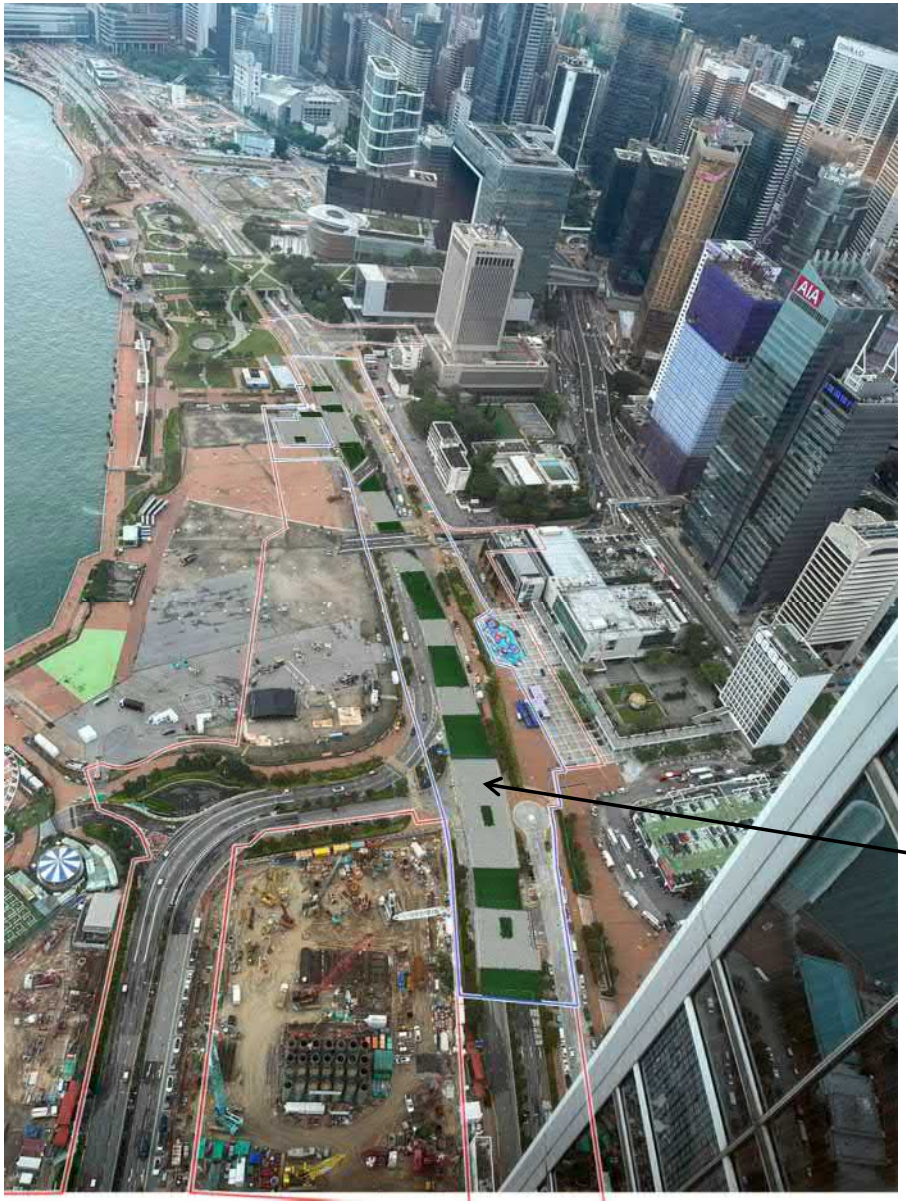
Works Site

Works Area

Dust screen / mesh cover (as far as practicable)

Construction deck (with concrete pavement)

Traffic deck



P5 (Q4 2027) – Excavated Zones A, B2, C1, ARB

Works Site

Works Area

Dust screen / mesh cover (as far as practicable)

Construction deck (with concrete pavement)

Traffic deck

This construction deck will become traffic deck at the end of 2027

Appendix 3.6 – Groundborne Noise Calculation

Groundborne Railway Noise

A) Introduction

When trains operate in tunnels that are located in close proximity to occupied structures, vibrations associated with train pass-bys will be transmitted through the ground and structure, and radiated as noise in the spaces occupied within the structure. Therefore, potential groundborne railway noise impact arising from the operation phase is anticipated. Ground-borne noise impact from the Project would be expected and therefore will be assessed.

B) Train Operation Parameter

The peak operation parameter for trains as provide by MTRC / Design Engineer have been listed below –

- 60km/h at the ARO for TCL and AEL
- 8 car trains for TCL and 10 car trains for AEL
- Trackform with precast concrete block
- Maximum 24 headways per hour per direction for TCL
- Maximum 8 headways per hour per direction for AEL
- Train Type: Adtranz–CAF EMU and K-Stocks for TCL
- Train Type: Adtranz–CAF EMU for AEL
- Crossover / turnout would be located adjacent to Site 3 Development and Hong Kong City Hall, subject to detailed design

C) Assessment Methodology

Assessment Approach

The prediction methodology recommended by the U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 2012 and/or "Transit Noise and Vibration Impact Assessment Manual", 2018, has been adopted in the noise assessment study. The manual is intended to provide guidance in preparing and reviewing the noise and vibrations sections of environmental submittals to the US Government.

The basic equation describing the model, in decibels (dB), is

$$L = FDL + LSR + TIL + TCF + BCF + BVR + CTN + TOC + SAF,$$

Where the prediction components are:

- L: Ground borne vibration or noise level within the structure, re: 1μ-in/sec or 20μ-Pascal
- FDL: Force density level for the train stock in TCL, re: 1 lb/in^0.5
- LSR: Unit force incoherent line source response for the ground, re: 1μ-in/sec
- TIL: Trackform attenuation or insertion loss, relative level
- TCF: Vibration coupling between the tunnel and the ground for soil based tunnels, relative level
- BCF: Vibration coupling loss factor between the soil and the foundation, relative level
- BVR: Building vibration reduction or amplification within a structure from the foundation to the occupied areas, relative level
- CTN: Conversion from floor and wall vibration to noise, 1 μ-in/sec to 20 μ-Pascal
- TOC: Turnout and Crossover Factor
- SAF: Safety margin to account for wheel/rail condition and projection uncertainties

Predictions are carried out for receiver at building that are closest to the tunnel alignment

Force Density Level (FDL)

With reference to the EIA Report of Tung Chung Line Extension (TUE) (EIA-277/2021), vibration sources strength level (FDL) measurement had been conducted for the Adtranz-CAF trains and the K-stock train at the ballasted track near Siu Ho Wan Depot for Tung Chung Line. Given that these train fleets are the operated trains in TCL and AEL, the FDL from the approved TUE EIA Report (AEIAR-235/2022) as shown in **Appendix A** would be adopted for this assessment.

With reference to Section 1.4 of **Appendix A** (i.e. Appendix 4.7.2 of TUE EIA Report), wheel flat noise from one of the wheelsets was noted during the train pass-by vibration measurement of Adtranz-CAF test train. Hence the FDL result of Adtranz-CAF test train represented that of a slightly deteriorated wheel condition, which adds conservativeness to ground-borne railway noise prediction. Hence, adopting the FDL of Adtranz-CAF trains in our assessment could represent a worst-case scenario. Nevertheless, the FDL adopted in this assessment (i.e. ARO) is the same as the FDL adopted in TUE EIA Report.

Based on TUE EIA Report, the vibration performance of a ballasted track and a slab track would be very similar if an equivalent fastener stiffness is used. Hence, the FDL measurement, which was conducted at ballasted track, is considered applicable for the slab track under the Project.

Line Source Response (LSR)

The LSR determines the vibration levels or attenuation in the ground as a function of distance caused by an incoherent line source of unit force point impacts, with a line source orientated along the alignment. The basic quantity required for the determination of LSR is the vibration response caused by a unit point source impact, which is defined as the PSR. Given the PSR is along the alignment over the length of the train, the LSR follows directly by incoherent integration of the PSR over the length of the train.

The LSR was referred to the TUE EIA Report as shown in **Appendix B**. The LSR measurement conducted at Yat Tung Estate is considered suitable for this Project as assessment purpose with similar geological characteristics (i.e. Soil-borne ground type, tunnel located about 20m below ground level). Detailed geological profile of TUE and ARO (this Project) are shown in **Appendix C.**

Trackform Insertion Loss (TIL)

Trackform attenuation has two components: the magnitude of the attenuation and the frequency above which attenuation occurs (resonance frequency of the trackform). Generally, more compliant trackform support and more massive elements in the trackform will result in a greater magnitude of attenuation occurring at lower frequencies. Thus, floating slab trackform (FST) will produce significantly more attenuation at lower frequencies than a resilient baseplate. However, greater compliance in the trackform support results in greater mobility of the rail, which requires careful examination of changes in rail geometry under loading, and consideration of associated fatigue and component life expectancy. In addition, larger trackform elements will take up more space in tunnels and may cause spatial incompatibilities that are difficult to be overcome in the design. The TIL for existing MTR trackforms in the previous approved EIAs were adopted where appropriate.

The TIL for various trackform types of existing MTR alignments had been presented in previous EIA reports, which includes TUE EIA. Wherever appropriate, these TIL as shown in **Appendix D** had been considered in the present study to include the following:

- Type 0 : Direct fixation
- Type 1 : BCT trackform with Alternative 1 baseplate (BCT)
- Type 2 : Floating Slab Trackform (FST)

The ground-borne noise levels at NSRs were calculated initially with direct fixation track without trackform insertion loss for the whole alignment as unmitigated scenario. If noise exceedances were predicted, low noise trackforms including low stiffness fasteners, floating slab track, etc would be considered as mitigated scenario.

The attenuation provided by different low noise trackforms would be included in the mitigated scenario to determine the appropriate trackforms for meeting the criteria, if applicable.

Tunnel Coupling Factor (TCF)

Referring to "High-Speed Ground Transportation Noise and Vibration Impact Assessment" 2012 and/or "Transit Noise and Vibration Impact Assessment Manual" 2018, a 3dB and 5dB reduction in ground-borne noise level with reference to bored tunnel in soil would be assumed for cut-and-cover tunnels and station structures.

Building Coupling Factor (BCF)

This factor is recommended by the "High-Speed Ground Transportation Noise and Vibration Impact Assessment" and/or "Transit Noise and Vibration Impact Assessment Manual". BCF represents the change in the incident ground-surface vibration due to the presence of the piled building foundation. The BCF values based on approved TUE EIA Report as shown in **Table 1** to **Table 3** and detailed in **Appendix E**

- 1 to 2 storeys residential;
- 2 to 4 storeys masonry building; and
- Large masonry building on piles.

Table 1: Loss Factor for Coupling into Building Foundation – 1 to 2 Storeys Residential Building

Frequency	One-third Octave Band Frequencies, Hz											
	3.15	**4**	**5**	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**32**	**40**
Loss coupling factor, dB	0.0	0.0	0.0	0.0	-2.0	-5.0	-5.5	-6.5	-7.5	-8.0	-8.5	-8.5
Frequency	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	
Loss coupling factor, dB	-8.5	-8.5	-8.0	-7.5	-7.5	-7.0	-6.0	-5.0	-5.0	-5.0	-5.0	

Table 2: Loss Factor for Coupling into Building Foundation – 2 to 4 Storeys Residential Building

Frequency	One-third Octave Band Frequencies, Hz											
	3.15	**4**	**5**	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**32**	**40**
Loss coupling factor, dB	0.0	0.0	0.0	-2.0	-5.0	-7.0	-8.0	-9.5	-11.0	-12.0	-12.5	-12.5
Frequency	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	
Loss coupling factor, dB	-12.5	-12.5	-12.5	-12.0	-11.5	-11.0	-10	-8.5	-8.5	-8.5	-8.5	

Table 3: Loss Factor for Coupling into Building Foundation – Large Masonry Building on Piles

Frequency	One-third Octave Band Frequencies, Hz											
	3.15	**4**	**5**	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**32**	**40**
Loss coupling factor, dB	-10.0	-10.0	-10.0	-10.0	-10.0	-10.5	-11.0	-11.5	-13.0	-14.0	-14.5	-14.5
Frequency	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	
Loss coupling factor, dB	-14.5	-14.5	-14.0	-13.0	-12.5	-12.0	-11.0	-10.0	-10.0	-10.0	-10.0	

For structures founded on rock, there is no impedance contrast between the soil and the foundation, as a conservative approach, the Building Coupling Factor (BCF) is considered to be zero.

Building Vibration Response (BVR)

The BVR is introduced to account for the floor-to-floor vibration attenuation. The corrections for resonance amplification due to floor, wall and ceiling spans for all buildings are presented in the **Table 4** as "BVR resonance". A -2dB attenuation per floor is adopted for the first 5 floors as "BVR – UP". This is in line with the "High-Speed Ground Transportation Noise and Vibration Impact Assessment" 2012 and/or "Transit Noise and Vibration Impact Assessment Manual" 2018.

Table 4: Building Amplification Values to be Adopted

Frequency	One-third Octave Band Frequencies, Hz											
	3.15	**4**	**5**	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**32**	**40**
Amplification factor, dB	0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0
Frequency	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	
Amplification factor, dB	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7	

Conversion To Noise (CTN)

The level of radiated noise inside a room will depend on the average vibration of the room surfaces, the radiation efficiency of the surfaces and the amount of absorption inside the room. Based on the conservation of power principle, the reverberant sound field inside the room can be approximated by the following equations:

Reverberant Sound Pressure Level

LA (dBA) = Lv (VdB ref 1 μ in/s) + CTN

CTN = K_{rad} + A-weighting Correction

where

K_{rad} : Adjustment to account for conversion from vibration to sound pressure level including accounting for the amount of acoustical absorption inside the room

For typical residential bedroom with nominal acoustical absorption treatment, the following factors are used (**Table 5**) for this study:

Table 5: Room Correction Factors

1/3 Octave Band Centre Frequency (Hz)	**3.15**	**4**	**5**	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**
Krad (dB)	0	0	0	0	0	0	0	0	0	0	0	0
A-weighting	-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6
CTN (for vibration)	-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6

1/3 Octave Band Centre Frequency (Hz)	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**
Krad (dB)	0	0	0	0	0	0	0	0	0	0	0
A-weighting	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
CTN (for vibration)	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2

For Lv vibration level reference to 1 µ in/s

A +2dB correction is assumed for conversion of vibration (re.: 10^{-6}in/sec) to noise (re.: 20 µPa). This is in line with previously approved EIA report for Tung Chung Line Extension (TUE) (EIA-277/2021).

Turnout and Crossover Factor (TOC)

At points and crossings, where the wheel transitions from one rail to another, the sudden loading/unloading of the leading and trailing rails results in increased broadband vibration levels over that of plain line continuous rail. In addition, it is not possible to machine grind the rails through either the points or crossings, so surface deterioration compared with that of the placed track, is often evident.

The increase in vibration level at turnouts and crossings is not easily characterized. For standard level turnouts and crossings receiving average maintenance, the "High-Speed Ground Transportation Noise and Vibration Impact Assessment" 2012 / "Transit Noise and/or Vibration Impact Assessment Manual", 2018 recommends a correction of 10dB. For modern inclined turnouts in good condition, where impact loads are lessened, it was found through measurement that a correction of 5dB is often more appropriate. This is in line with Section 4.7.1.11 of previously approved EIA report for Tung Chung Line Extension (TUE) (EIA-277/2021).

The inclined turnout/ crossover would be adopted and located adjacent to Site 3 development and Hong Kong City Hall, subject to detailed design. Therefore, 5dB correction factor would be adopted for GBN3 to GBN5 under current stage.

Safety Factor (SAF)

According to the approved EIA for Shatin to Central Link – Tai Wai to Hung Hum Station (AEIAR-167/2012), the safety factor is determined as 5 dB for NSRs where site specific FDL and non site-specific LSR data are adopted.

D) Prediction and Evaluation of Groundborne Railway Noise Impact (Unmitigated Scenario)

Area Sensitivity Rating (ASR)

The ASR and ANLs adopted in this Project Profile are used for assessment purpose only, they should not bind the Noise Control Authority's decision in determining the noise criteria based on the legislation and practices being in force, and contemporary conditions/ situations of adjoining land uses.

The representative NSRs have been identified as shown in **Table 6.** The Project site and its representative NSRs are located in Central which is an urban area with majority business and commercial development and leisure facilities near the harbourfront. Connaught Road Central is located to the south of the representative NSRs has an annual average daily traffic flow (AADT) of 98,640 (station no. 1030) according to the Annual Traffic Census 2021, which is three times more than the standard of an Influencing Factor (i.e. 30,000 AADT) in the IND-TM. Thus, Connaught Road Central is identified as Influencing Factor (IF). Based on the site observations, as the representative NSRs are not directly facing the Connaught Road Central, the noise from Connaught Road Central could be perceived but not the dominant noise source at the representative NSRs. Therefore, it is considered that the representative NSRs are only indirectly affected by the IF. Hence, ASR "C" would be assigned to representative NSRs according to IND-TM.

Nevertheless, the ASR could be subjected to change due to the future conditions (e.g. after the Site 3 Development). Therefore, the ASR (e.g. ASR "B" or ASR "C") will be reviewed subject to detailed design and further assessment.

Predicted Noise Results

The peak headways would be adopted in the night-time groundborne railway noise impact assessment as the worst-case scenario (i.e. with the maximum headways and most stringent noise criteria).

The predicted groundborne railway noise levels under unmitigated scenario (i.e. direct fixation) for the representative NSRs are provided in **Table 6** and detailed in **Appendix F.**

Table 6: Predicted Groundborne Railway Noise Levels (Unmitigated Scenario)

NSR ID	Uses	Existing/Planned	ASR [1]	Predicted Noise Level, dB(A)	Nigh-time Noise Criteria, dB(A)	Compliance [Y/N]
GBN1	Residential	Existing	C	22 [2]	50	Y
GBN2	Residential	Existing	C	22 [2]	50	Y
GBN3	Performing Art Centre	Existing	C	24 [2]	50	Y
GBN4	Performing Art Centre [3]	Planned	C	27 [2]	50	Y
GBN5	Performing Art Centre [3]	Planned	C	34 [2]	50	Y

Note [1] – Area Sensitivity Rating (ASR) will be reviewed subject to detailed design and further assessment. (e.g. ASR "B" or ASR "C").
Note [2] – The noise levels are also complied with other Area Sensitive Rating (i.e. ASR"B").
Note [3] – Assume the theatre use in Site 3 (GBN4 and GBN5) is similar to the use of performing art centre.

As shown in **Table 6**, the predicted groundborne railway noise levels at all representative NSRs comply with the most stringent noise criteria (i.e. night-time noise criteria). No adverse groundborne railway noise impact arising from operation of the Project is anticipated. Therefore, no mitigation measure would be required.

Appendix A - FDL from the Approved TUE EIA Report (AEIAR-235/2022)

1 FDL Measurements and the Results

1.1 Measurement Methodology

1.1.1.1 The measurements consist of 2 parts: measurement of vibration levels during train passage of a test train, and Line Source Response (LSR) measurements at the same location by hammer impact test.

1.1.1.2 For the test train vibration measurement, accelerometers are placed at the rail and on ground surface at various setbacks from the alignment. Vibration levels during train passby L_v in 1/3-octave bands (3.15Hz to 500Hz) are continuously logged for further analysis.

1.1.1.3 The soil mobility of the test site is determined by hammer impact test. The impacts conducted consecutively give the Point Source Response (PSR) at individual setback locations. LSR is calculated from numerical integration of the PSR along the length of the train for each individual 1/3-octave band.

1.1.1.4 FDL is determined by subtracting train induced vibration by LSR in logarithmic scale according to the equation below (reference: U.S. Department of Transportation "Transit Noise and Vibration Impact Assessment Manual", 2018):

$$\mathbf{FDL}(f) = L_v(f,x,y,z) - \mathbf{LSR}(f,x,y,z)$$

where

$\mathbf{FDL}(f)$: FDL in dB re 1 lb/in$^{0.5}$, as a function of frequency *f*. FDL depends on the geology and train operating conditions.

$L_v(f,x,y,z)$: Vibration level at ground surface outside building structure in dB re 1 µin/s, as a function of vibration frequency *f* and the sensor coordinate *x*, *y*, *z*.

$\mathbf{LSR}(f,x,y,z)$: LSR from track to ground in dB, re 1 µin/s/(lb/in$^{0.5}$), as a function of vibration frequency *f* and the sensor coordinate *x*, *y*, *z*.

1.2 Train Types Measured

1.2.1.1 FDL measurements were only conducted for TCL. The current TCL train fleet comprises both the Adtranz-CAF trains and the K-stock trains. A test train of each train types was arranged for the FDL measurements.

1.3 Measurement Location and Procedure

1.3.1.1 The FDL measurements were conducted at a ballast section of the test track of Siu Ho Wan Depot (SHD) as shown in **Annex Figure 4.7.1**. Photos of setback and hammer impact test locations are given in **Annex 4.7.1**. The FDL measurements comprises train passby vibration measurement and LSR measurement by hammer impact test at the same locations.

1.3.1.2 The train speeds at 30km/h, 40km/h and 60km/h were tested. For each train type, a test train was arranged to pass the track section at constant speed as far as practicable.

1.3.1.3 The vibration levels under rails, on sleeper, and at various setback distances at 5m, 15.5m, 20.5m, 30.5m and 40.5m were measured simultaneously by accelerometers.

1.3.1.4 Hammer impact test was conducted at 3 impact points along track alignment with the same setback locations of accelerometers for determining the soil mobility of the test site.

1.3.1.5 Rail roughness condition at the test site was taken record using a Corrugation Analysis Trolley (CAT). Rail roughness measurement was conducted in accordance with BS EN 15610: 2019 "*Railway applications. Acoustics. Rail and wheel roughness measurement related to noise generation*" over a track section of 200m at both rails.

1.4 Testing Conditions of Test Trains and Track

1.4.1.1 The test trains were controlled at constant speed specified when passing the measurement location. At least 3 – 5 runs were conducted for each train speed.

1.4.1.2 The timing of each test train passby was controlled to avoid overlapping with operational train passbys along AEL and TCL (Note: The operational tracks in both eastbound and westbound directions near the measurement location are shared by AEL and TCL, and are located at approximately 22m and 26m respectively from the test track inside SHD).

1.4.1.3 Wheels are preferably to be in normal operation conditions, without audible wheel flats or any other unusual noise associated with the running of the test trains. During train passby vibration measurement of Adtranz-CAF test train, wheel flat noise from one of the wheelsets was noted, hence the FDL result of Adtranz-CAF test train represented that of a slightly deteriorated wheel condition, which adds conservativeness to groundborne noise prediction.

1.4.1.4 The rails of the test section were continuously welded. The measurement locations were at least 50m away from any rail expansion joints or insulation joints, where any vibration impact induced by the joints should be minimized.

1.4.1.5 The rails should not have corrugation or fresh lateral grinding groove. A visual check was conducted prior to the measurement to verify the rail condition. Rail roughness measurement was conducted to keep record of the rail surface conditions.

1.5 Data Analysis

1.5.1.1 PSR from hammer impact point at track to accelerometer locations is determined by adopting the standard signal-processing techniques of frequency response function of the measured groundborne vibration velocities reference to the excitation force, averaged for 5 to 10 hammer impacts.

1.5.1.2 LSR is then evaluated by interpolation of the measured PSR and numerical integration along the train length.

$$\mathbf{LSR}(s,d,f) = 10\log\left\{\int_{-\frac{L}{2}}^{\frac{L}{2}}\left[10^{\mathbf{PSR}\left(\sqrt{d^2+s^2+y^2},f\right)/20}\right]^2 dy\right\}$$

where s, d and L represents the perpendicular setback distance, the depth of track level and the train length respectively.

1.5.1.3 FDL for each train type is determined by subtracting the LSR from the measured train passby vibration levels of the respective test train. The average values and standard deviations are derived from the obtained FDL at various setback locations.

1.6 FDL Measurement Results

1.6.1.1 The FDL measurement results with averaged spectra and the averaged spectra plus two standard deviations of the FDL results at train speed 60km/h are presented in **Annex 4.7.2**.

Annex Figure

CHEK LAP KOK

CHEK LAP KOK

SIU HO WAN DEPOT

YING TUNG ESTATE

NORTH LANTAU HIGHWAY

TUNG CHUNG WATERFRONT ROAD

CARIBBEAN COAST

LAUNCHING/ RETRIEVAL SHAFT

FU TUNG ESTATE

EAP/ EEP

YAT TUNG ESTATE

MUN TUNG ESTATE

NGAU AU

SHEK LAU PO

Pak Sha Tsui

TUNG CHUNG BAY

Sha Tsui Tau

TAI HO WAN

0 100 200 300 400 500
METRES

MEASUREMENT LOCATION

1.5m

ACCELEROMETERS ON SLEEPER AND UNDER RAIL

40.5m

30.5m

20.5m

15.5m

5m

20m

20m

LEGEND

- TCL REALIGNMENT - AT GRADE
- TCW EXTENSION ALIGNMENT - UNDERGROUND STATION
- TCW EXTENSION ALIGNMENT - TUNNEL
- LATEST WORKS AREA
- LATEST WORKS SITE
- LATEST UNDERGROUND WORKS SITE
- TRACK FOR FDL MEASUREMENT
- IMPACT LOCATION
- ACCELEROMETER FOR MEASURING GROUND VIBRATION

REV	DESCRIPTION	BY	DATE	APPROVED
E	FIFTH ISSUE	GL	151021	FC
D	FOURTH ISSUE	GL	230821	FC
C	THIRD ISSUE	GL	180321	FC
B	SECOND ISSUE	GL	110121	FC
A	FIRST ISSUE	GL	221220	FC

DRAWN	GL
DESIGNED	GL
CHECKED	EL
APPROVED	FC
DATE	15/10/2021

MTR

C1202 – EIA for Tung Chung Line Extension

ORIGINATOR

ARUP Ove Arup & Partners Hong Kong Limited

CADD REF. FIGURE 3.1_E.dgn

TITLE

MEASUREMENT LOCATION AT SHD

SCALE 1: 20000 (A3)

DRAWING NO. ANNEX FIGURE 4.7.1

REV. E

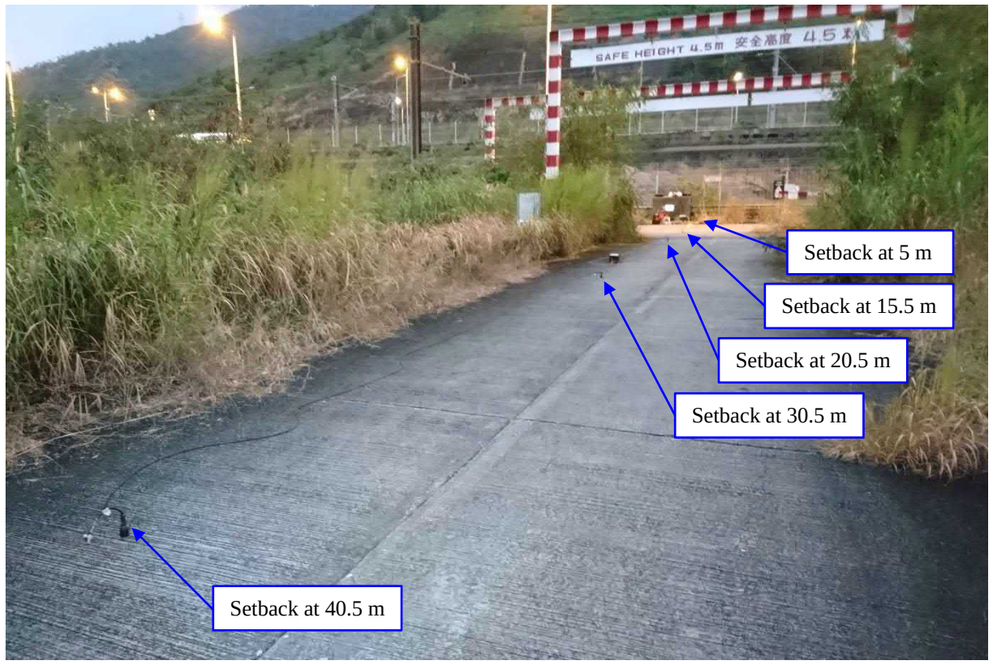
PLOT DRV:
MODELNAME: g:\common\microstation standard\ptdrv\hp_arupbk_a3-pdf-c.env
DefaulT PRINTED BY: HKGTRA04 10/5/2021 4:33:32 PM
FILENAME: \\hkgrts27\OENV\env\project\27146\07 Drawing Deliverables\report\023 Noise Measurement Report for FDL of Passenger Train\FIGURE 3.1_E.dgn

Annex 4.7.1

Photos of setback and hammer impact test location

Photos of Setback and Hammer Impact Test Locations

a) Photo of the Setback Locations at SHD



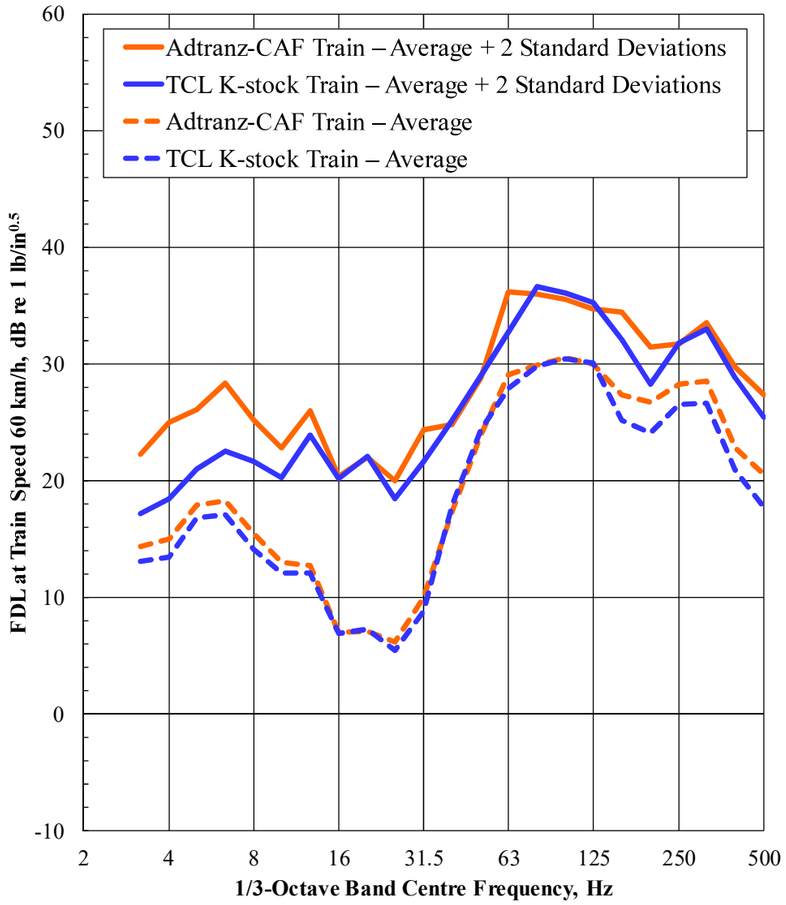
b) Photo of the Impact Hammer Setup at SHD Test Track

Annex 4.7.2

FDL measurement result

Force Density Level

Force Density Level Results of TCL Adtranz-CAF and K-stock Trains



Appendix B - LSR from the Approved TUE EIA Report (AEIAR-235/2022)

1 LSR Measurements and the Results

1.1 Measurement Methodology

1.1.1.1 Borehole impact tests were conducted to investigate the transfer mobility from track level to the ground surface and building structure. Force excitation by hammer impact was performed at the bottom of the borehole having similar depth as the track level. In view of there being no major sources of background vibration near the borehole impact sites (e.g. busy road traffics, fixed plants, construction activities, etc.), the measurements were conducted during daytime.

1.1.1.2 According to the Transit Noise and Vibration Impact Assessment, two methods are recommended to determine the LSR from the PSR data collected from measurements: (A) lines of transducers and (B) line of impacts. The former refers to the setting up of one or more lines of transducers corresponding to a single impact location at each site, while the latter refers to the setting up of multiple impact locations along the rail alignment with transducers at specific vibration paths and/or specific buildings at each specific site. For practical reasons, the number of borehole locations is limited. Thus, the lines of transducers method has been adopted.

1.1.1.3 The measurement setup of borehole impact test is illustrated in **Annex 4.5.1**. The impact hammer is mounted at the top of the connecting pipe. The bottom side of the connecting pipe is installed with an impact head for the transmission of the hammer impact to the bottom of the borehole. Instantaneous impact forces transmitted are measured by the load cell of the impact hammer. Lines of accelerometers are installed at the ground surface to detect the vibration transmission from each borehole.

1.2 Selection of Measurement Locations

1.2.1.1 It should be noted that the trackform of TUE at TCE would be at-graded ballast track except the TCE station section which is non-ballast track. In addition, the nearest distance between the NSR and the track at TCE is approximately 120m. Considering that the TUE trackform is at-grade with sufficient separation distance between the NSRs and the track, adverse groundborne noise impact for this part of the alignment are not anticipated. Hence, LSR measurements were not considered of TCE.

1.2.1.2 For TCW however, the alignment runs in tunnel from Tung Chung Crescent, through Ma Wan Chung until it reaches the TCW Station to the west of Yat Tung Estate. NSRs in close proximity of the tunnel alignment include the village houses in Ma Wan Chung, high-rise residential buildings in Yat Tung Estate, etc. According to the latest design, the tunnel track level is approximately 20m below ground at near Yat Tung Estate. In order to establish the LSR as specific to the alignment and NSRs as possible, 2 borehole locations representing the village houses in Ma Wang Chung and Yat Tung Estate have been selected. Their locations are shown in **Figure 1** and details are listed in the following table. The LSR measurements were conducted when the borehole depths reached about the proposed track levels.

Table 1 Borehole impact test sites

No.	Borehole Impact Test Site	Borehole Depth	Geological Condition
1	Tung Chung Road North	30.0 m (bottom level at -14.8 mPD)	Rock
2	Yat Tung Estate	17.8 m (bottom level at -13.8 mPD)	Soil

1.2.1.3 Accelerometer locations of the vibration measurement conducted at each borehole impact test site were set at horizontal distances from 5 m to 50 m, as shown in **Table 2** and **Annex Figure 4.5.1**.

Table 2 Distances between accelerometers and the borehole impact location at each test site

Borehole Impact Test Site 1				Borehole Impact Test Site 2			
ID	Horizontal Distance (m)	Vertical Distance (m)	Slant Distance (m)	ID	Horizontal Distance (m)	Vertical Distance (m)	Slant Distance (m)
1A	9.9	28.8	30.5	2A	5.0	17.8	18.5
1B	19.9	27.8	34.2	2B	12.5	21.0	24.4
1C	29.9	27.8	40.8	2C	21.5	21.0	30.1
1D	38.9	27.9	47.9	2D	32.0	21.0	38.3
1E	50.0	28.1	57.3	2E	42.0	21.0	47.0
1F	10.0	30.8	32.4	2F	50.0	21.0	54.2
1G	19.9	31.8	37.5	2G	19.0	21.0	28.3
1H	29.8	33.8	45.0	2H	37.0	21.0	42.5
1I	39.6	35.8	53.4	2I	44.0	21.0	48.8
1J	49.4	37.8	62.2	-	-	-	-

1.3 Data Analysis

1.3.1.1 PSR from borehole impact location to accelerometer locations is determined by the standard signal-processing techniques of frequency response function of the measured groundborne vibration velocities reference to the excitation force, averaged for 20 to 30 hammer impacts.

1.3.1.2 LSR is then evaluated by numerical regression of the measured PSR and numerical integration along the train length.

$$\mathbf{LSR}(s,d,f) = 10\log\left\{\int_{-\frac{L}{2}}^{\frac{L}{2}}\left[10^{\mathbf{PSR}\left(\sqrt{d^2+s^2+y^2},f\right)/20}\right]^2 dy\right\}$$

where s, d and L represents the perpendicular setback distance, the depth of track level and the train length respectively.

1.4 Measurement Results

1.4.1.1 PSR and LSR results are shown in **Annex 4.5.2**. All the measured spectra cover from 3.15Hz up to 500Hz.

Annex Figure

PROPOSED BOREHOLE
IMPACT TEST LOCATION 1

PROPOSED BOREHOLE
IMPACT TEST LOCATION 2

FU TUNG ESTATE

LION ROCK HILL

MA WAN CHUNG

NORTH LANTAU
HOSPITAL

YAT TUNG ESTATE

YU TUNG ROAD

0 25 50 75 100 125
METRES

LEGEND

TCW EXTENSION ALIGNMENT
- UNDERGROUND STATION

TCW EXTENSION ALIGNMENT
- TUNNEL

BORDHOLE IMPACT TEST LOCATION

LOCATION OF ACCELEROMETER

BOREHOLE
IMPACT TEST LOCATION 2

道路 Road

悅逸樓
Yuet Yat House

翠逸樓
Chui Yat House

籃球
Baske

IMPACT
LOCATION 2

2A 2B 2C 2D 2E 2F 2G 2H 2I

BOREHOLE
IMPACT TEST LOCATION 1

IMPACT
LOCATION 1

1A 1B 1C 1D 1E 1F 1G 1H 1I 1J

CUL

REV	DESCRIPTION	BY	DATE	APPROVED
F	SIXTH ISSUE	GL	230821	FC
E	FIFTH ISSUE	GL	091220	FC
D	FOURTH ISSUE	GL	150920	FC
C	THIRD ISSUE	GL	080920	FC
B	SECOND ISSUE	GL	070920	FC
A	FIRST ISSUE	GL	040920	FC

DRAWN	GL
DESIGNED	GL
CHECKED	EL
APPROVED	FC
DATE	23/08/2021

MTR

C1202 – EIA for Tung Chung Line Extension

ORIGINATOR

ARUP Ove Arup & Partners Hong Kong Limited

CADD REF.

TITLE

BOREHOLE IMPACT
TEST LOCATION 1 AND 2 FOR
THE TENTATIVE ALIGNMENT

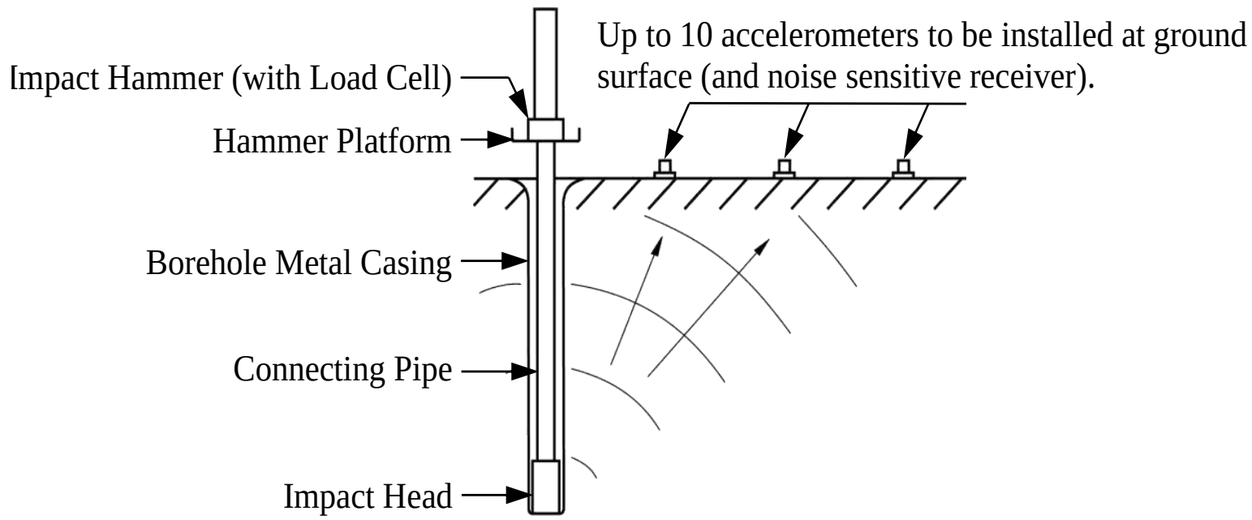
SCALE	DRAWING NO.	REV.
1: 5000 (A3)	ANNEX FIGURE 4.5.1	F

PLOT DRV: g:\common\microstation_standards\plotdrv\hp_arupbk_a3-pdf-c.envplt
MODELNAME: Default PRINTED BY: MKGTRAD4 8/23/2021 6:44:52 PM
FILENAME: \\tkgnts27\CIENV\env_projects\27TH6.10 Drawing Deliverables\report\106 Working Paper on LSR Measurement Methodology\FIGURE 3.1.F.dgn

Annex 4.5.1

Measurement setup of borehole impact test

Project: Environmental Consultancy No. C1202 EIA Study for Tung Chung Line Extension
Title: Measurement setup of borehole impact test

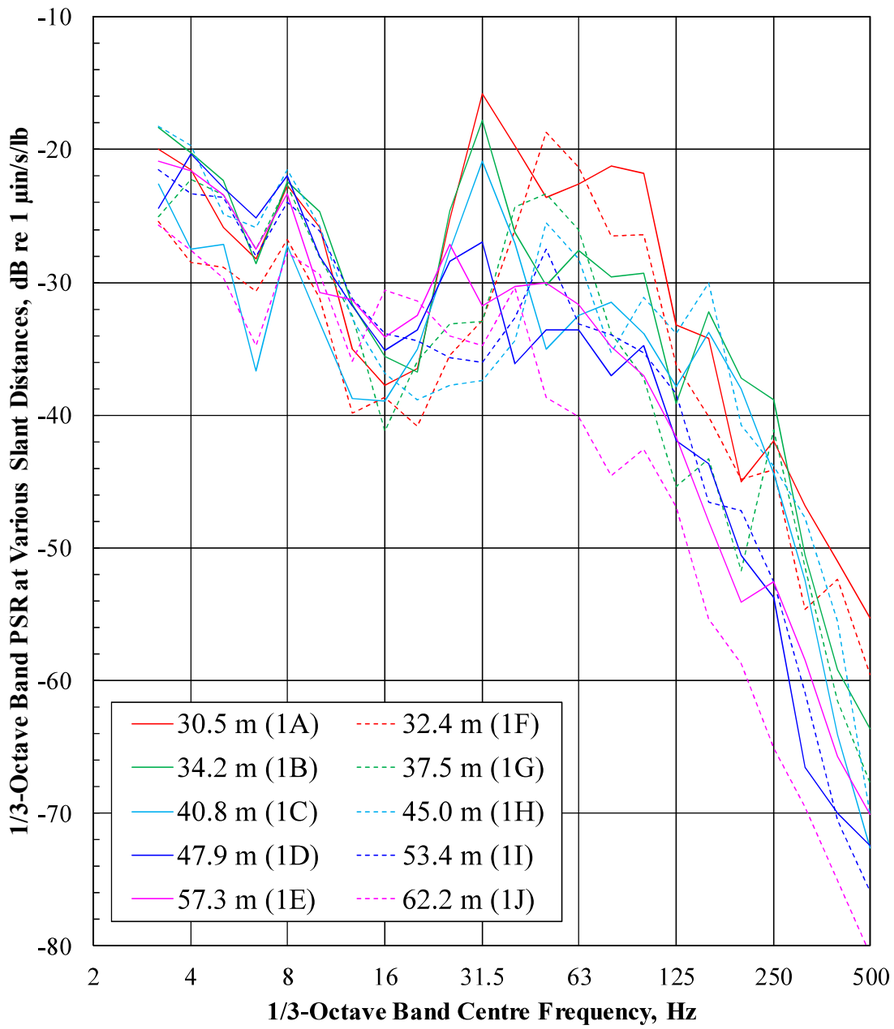


Annex 4.5.2

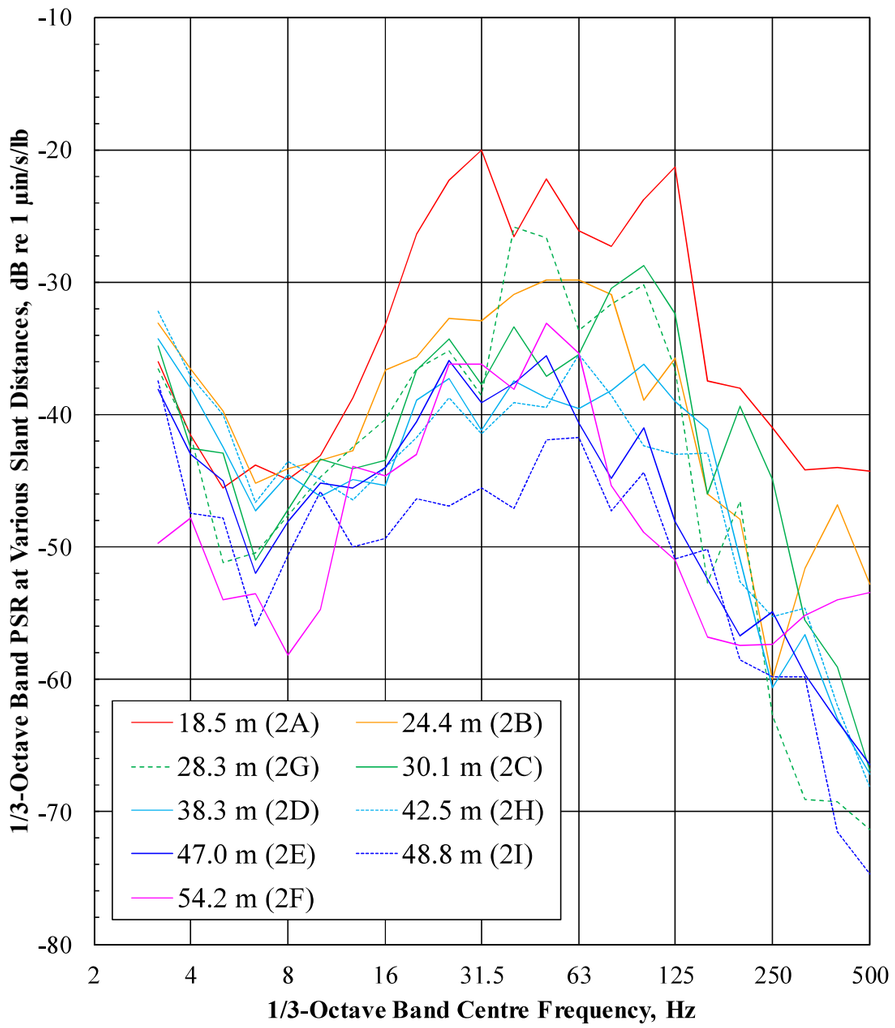
PSR and LSR measurement result

Project: Environmental Consultancy No. C1202 EIA Study for Tung Chung Line Extension
Title: PSR results for Tung Chung Road Noth and Yat Tung Estate

PSR results at Borehole Impact Test Site 1 (Tung Chung Road North)

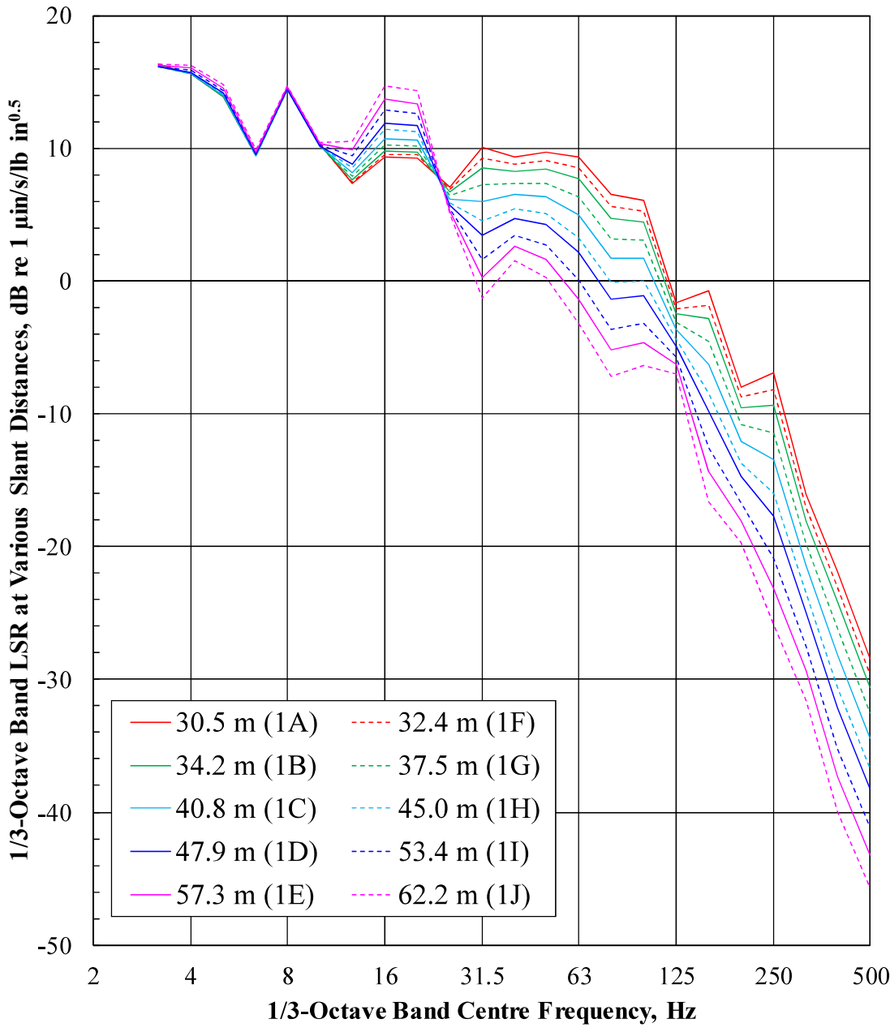


PSR results at Borehole Impact Test Site 2 (Yat Tung Estate)

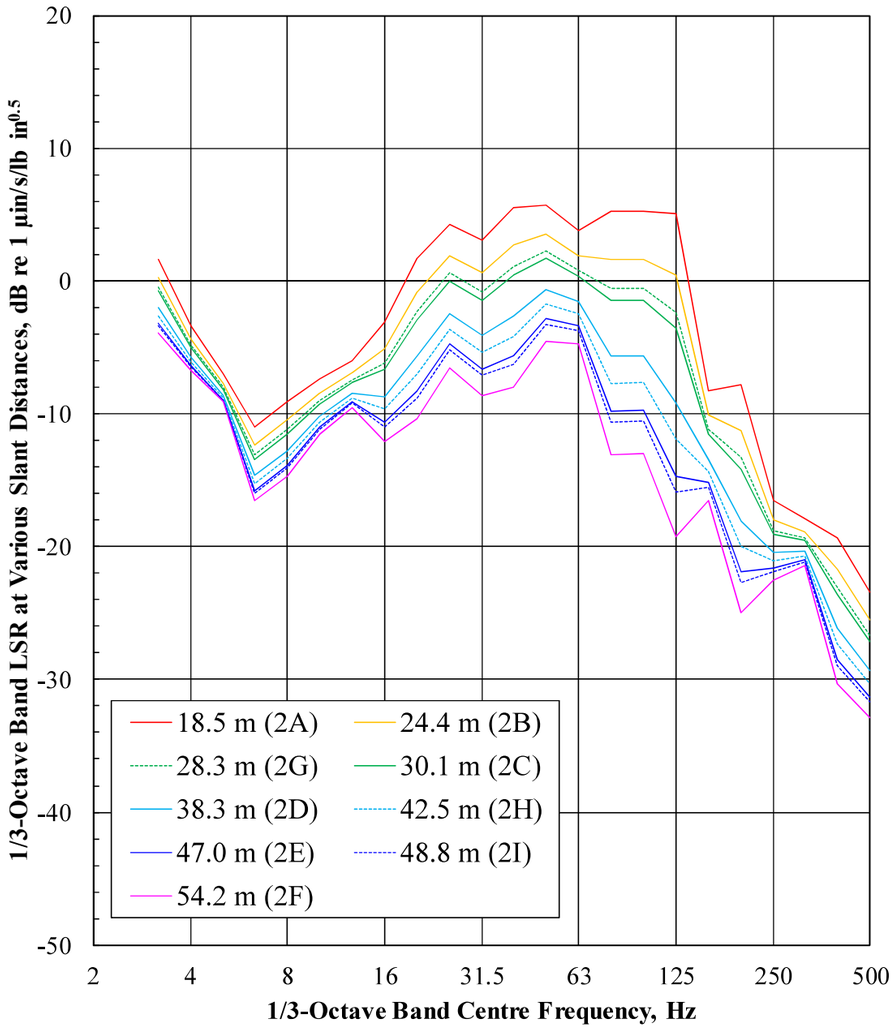


Project: Environmental Consultancy No. C1202 EIA Study for Tung Chung Line Extension
Title: LSR results for Tung Chung Road Noth and Yat Tung Estate

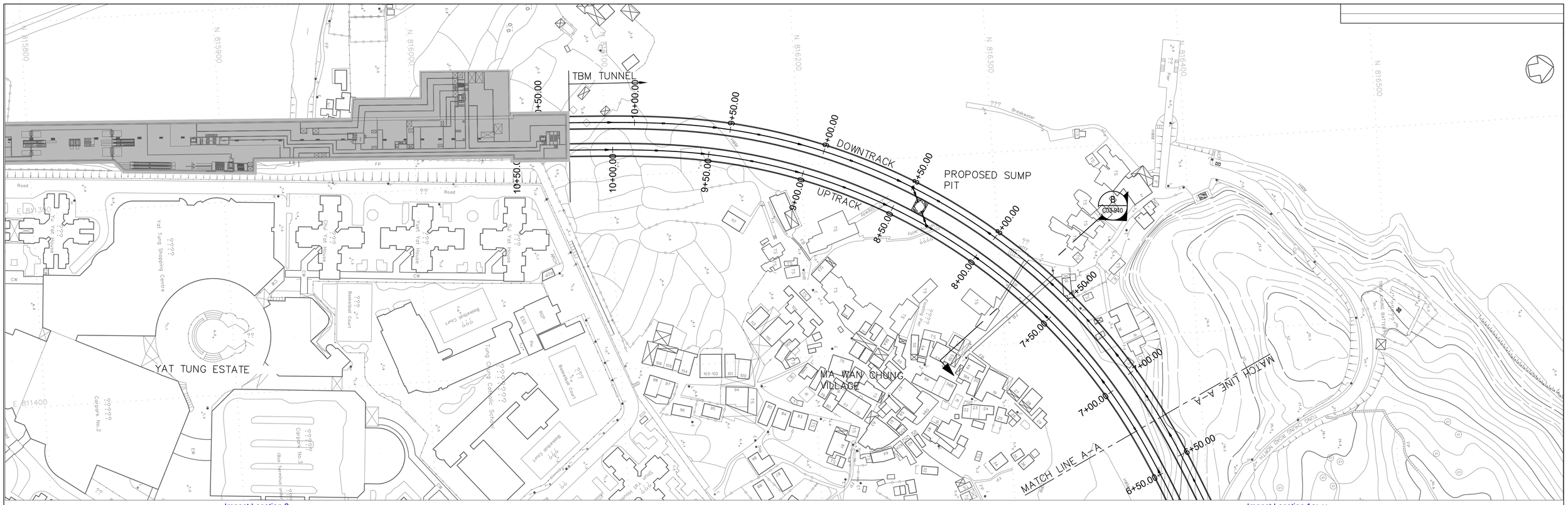
LSR results at Borehole Impact Test Site 1 (Tung Chung Road North)

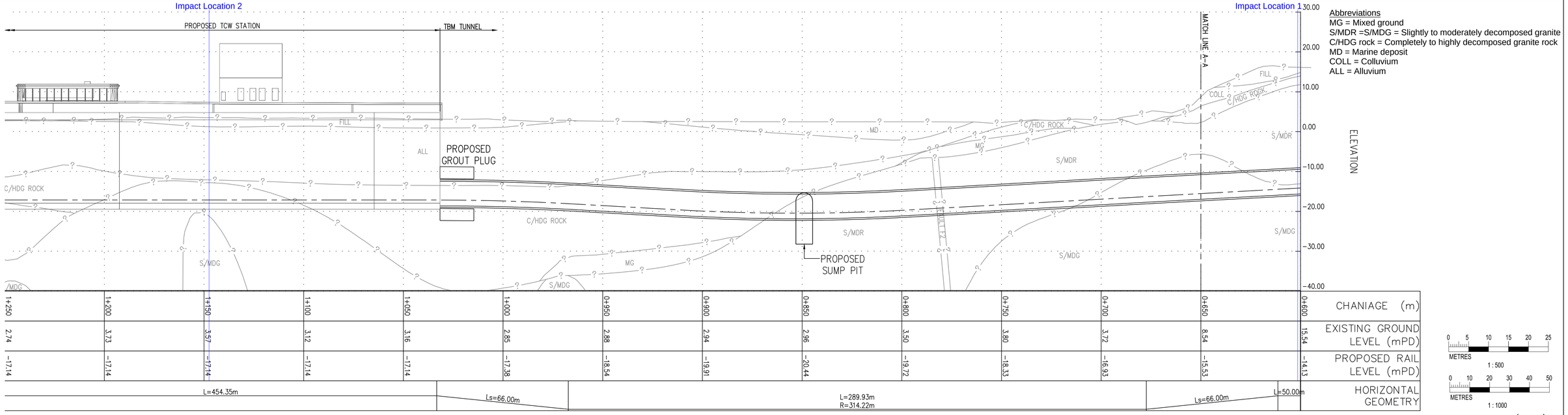


LSR results at Borehole Impact Test Site 2 (Yat Tung Estate)



Appendix C - Geological Profile of TUE and ARO





	1+250	1+200	1+150	1+100	1+050	1+000	0+950	0+900	0+850	0+800	0+750	0+700	0+650	0+600
CHAINAGE (m)														
EXISTING GROUND LEVEL (mPD)	2.74	3.73	3.57	3.12	3.16	2.85	2.88	2.94	2.96	3.50	3.80	3.72	8.54	15.54
PROPOSED RAIL LEVEL (mPD)	−17.14	−17.14	−17.14	−17.14	−17.14	−17.38	−18.54	−19.91	−20.44	−19.72	−18.33	−16.93	−15.53	−14.13
HORIZONTAL GEOMETRY	L=454.35m				Ls=66.00m		L=289.93m R=314.22m					Ls=66.00m	L=50.00m	

METRES 0 5 10 15 20 25 — 1 : 500

METRES 0 10 20 30 40 50 — 1 : 1000

Advanced Check Print (ACP)

LONGITUDINAL SECTION OF DOWNTRACK

HORI 1:1000 VERT 1:500
Ch. 0+600.000 TO 1+250.000

REV	DESCRIPTION	BY	DATE	APPROVED
A2	INTERIM REPORT SUBMISSION	TC	22DEC20	JB
A1	INTERIM REPORT SUBMISSION	TC	24SEP20	JB

DRAWN	HT
DESIGNED	HL
CHECKED	TC
APPROVED	TR
DATE	24SEP20

MTR

TUNG CHUNG LINE EXTENSION

ORIGINATOR

Atkins Arup JV

Supported by Arcadis

CADD REF. C1201_S_301_AAJ_C03_911.pdf

TITLE

CONTRACT C1201
DESIGN SERVICES FOR TUNG CHUNG LINE EXTENSION
PERMANENT TUNNEL – PLAN AND PROFILES
(BASE SCHEME) DOWNTRACK SHEET 2

SCALE 1:1000 (A1)

DRAWING NO. C1201/S/301/AAJ/C03/911

REV. A2

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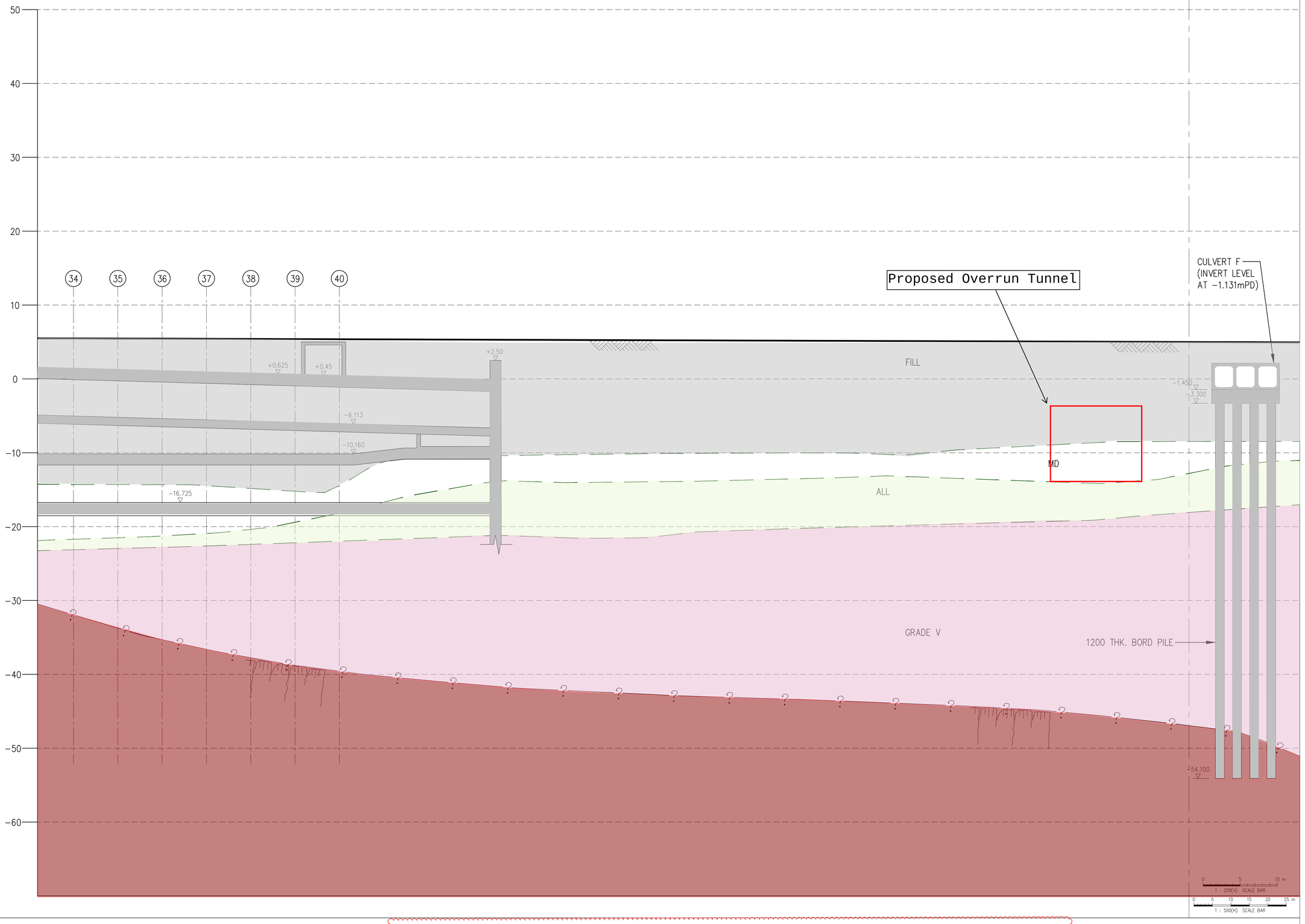


MTR

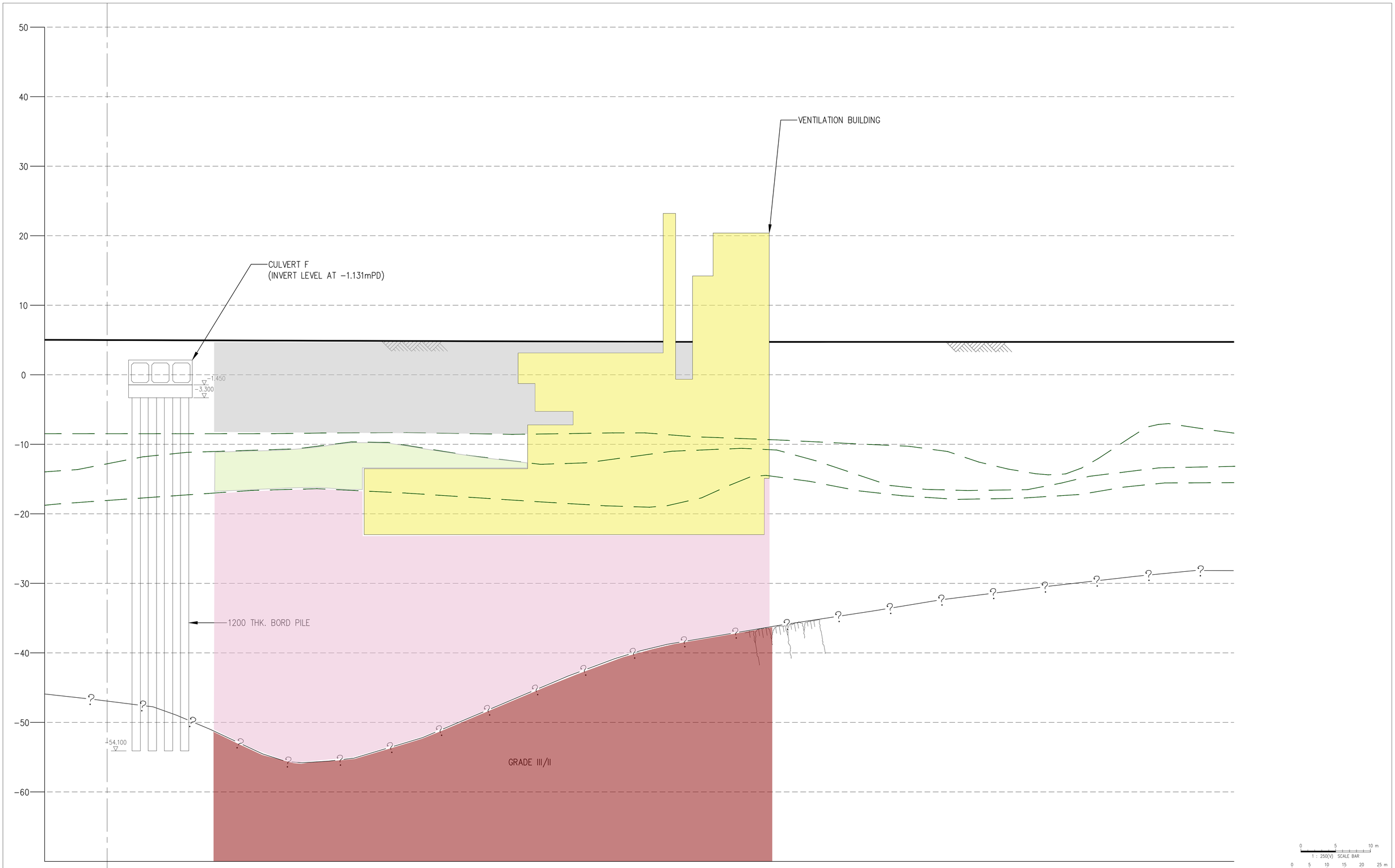
MOTT MACDONALD

CONSULTANCY AGREEMENT NO. C1901

DESIGN SERVICES FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL – ARO

ARO GENERAL LAYOUT PLAN – EXISTING UTILITIES

A



MTR

MOTT MACDONALD

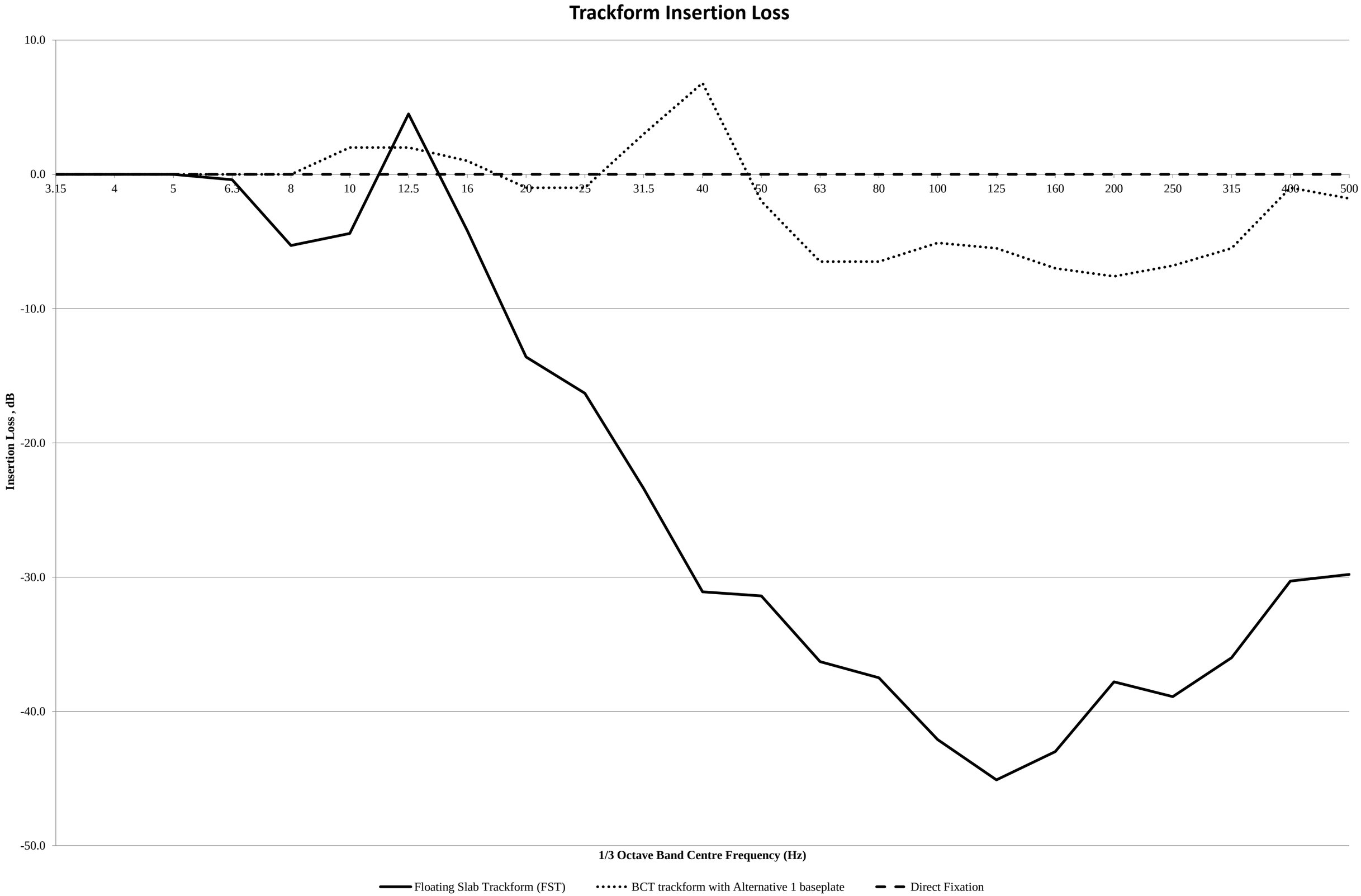
CONSULTANCY AGREEMENT NO. C1901

DESIGN SERVICES FOR AIRPORT RAILWAY EXTENDED OVERRUN TUNNEL – ARO

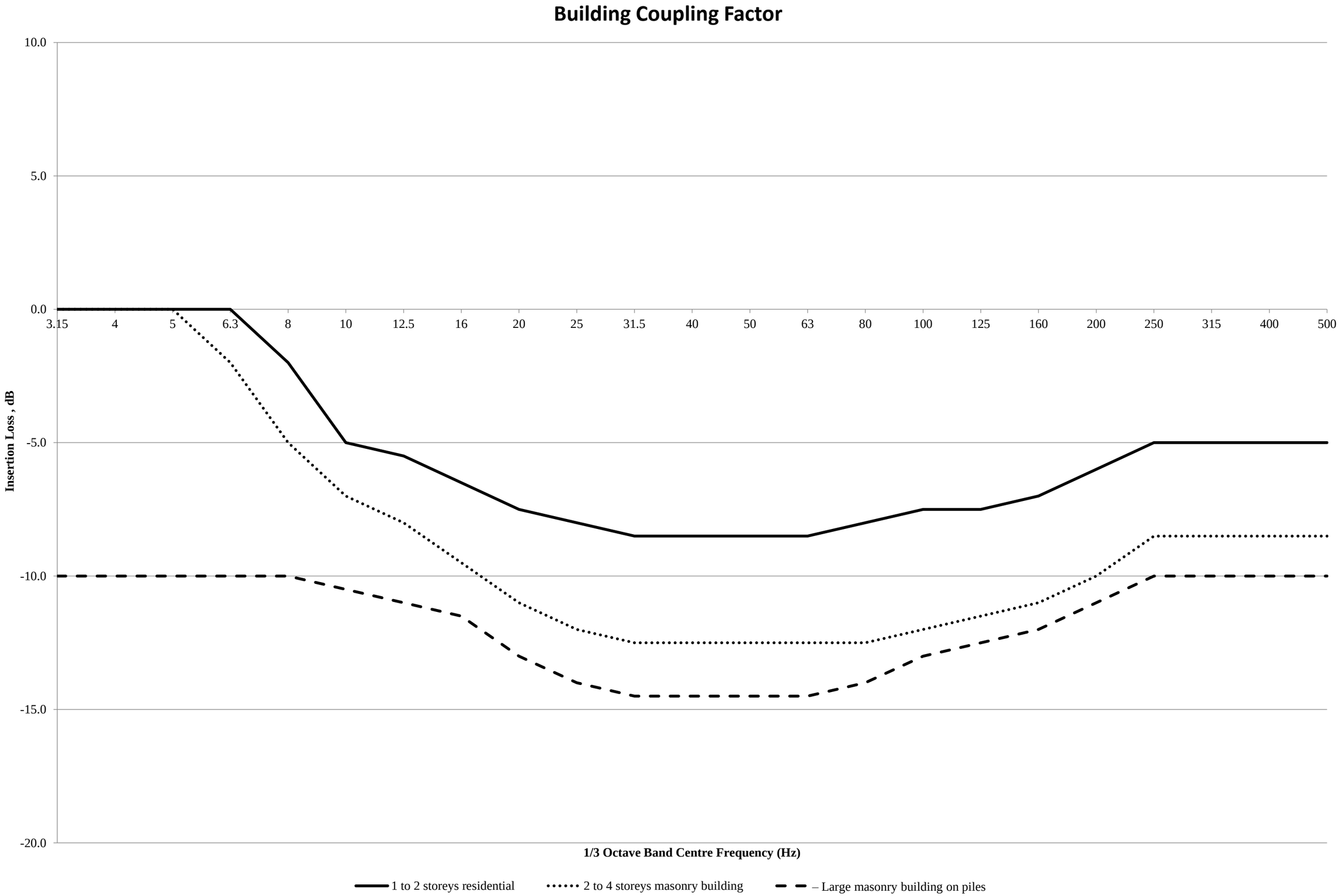
ARO GENERAL LAYOUT PLAN – EXISTING UTILITIES

B

Appendix D - TIL from the Approved TUE EIA Report (AEIAR-235/2022)


Trackform Insertion Loss
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
Insertion Loss , dB
3.15
4
5
6.3
8
10
12.5
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
1/3 Octave Band Centre Frequency (Hz)
Floating Slab Trackform (FST)
BCT trackform with Alternative 1 baseplate
Direct Fixation

Appendix E - BCF from the Approved TUE EIA Report (AEIAR-235/2022)


Building Coupling Factor
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Insertion Loss , dB
3.15
4
5
6.3
8
10
12.5
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
1/3 Octave Band Centre Frequency (Hz)
1 to 2 storeys residential
2 to 4 storeys masonry building
– Large masonry building on piles

Appendix F - Groundborne Railway Noise Impact (Unmitigated)

Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

NSR ID	Location	ASR	Type	Assessment Floor	Noise Criteria, dB(A)		LAeq(30mins), dB(A)				Remark
					Daytime and Evening 0700-2300	Night-time 2300-0700	AEL	TCL	AEL + TCL	Exceedance	
GBN1	Central Barracks Amethyst Block	C	Residential	B/F	60	50	17	21	22	N	AEL&TCL : Direct fixation
GBN2	Central Barracks Blake Block	C	Residential	B/F	60	50	17	21	22	N	AEL&TCL : Direct fixation
GBN3	Hong Kong City Hall	C	Performing Art Centre	G/F	60	50	18	22	24	N	AEL&TCL : Direct fixation
GBN4	New Central Harbourfront Site 3 Development (Theatre 1 - Site 3A)	C	Performing Art Centre	B4 (1)	60	50	22	26	27	N	AEL&TCL : Direct fixation
GBN5	New Central Harbourfront Site 3 Development (Theatre 2 - Site 3B)	C	Performing Art Centre	B2 (1)	60	50	31	32	34	N	AEL&TCL : Direct fixation

For Night-time period,

Max. LAeq(30mins) **34** **(16 dB(A) lower than Noise Criteria)**

Remark: The number of headway during peak hour is adopted for the night-time ground-borne noise impact assessment as conservative approach.

Note(s):
(1) Based on the information provided by Henderson.
(2) Assume the theatre use in Site 3 (e.g. GBN4 and GBN5) is similar to the use of performing art centre.

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN1

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B/F			
Floor Level (mPD):	--		48.2	48.2

Railway Line : AEL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 4

Parameters / Correction Factors	Type	Frequency, Hz																						
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																								
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Up Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Down Track																								
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Down Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Total Vibration Level																								
Total Vibration Level Outside the Building, dB		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock)	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	42.5m (2H)	-3.0	-6.0	-9.0	-15.0	-13.0	-11.0	-9.0	-10.0	-7.0	-4.0	-5.0	-4.0	-2.0	-3.0	-8.0	-8.0	-12.0	-14.0	-20.0	-21.0	-21.0	-27.0	-30.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		26.3	26.0	24.1	21.3	21.2	21.8	28.0	22.4	28.1	29.0	32.4	34.2	39.8	45.6	40.8	40.1	35.0	31.4	21.5	19.8	20.5	10.4	5.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-82.6	-74.7	-69.0	-64.1	-56.6	-48.6	-35.4	-34.3	-22.4	-15.7	-7.0	-0.4	9.6	19.4	18.3	21.0	18.9	18.0	10.6	11.2	13.9	5.6	1.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-82.1	-74.2	-68.5	-63.6	-56.1	-48.1	-34.9	-33.8	-21.9	-15.2	-6.5	0.1	10.1	19.9	18.8	21.5	19.4	18.5	11.1	11.7	14.4	6.1	2.4
Passby duration from TUE EIA, s [4]		23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-92.5**	**-84.6**	**-78.9**	**-74.0**	**-66.5**	**-58.5**	**-45.3**	**-44.2**	**-32.3**	**-25.6**	**-16.9**	**-10.3**	**-0.3**	**9.5**	**8.4**	**11.1**	**9.0**	**8.1**	**0.7**	**1.3**	**4.0**	**-4.3**	**-8.0**

Lmax, dB(A)	**27.4**
Overall Leq (30-min), dB(A)	**17.0**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the minimum distance between the AEL and GBN1-GBN2 is at least 45.4m ,the 42.5m(2H) LSR from TCL Extension (TUE) EIA Report will be adpoted for GBN1-GBN2 as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 23.3s under the speed of 60km/hr (10-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN1

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B/F			
Floor Level (mPD):	--		48.2	48.2

Railway Line : TCL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 12

Parameters / Correction Factors	Type	Frequency, Hz																						
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																								
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Up Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Down Track																								
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Down Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Total Vibration Level																								
Total Vibration Level Outside the Building, dB		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock) [2]	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	42.5m (2H)	-3.0	-6.0	-9.0	-15.0	-13.0	-11.0	-9.0	-10.0	-7.0	-4.0	-5.0	-4.0	-2.0	-3.0	-8.0	-8.0	-12.0	-14.0	-20.0	-21.0	-21.0	-27.0	-30.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		26.3	26.0	24.1	21.3	21.2	21.8	28.0	22.4	28.1	29.0	32.4	34.2	39.8	45.6	40.8	40.1	35.0	31.4	21.5	19.8	20.5	10.4	5.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-82.6	-74.7	-69.0	-64.1	-56.6	-48.6	-35.4	-34.3	-22.4	-15.7	-7.0	-0.4	9.6	19.4	18.3	21.0	18.9	18.0	10.6	11.2	13.9	5.6	1.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-82.1	-74.2	-68.5	-63.6	-56.1	-48.1	-34.9	-33.8	-21.9	-15.2	-6.5	0.1	10.1	19.9	18.8	21.5	19.4	18.5	11.1	11.7	14.4	6.1	2.4
Passby duration from TUE EIA, s [4]		18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-88.7**	**-80.8**	**-75.1**	**-70.2**	**-62.7**	**-54.7**	**-41.5**	**-40.4**	**-28.5**	**-21.8**	**-13.1**	**-6.5**	**3.5**	**13.3**	**12.2**	**14.9**	**12.8**	**11.9**	**4.5**	**5.1**	**7.8**	**-0.5**	**-4.2**

Lmax, dB(A)	**27.4**
Overall Leq (30-min), dB(A)	**20.8**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the minimum distance between the TCL and GBN1-GBN2 is at least 45.4m ,the 42.5m(2H) LSR from TCL Extension (TUE) EIA Report will be adpoted for GBN1-GBN2 as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 18.7s under the speed of 60km/hr (8-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN2

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B/F			
Floor Level (mPD):	--		45.4	45.4

Railway Line : AEL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 4

Parameters / Correction Factors	Type	Frequency, Hz																						
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																								
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Up Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Down Track																								
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Down Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Total Vibration Level																								
Total Vibration Level Outside the Building, dB		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock) [2]	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	42.5m (2H)	-3.0	-6.0	-9.0	-15.0	-13.0	-11.0	-9.0	-10.0	-7.0	-4.0	-5.0	-4.0	-2.0	-3.0	-8.0	-8.0	-12.0	-14.0	-20.0	-21.0	-21.0	-27.0	-30.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		26.3	26.0	24.1	21.3	21.2	21.8	28.0	22.4	28.1	29.0	32.4	34.2	39.8	45.6	40.8	40.1	35.0	31.4	21.5	19.8	20.5	10.4	5.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-82.6	-74.7	-69.0	-64.1	-56.6	-48.6	-35.4	-34.3	-22.4	-15.7	-7.0	-0.4	9.6	19.4	18.3	21.0	18.9	18.0	10.6	11.2	13.9	5.6	1.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-82.1	-74.2	-68.5	-63.6	-56.1	-48.1	-34.9	-33.8	-21.9	-15.2	-6.5	0.1	10.1	19.9	18.8	21.5	19.4	18.5	11.1	11.7	14.4	6.1	2.4
Passby duration from TUE EIA, s [4]		23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-92.5**	**-84.6**	**-78.9**	**-74.0**	**-66.5**	**-58.5**	**-45.3**	**-44.2**	**-32.3**	**-25.6**	**-16.9**	**-10.3**	**-0.3**	**9.5**	**8.4**	**11.1**	**9.0**	**8.1**	**0.7**	**1.3**	**4.0**	**-4.3**	**-8.0**

Lmax, dB(A)	**27.4**
Overall Leq (30-min), dB(A)	**17.0**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the minimum distance between the AEL and GBN1-GBN2 is at least 45.4m ,the 42.5m(2H) LSR from TCL Extension (TUE) EIA Report will be adpoted for GBN1-GBN2 as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 23.3s under the speed of 60km/hr (10-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN2

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:				
Floor Level (mPD):	--		45.4	45.4

Railway Line : TCL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 12

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Up Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Down Track Vibration Level, dB		19.3	22.0	23.1	25.3	22.2	19.8	23.0	17.4	19.1	17.0	21.4	22.2	26.0	33.2	33.6	33.1	32.2	31.4	28.5	28.8	30.5	26.7	24.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock) [2]	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	42.5m (2H)	-3.0	-6.0	-9.0	-15.0	-13.0	-11.0	-9.0	-10.0	-7.0	-4.0	-5.0	-4.0	-2.0	-3.0	-8.0	-8.0	-12.0	-14.0	-20.0	-21.0	-21.0	-27.0	-30.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		26.3	26.0	24.1	21.3	21.2	21.8	28.0	22.4	28.1	29.0	32.4	34.2	39.8	45.6	40.8	40.1	35.0	31.4	21.5	19.8	20.5	10.4	5.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-82.6	-74.7	-69.0	-64.1	-56.6	-48.6	-35.4	-34.3	-22.4	-15.7	-7.0	-0.4	9.6	19.4	18.3	21.0	18.9	18.0	10.6	11.2	13.9	5.6	1.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-82.1	-74.2	-68.5	-63.6	-56.1	-48.1	-34.9	-33.8	-21.9	-15.2	-6.5	0.1	10.1	19.9	18.8	21.5	19.4	18.5	11.1	11.7	14.4	6.1	2.4
Passby duration from TUE EIA, s [4]		18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-88.7**	**-80.8**	**-75.1**	**-70.2**	**-62.7**	**-54.7**	**-41.5**	**-40.4**	**-28.5**	**-21.8**	**-13.1**	**-6.5**	**3.5**	**13.3**	**12.2**	**14.9**	**12.8**	**11.9**	**4.5**	**5.1**	**7.8**	**-0.5**	**-4.2**

Lmax, dB(A)	**27.4**
Overall Leq (30-min), dB(A)	**20.8**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the minimum distance between the TCL and GBN1-GBN2 is at least 45.4m ,the 42.5m(2H) LSR from TCL Extension (TUE) EIA Report will be adpoted for GBN1-GBN2 as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 18.7s under the speed of 60km/hr (8-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN3

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	G/F			
Floor Level (mPD):	--		66.2	66.2

Railway Line : AEL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 4

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Up Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Down Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		27.3	30.0	31.1	33.3	30.2	27.8	31.0	25.4	27.1	25.0	29.4	30.2	34.0	41.2	41.6	41.1	40.2	39.4	36.5	36.8	38.5	34.7	32.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock) [2]	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	54.2m (2F)	-4.0	-7.0	-9.0	-17.0	-15.0	-12.0	-10.0	-12.0	-10.0	-7.0	-9.0	-8.0	-5.0	-5.0	-13.0	-13.0	-19.0	-17.0	-25.0	-23.0	-21.0	-30.0	-33.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		30.3	30.0	29.1	24.3	24.2	25.8	32.0	25.4	30.1	31.0	33.4	35.2	41.8	48.6	40.8	40.1	33.0	33.4	21.5	22.8	25.5	12.4	7.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-78.6	-70.7	-64.0	-61.1	-53.6	-44.6	-31.4	-31.3	-20.4	-13.7	-6.0	0.6	11.6	22.4	18.3	21.0	16.9	20.0	10.6	14.2	18.9	7.6	3.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-78.1	-70.2	-63.5	-60.6	-53.1	-44.1	-30.9	-30.8	-19.9	-13.2	-5.5	1.1	12.1	22.9	18.8	21.5	17.4	20.5	11.1	14.7	19.4	8.1	4.4
Passby duration from TUE EIA, s [4]		23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-88.5**	**-80.6**	**-73.9**	**-71.0**	**-63.5**	**-54.5**	**-41.3**	**-41.2**	**-30.3**	**-23.6**	**-15.9**	**-9.3**	**1.7**	**12.5**	**8.4**	**11.1**	**7.0**	**10.1**	**0.7**	**4.3**	**9.0**	**-2.3**	**-6.0**

Lmax, dB(A)	**28.7**
Overall Leq (30-min), dB(A)	**18.3**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the distance between the AEL and GBN3 is about 66.2m ,the 54.2m (2F) LSR from TCL Extension (TUE) EIA Report will be adpoted as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 23.3s under the speed of 60km/hr (10-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN3

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	G/F			
Floor Level (mPD):	--		66.2	66.2

Railway Line : TCL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 12

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Up Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Down Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		27.3	30.0	31.1	33.3	30.2	27.8	31.0	25.4	27.1	25.0	29.4	30.2	34.0	41.2	41.6	41.1	40.2	39.4	36.5	36.8	38.5	34.7	32.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock) [2]	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	54.2m (2F)	-4.0	-7.0	-9.0	-17.0	-15.0	-12.0	-10.0	-12.0	-10.0	-7.0	-9.0	-8.0	-5.0	-5.0	-13.0	-13.0	-19.0	-17.0	-25.0	-23.0	-21.0	-30.0	-33.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		30.3	30.0	29.1	24.3	24.2	25.8	32.0	25.4	30.1	31.0	33.4	35.2	41.8	48.6	40.8	40.1	33.0	33.4	21.5	22.8	25.5	12.4	7.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-78.6	-70.7	-64.0	-61.1	-53.6	-44.6	-31.4	-31.3	-20.4	-13.7	-6.0	0.6	11.6	22.4	18.3	21.0	16.9	20.0	10.6	14.2	18.9	7.6	3.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-78.1	-70.2	-63.5	-60.6	-53.1	-44.1	-30.9	-30.8	-19.9	-13.2	-5.5	1.1	12.1	22.9	18.8	21.5	17.4	20.5	11.1	14.7	19.4	8.1	4.4
Passby duration from TUE EIA, s [4]		18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-84.7**	**-76.8**	**-70.1**	**-67.2**	**-59.7**	**-50.7**	**-37.5**	**-37.4**	**-26.5**	**-19.8**	**-12.1**	**-5.5**	**5.5**	**16.3**	**12.2**	**14.9**	**10.8**	**13.9**	**4.5**	**8.1**	**12.8**	**1.5**	**-2.2**

Lmax, dB(A)	**28.7**
Overall Leq (30-min), dB(A)	**22.1**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the distance between the TCL and GBN3 is about 66.2m ,the 54.2m(2F) LSR from TCL Extension (TUE) EIA Report will be adpoted as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 18.7s under the speed of 60km/hr (8-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN4

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B4			
Floor Level (mPD):	--		45.4	45.4

Railway Line : AEL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 4

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Up Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Down Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		27.3	30.0	31.1	33.3	30.2	27.8	31.0	25.4	27.1	25.0	29.4	30.2	34.0	41.2	41.6	41.1	40.2	39.4	36.5	36.8	38.5	34.7	32.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock)	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	42.5m (2H)	-3.0	-6.0	-9.0	-15.0	-13.0	-11.0	-9.0	-10.0	-7.0	-4.0	-5.0	-4.0	-2.0	-3.0	-8.0	-8.0	-12.0	-14.0	-20.0	-21.0	-21.0	-27.0	-30.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		31.3	31.0	29.1	26.3	26.2	26.8	33.0	27.4	33.1	34.0	37.4	39.2	44.8	50.6	45.8	45.1	40.0	36.4	26.5	24.8	25.5	15.4	10.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-77.6	-69.7	-64.0	-59.1	-51.6	-43.6	-30.4	-29.3	-17.4	-10.7	-2.0	4.6	14.6	24.4	23.3	26.0	23.9	23.0	15.6	16.2	18.9	10.6	6.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-77.1	-69.2	-63.5	-58.6	-51.1	-43.1	-29.9	-28.8	-16.9	-10.2	-1.5	5.1	15.1	24.9	23.8	26.5	24.4	23.5	16.1	16.7	19.4	11.1	7.4
Passby duration from TUE EIA, s [4]		23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-87.5**	**-79.6**	**-73.9**	**-69.0**	**-61.5**	**-53.5**	**-40.3**	**-39.2**	**-27.3**	**-20.6**	**-11.9**	**-5.3**	**4.7**	**14.5**	**13.4**	**16.1**	**14.0**	**13.1**	**5.7**	**6.3**	**9.0**	**0.7**	**-3.0**

Lmax, dB(A)	**32.4**
Overall Leq (30-min), dB(A)	**22.0**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the distance between the AEL and GBN4 is about 45.4m ,the 42.5m(2H) LSR from Tung Chung Line Extension (TUE) EIA Report will be adpoted as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 23.3s under the speed of 60km/hr (10-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN4

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B4			
Floor Level (mPD):	--		45.4	45.4

Railway Line : TCL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 12

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Up Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Down Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		27.3	30.0	31.1	33.3	30.2	27.8	31.0	25.4	27.1	25.0	29.4	30.2	34.0	41.2	41.6	41.1	40.2	39.4	36.5	36.8	38.5	34.7	32.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock)	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	42.5m (2H)	-3.0	-6.0	-9.0	-15.0	-13.0	-11.0	-9.0	-10.0	-7.0	-4.0	-5.0	-4.0	-2.0	-3.0	-8.0	-8.0	-12.0	-14.0	-20.0	-21.0	-21.0	-27.0	-30.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		31.3	31.0	29.1	26.3	26.2	26.8	33.0	27.4	33.1	34.0	37.4	39.2	44.8	50.6	45.8	45.1	40.0	36.4	26.5	24.8	25.5	15.4	10.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-77.6	-69.7	-64.0	-59.1	-51.6	-43.6	-30.4	-29.3	-17.4	-10.7	-2.0	4.6	14.6	24.4	23.3	26.0	23.9	23.0	15.6	16.2	18.9	10.6	6.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-77.1	-69.2	-63.5	-58.6	-51.1	-43.1	-29.9	-28.8	-16.9	-10.2	-1.5	5.1	15.1	24.9	23.8	26.5	24.4	23.5	16.1	16.7	19.4	11.1	7.4
Passby duration from TUE EIA, s [4]		18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-83.7**	**-75.8**	**-70.1**	**-65.2**	**-57.7**	**-49.7**	**-36.5**	**-35.4**	**-23.5**	**-16.8**	**-8.1**	**-1.5**	**8.5**	**18.3**	**17.2**	**19.9**	**17.8**	**16.9**	**9.5**	**10.1**	**12.8**	**4.5**	**0.8**

Lmax, dB(A)	**32.4**
Overall Leq (30-min), dB(A)	**25.8**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the distance between the TCL and GBN4 is about 45.4m ,the 42.5m(2H) LSR from Tung Chung Line Extension (TUE) EIA Report will be adpoted.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 18.7s under the speed of 60km/hr (8-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN5

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B2			
Floor Level (mPD):	--		28.1	28.1

Railway Line : AEL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 4

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Up Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Down Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		27.3	30.0	31.1	33.3	30.2	27.8	31.0	25.4	27.1	25.0	29.4	30.2	34.0	41.2	41.6	41.1	40.2	39.4	36.5	36.8	38.5	34.7	32.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock)	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	24.4m (2B)	0.0	-4.0	-8.0	-12.0	-11.0	-8.0	-7.0	-5.0	-1.0	2.0	1.0	3.0	4.0	2.0	2.0	2.0	1.0	-10.0	-11.0	-18.0	-19.0	-22.0	-26.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		34.3	33.0	30.1	29.3	28.2	29.8	35.0	32.4	39.1	40.0	43.4	46.2	50.8	55.6	55.8	55.1	53.0	40.4	35.5	27.8	27.5	20.4	14.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-74.6	-67.7	-63.0	-56.1	-49.6	-40.6	-28.4	-24.3	-11.4	-4.7	4.0	11.6	20.6	29.4	33.3	36.0	36.9	27.0	24.6	19.2	20.9	15.6	10.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-74.1	-67.2	-62.5	-55.6	-49.1	-40.1	-27.9	-23.8	-10.9	-4.2	4.5	12.1	21.1	29.9	33.8	36.5	37.4	27.5	25.1	19.7	21.4	16.1	11.4
Passby duration from TUE EIA, s [4]		23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-84.5**	**-77.6**	**-72.9**	**-66.0**	**-59.5**	**-50.5**	**-38.3**	**-34.2**	**-21.3**	**-14.6**	**-5.9**	**1.7**	**10.7**	**19.5**	**23.4**	**26.1**	**27.0**	**17.1**	**14.7**	**9.3**	**11.0**	**5.7**	**1.0**

Lmax, dB(A)	**41.7**
Overall Leq (30-min), dB(A)	**31.3**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the distance between the AEL and GBN5 is about 28.1m ,the 24.4m(2B) LSR from Tung Chung Line Extension (TUE) EIA Report will be adpoted as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 23.3s under the speed of 60km/hr (10-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Project: ARO
Study Title: Ground-borne Railway Noise and Vibration Assessment Results for the Proposed Overrun Tunnel (Operational Phase) - Unmitigated (Direct fixation)

Assessment Point: GBN5

	Rockhead Depth, m	Vertical Distance, m	Horizontal Distance, m	Slant Distance, m
Floor:	B2			
Floor Level (mPD):	--		31.4	31.4

Railway Line : TCL
Speed (km/hr): 60
Max. headway per 30 minutues per track (Night-time): 12

Parameters / Correction Factors	Type	Frequency, Hz																							
		3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
Up Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Up Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Down Track																									
FDL from TUE EIA at 60kph [1]		22.3	25.0	26.1	28.3	25.2	22.8	26.0	20.4	22.1	20.0	24.4	25.2	29.0	36.2	36.6	36.1	35.2	34.4	31.5	31.8	33.5	29.7	27.4
Speed Correction		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Coupling Factor (TCF), dB (0: bored tunnel; 1: cut-and-cover tunnel; 2: station structure)	1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Turnout and Crossover Factor (TOC) (Y: with turnout / crossover; N: without turnout / crossover) [6]	Y	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Down Track Vibration Level, dB		24.3	27.0	28.1	30.3	27.2	24.8	28.0	22.4	24.1	22.0	26.4	27.2	31.0	38.2	38.6	38.1	37.2	36.4	33.5	33.8	35.5	31.7	29.4
Total Vibration Level																									
Total Vibration Level Outside the Building, dB		27.3	30.0	31.1	33.3	30.2	27.8	31.0	25.4	27.1	25.0	29.4	30.2	34.0	41.2	41.6	41.1	40.2	39.4	36.5	36.8	38.5	34.7	32.4
Building Coupling Factor (BCF) (1:1 to 2 storeys building, 2:2 to 4 storeys building, 3:large building on piles, 4:structures founded on rock)	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Up, dB (No. of floor increased)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Vibration Response (BVR) - Resonance, dB		0.0	0.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
Conversion from Vibration to Noise (CTN)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Safety Factor (SAF)		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Line Source Response from TUE EIA (Soil-borne Ground Type) [2]	30.1m (2C)	-1.0	-5.0	-8.0	-13.0	-12.0	-9.0	-8.0	-7.0	-3.0	0.0	-1.0	0.0	2.0	0.0	-2.0	-1.0	-4.0	-12.0	-14.0	-19.0	-20.0	-24.0	-27.0
Trackform Insertion Loss (TIL) (0:Direct fixation; 1: BCT; 2: FST)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Predicted Noise Level per Train for Two Directon, dB		33.3	32.0	30.1	28.3	27.2	28.8	34.0	30.4	37.1	38.0	41.4	43.2	48.8	53.6	51.8	52.1	48.0	38.4	32.5	26.8	26.5	18.4	13.1
A-weighting Factor		-108.9	-100.7	-93.1	-85.4	-77.8	-70.4	-63.4	-56.7	-50.5	-44.7	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2
Predicted Noise Level, $L_{eq\ (double\ passby)}$, dB(A)		-75.6	-68.7	-63.0	-57.1	-50.6	-41.6	-29.4	-26.3	-13.4	-6.7	2.0	8.6	18.6	27.4	29.3	33.0	31.9	25.0	21.6	18.2	19.9	13.6	9.9
Predicted Maximum Noise Level, $L_{max\ (double\ passby)}$, dB(A) [3]		-75.1	-68.2	-62.5	-56.6	-50.1	-41.1	-28.9	-25.8	-12.9	-6.2	2.5	9.1	19.1	27.9	29.8	33.5	32.4	25.5	22.1	18.7	20.4	14.1	10.4
Passby duration from TUE EIA, s [4]		18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Predicted Noise Level, $L_{eq\ (30\text{-}minute)}$, dB(A) [5]		**-81.7**	**-74.8**	**-69.1**	**-63.2**	**-56.7**	**-47.7**	**-35.5**	**-32.4**	**-19.5**	**-12.8**	**-4.1**	**2.5**	**12.5**	**21.3**	**23.2**	**26.9**	**25.8**	**18.9**	**15.5**	**12.1**	**13.8**	**7.5**	**3.8**

Lmax, dB(A)	**38.1**
Overall Leq (30-min), dB(A)	**31.5**
Criteria	**50.0**
Exceedance	**N**

Notes:
[1] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[2] Given that the distance between the TCL and GBN5 is about 31.4m ,the 30.1m(2C) LSR from Tung Chung Line Extension (TUE) EIA Report will be adpoted as conservative appraoch.
[3] According to Appendix 4.7.3 of from Tung Chung Line Extension (TUE) EIA Report, Lmax has incorporated a +0.5 dB(A) correction to passby Leq.
[4] Based on the information from Appendix 4.7.3 of Tung Chung Line Extension (TUE) EIA Report, the passby duration is 14s under the speed of 80km/hr (8-car). Therefore, the passby duartion has been adjsted to 18.7s under the speed of 60km/hr (8-car).
[5] Leq,30mins = Leq(double passbys) + 10log(Passby duration in sec) + 3dB(A) + 10log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to Leq,30mins for leading and trailing effect for conservative approaches.)
[6] As modern inclined turnouts would be adopted in the ARO Project, 5dB correction factor would be adopted for GBN3 to GBN5 (i.e. NSR adjacent to the turnout / corssover section).

Appendix 4.1 – Project Implementation Schedule

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
Air Quality (Construction Phase)					
• Provision of dust screen/ mesh cover for those excavation areas without the decking as far as practicable, which will be supplemented by the use of automatic sprinkler system for regular water spraying wherever practicable.	To minimize dust impact	The contractor	Works site	Construction phase	APCO
• The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. Effective dust suppression measures, as necessary, should be installed to minimise air quality impacts, at the boundary of the site and at any sensitive receivers. • The working area of any excavation or earthmoving operation shall spray with water immediately before, during and immediately after the operation so as to maintain the entire surface wet; • Exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen or other suitable surface stabiliser within six months after the last construction activity on the construction site or part of the construction site where the exposed earth lies; • Effective water sprays shall be used during the delivery and handling of all raw sand, aggregate and other similar materials, when dust is likely to be created, to dampen all stored materials during dry and windy weather.	To minimize dust impact	The contractor	All works site/area	Construction phase	APCO

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Watering of exposed surfaces shall be conducted as often as possible depending on the circumstances. • Areas within the site where there is a regular movement of vehicles shall have an approved hard surface, be kept clear of loose surface materials and / or regularly watered. • The Contractor shall confine haulage and delivery vehicles to designated roadways inside the site. If in the opinion of the Engineer, any motorised vehicle is causing dust nuisance, the Engineer may require that the vehicle be restricted to a maximum speed of 10 km per hour while within the site area. • Wheel cleaning facilities shall be installed and used by all vehicles leaving the site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be treated before discharge /recycling and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel cleaning facilities shall be usable prior to any earthwork excavation activity on site. The Contractor shall provide a hard surfaced road between any cleaning facility and the public road. • Any stockpile of dusty material shall be either: a) covered entirely by impervious sheeting; b) placed in an area sheltered on the top and the three sides; or c)					

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
sprayed with water so as to maintain the entire surface wet. • Chemical wetting agents shall only be used on completed cuts and fills to reduce wind erosion. • All site vehicular exhausts should be directed vertically upwards or directed away from ground to minimise dust nuisance. • Ventilation system, equipped with proprietary filters, should be provided to ensure the safe working environment inside the tunnel. Particular attention should be paid to the location and direction of the ventilation exhausts. The exhausts should not be allowed to face any sensitive receivers directly. Consideration should also be given to the location of windows, doors and direction of prevailing winds in relation to the nearby sensitive receivers. • Where a vehicle leaving the Project site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle. • Restricting heights from which materials are to be dropped, as far as practicable to minimise the fugitive dust arising from unloading/ loading; • Where practicable and subject to any site constraints, hoarding of not less than 2.4 m high from ground level shall be provided along the site boundary;					

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Plan site layout so that machinery and dust causing activities (e.g. haul roads and stockpiling areas) are located away from nearby ASRs; • Avoid concurrent construction works around ASRs in close proximity at the same time; • Taller hoarding are recommended along site boundary with ASRs in close proximity; • Other suitable dust control measures as stipulated in the Air Pollution Control (Construction Dust) Regulation, where appropriate, should be adopted.					
The following measures should be deployed as far as practicable: • Deploy electrified NRMMs as far as practicable; • Use of exempted NRMMs should be avoided as far as practicable	To minimize the emission from NRMM	The contractor	All works site/area	Construction phase	Air Pollution Control (NRMMs) (Emission) Regulation
Implement regular dust monitoring during the construction phase.	Monitoring of dust impact	The contractor	Selected dust monitoring locations	Construction phase	EIAO-TM
Construction Noise					
The site practices listed below should be followed during construction: • Only well-maintained plant should be operated on-site and plant should be serviced regularly during construction; • Silencers or mufflers on construction equipment should be utilised and should be properly maintained during construction;	To reduce impact to surrounding NSRs	The contractor	All works sites/areas	Construction phase	EIAO-TM

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Mobile plant, if any, should be sited as far from NSRs as possible; • Machines and plant (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum; • The engine of lorry should be switched off after arriving the unloading position. • Plant known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from the nearby NSRs; • Material stockpiles should be effectively utilized, wherever practicable, in screening noise from on-site construction activities; • Use of purpose-built acoustic barriers, panels and enclosures, where practicable and applicable; • Use of Quality Powered Mechanical Equipment (QPME); • Use of Quiet Construction Method					
Implement regular airborne construction noise monitoring before and during the construction phase.	Monitor the airborne construction noise levels at the selected representative locations	The contractor	Selected noise Monitoring stations	Constriction Phase	EIAO-TM
Water Quality (Construction phase)					
Mitigation measures for works of Culvert F diversion: • The existing and temporary diversion for Culvert F should be kept hydraulically isolated from other construction works areas of the Project at all times	To ensure no uncontrolled discharge of construction site runoff or excavation wastewater into the existing or diverted culvert	The contractor	All works sites/areas	Construction phase	WPCO EIAO-TM ProPECC PN1/94

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Controlled discharge of treated runoff and excavation wastewater into the culvert system is only permitted with a valid discharge license under the WPCO.	system				TM-ICW
Mitigation measures for construction site runoff: • Surface run-off from construction sites should be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sedimentation basins. Channels or earth bunds or sandbag barriers should be provided on site to properly direct stormwater to such silt removal facilities. • Perimeter channels should be provided on site boundaries where necessary to intercept storm run-off from outside the Site so that it will not wash across the Site. Catch-pits and perimeter channels should be constructed in advance of site formation works and earthworks. • Silt removal facilities, channels and manholes should be maintained, and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to prevent local flooding. • Construction works should be programmed to minimise soil excavation works in rainy seasons (April to September). If excavation in soil cannot be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporary exposed slope surfaces should be covered e.g. by tarpaulin and the size of the excavation should be minimised as far as practicable. Arrangements should	To minimise impact from construction site run-off and general construction activities	The contractor	All works sites/areas	Construction phase	WPCO EIAO-TM ProPECC PN1/94 TM-ICW

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm. Measures should be taken to minimize the ingress of rainwater into trenches. • If excavation of trenches in wet seasons is necessary, they Excavation of trenches should be dug and backfilled in short sections. Rainwater pumped out from trenches or excavations should be discharged into storm drain via silt removal facilities. • Temporary access roads should be protected by crushed stone or gravel. Appropriate drainage such as intercepting channels should be provided where necessary. • Earthworks final surfaces should be well compacted and the subsequent permanent work or surface protection should be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms. • As bentonite slurries are required for construction of diaphragm walls, they should be reconditioned and reused wherever practicable to minimise the disposal volume of used bentonite slurries. Temporary enclosed storage locations should be provided on-site for any unused bentonite that needs to be transported away after the related construction activities are completed. Requirements as stipulated in ProPECC Note PN 1/94					

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
should be closely followed when handling and disposing bentonite slurries. • Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers. Discharge of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system. • Good site practices should be adopted to remove rubbish and litter from construction sites so as to prevent the rubbish and litter from spreading from the site area. It is recommended to clean the construction sites on a regular basis. • Any open stockpiles on site should be covered with by impervious sheeting or placed in sheltered area during rainstorms to prevent wash away of construction materials, soil, silt or debris into any drainage system. • Any groundwater that may be pumped out during tunnel/ foundation construction should be discharged into storm drains after the removal of silt in silt removal facilities. • Water used in ground boring and drilling should as far as practicable be recirculated after sedimentation. When there is a need for final disposal, the wastewater should be discharged into storm drains via silt removal facilities.					

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Wastewater discharged from wheel washing bay should have sand and silt settled out or removed before discharging into storm drains. The section of construction road between the wheel washing bay and the public road should be paved with backfall to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.					
Mitigation measures for wastewater discharge from excavation: • Wastewater with a high level of SS should be treated before discharge by settlement in tanks with sufficient retention time • Oil interceptors would be required to remove the oil, lubricants, and grease from wastewater • A discharge licence under the WPCO would be required for discharge to the stormwater drain • The Contractor might be stipulated under the discharge license to monitor the quantity and quality of discharge to ensure compliance with the conditions of the discharge license	To minimise impact from construction site run-off and general construction activities	The contractor	All works sites/areas	Construction phase	WPCO EIAO-TM ProPECC PN1/94 TM-ICW
Mitigation measures for sewage effluent from workforce: • The Contractor should provide temporary sanitary facilities, such as portable chemical toilets within the construction site to handle sewage from the workforce • To ensure that chemical toilets are used and properly maintained, and that licensed Contractors are employed	To minimise impact from workforces sewage effluent	The contractor	All works sites/areas	Construction phase	WPCO EIAO-TM ProPECC PN1/94 TM-ICW

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
to collect and dispose of the waste off-site at approved locations					
Mitigation measures for accidental spillage of chemicals: • Any chemical storage, service shop and maintenance facilities should be located on hard standings within a bunded area, sumps and oil interceptors should be provided • Maintenance of vehicles and equipment involving activities with potential of leakage and spillage should only be undertaken within the areas appropriately equipped to control these discharges • Disposal of chemical wastes should be carried out in compliance with the Waste Disposal Ordinance and the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes	To minimise impact from accidental spillage	The contractor	All works sites/areas	Construction phase	WPCO EIAO-TM Waste Disposal (Chemical Waste) (General) Regulation
Waste Management Implication (Construction Phase)					
Recommendations for good site practices during the construction phase include: • Nomination of an approved person, such as a site manager, to be responsible for implementation of good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site and effective disposal to appropriate facilities; • Training of site personnel in proper waste management and chemical handling procedures;	To avoid and minimize impacts arising from waste management	The contractor	All works sites/areas	Construction phase	WDO ETWB TC(W) 19/2005

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Provision of sufficient waste disposal points and regular collection of waste for disposal; • Minimisation of windblown litter and dust/odour during transportation of waste by transporting wastes in enclosed containers; • Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors; • An EMP should be prepared by the Contractor with reference to the requirements in ETWB TCW No. 19/2005 and should be submitted to the Engineer for approval before construction; • A Waste Management Plan (WMP), as part of EMP, should be submitted to the Engineer for approval prior to the commencement of construction works; and • Well planned delivery programme for offsite disposal such that adverse environmental impact from transporting the C&D materials is not anticipated.					
Recommendations to achieve waste reduction are as follow: • Sort non-inert C&D materials to recover any recyclable portions; • Segregation and storage of different types of waste in different containers or skips or stockpiles to enhance reuse or recycling of materials and their proper disposal; • Any unused chemicals or those with remaining functional capacity shall be recycled;	To minimize waste generation	The contractor	All works sites/areas	Construction phase	WDO

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Maximising the use of reusable steel formwork to reduce the amount of C&D material; • Encourage collection of recyclable waste such as waste paper and aluminium cans by providing separate labelled bins to enable such waste to be segregated from other general refuse generated by the work force; • Prior to disposal of non-inert C&D material, it is recommended that wood, steel and other metals shall be separated for re-use and / or recycling to minimise the quantity of waste to be disposed of to landfill; • Proper storage and site practices to minimise the potential for damage or contamination of inert C&D materials; • Provide training to workers on the importance of appropriate waste management procedures, including waste reduction, reuse and recycling; • Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste; and • Minimise over ordering of concrete, mortars and cement grout by doing careful check before ordering.					
If sufficient and suitable areas being identified, it will be designated within the site for temporary stockpiling of C&D material as far as practical and to facilitate the sorting process. Within stockpile areas, the following measures should be taken to control potential environmental impacts or nuisance:	To minimise the impact resulting from collection and transportation of C&D materials	The contractor	All works sites/areas	Construction phase	WDO Land (Miscellaneous Provisions) Ordinance ETWB TCW No. 19/2005

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• Covering material during heavy rainfall; • Locating stockpiles to minimise potential air quality, water quality and visual impacts; and • Minimising land intake of stockpile areas as far as possible. Non-inert C&D materials / C&D wastes should be reused and recycled on-site as far as possible before disposal at the designated landfill site. The Contractor shall record the amount of wastes generated, recycled and disposed of (including the disposal sites). A trip ticket system (i.e. DEVB TC(W) No. 6/2010) shall be implemented for the disposal of C&D materials and/or C&D waste to any designated public filling facility and/or landfill respectively.					
If chemical wastes would be produced from the construction activities, the following measures shall be observed: • The Contractor will be required to register with the EPD as a chemical waste producer and to follow the guidelines stated in the "Code of Practice on the Packaging Labelling and Storage of Chemical Wastes"; • Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately; • Appropriate labels should be securely attached on each chemical waste container indicating the corresponding chemical characteristics of the chemical waste, such as	Control the chemical waste and ensure proper storage, handling and disposal	The contractor	All works sites/areas	Construction phase	WDO Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Waste

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
explosive, flammable, oxidising, irritant, toxic, harmful, corrosive, etc; and • The Contractor should use a licensed collector to transport and dispose of the chemical wastes at the approved Chemical Waste Treatment Centre or other licensed recycling facilities, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.					
The following measures shall be conducted for general waste: • General refuse should be stored in enclosed bins or compaction units separated from inert C&D materials. • A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from C&D materials. • An enclosed and covered area is preferred to reduce the occurrence of 'wind-blown' light material.	Minimise production of the general refuse and avoid odour, pest and litter impacts	The contractor	All works sites/areas	Construction phase	WDO
Waste Management Implication (Operation Phase)					
The following measures shall be conducted for general refuse: • Proper storage and collection of general refuse should be provided on site to minimise potential impacts that may arise from improper storage of waste. • The general refuse would be regularly collected and disposed of at designated waste collection facilities by a reputable waste collector. • Recycling bins would also be provided as far as practicable (subjected to the actual setting in operation	To monitor the disposal of general refuse	MTRCL	All working areas of the tunnel and ARB	Operation phase	WDO

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
phase) to maximise the capture of recyclables from general refuse.					
Chemical wastes • All chemical wastes such as used solvents, cleaning fluids and waste lubricating oil should be collected and handled carefully. • To minimise potential environmental hazard due to waste handling, localized chemical waste storage areas should be located close to the source of waste generation for temporary storage. Drum-type containers with proper labelling should be used to collect chemical wastes for storage at the designated areas. • The producers should register with EPD as chemical waste producers. Chemical wastes should be stored in appropriate containers and collected by a licensed chemical waste collector. All chemical wastes generated should be dealt with according to the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes under the provisions of the Waste Disposal (Chemical Waste) (General) Regulation. Collection and disposal of chemical waste shall comply with the Waste Disposal Ordinance.	To monitor the disposal of chemical waste	MTRCL	All working areas of the tunnel and ARB	Operation phase	WDO Code of Practice on the Packaging, Labelling and Storage of Chemical Waste
Cultural Heritage (Construction Phase)					
• Pre- and post-construction condition surveys shall take place to record conditions of the Hong Kong City Hall • Monitoring of building settlement, tilting and vibration under the requirement of the Buildings Ordinance	Precautionary measure to avoid disturbance / damage to Hong Kong City Hall.	The contractor / Qualified Buildings Surveyor / Structural Engineer	To be agreed with BD and AMO	Construction Phase	PNAP APP-137 Ground-borne Vibrations and Ground Settlements Arising from Pile Driving and Similar Operations

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
• The Contractor should inform the AMO in case of discovery of antiquities or supposed antiquities in the course of works	To avoid / minimize impact on archaeological resources, if any	The contractor	All works sites / areas where applicable	Construction Phase	Antiquities and Monuments Ordinance (Cap.53)
Landscape and Visual Impact (Construction Phase)					
CM1 - Preservation of Existing Trees and Other Vegetation: All the existing Trees to be retained and not to be affected by the Project should be carefully protected during the construction phase in accordance with DEVB TCW No. 4/2020 – titled "Tree Preservation" and the latest "Guidelines on Tree Preservation during Development" issued by GLTM Section of DEVB, including provision of Tree Protection Zones (TPZs).	To minimize the landscape and visual impact on surrounding setting	The contractor	All works sites/areas	Construction Phase	DEVB TC(W) 4/2020 – Tree Preservation
CM2 - Control of Night-time Lighting Glare: Lighting for the construction works at night, if any, should be carefully controlled to prevent light overspill to the nearby VSRs and into the sky.	To minimize the landscape and visual impact on surrounding setting	The contractor	All works sites/areas	Construction Phase	EIAO-TM
CM3 - Erection of screen hoarding compatible with the surround setting.	To minimize the landscape and visual impact on surrounding setting	The contractor	All works sites/areas	Construction Phase	EIAO-TM
CM4 - Management of Construction Activities and Facilities: Openings will be decked over wherever feasible to minimise the visual impact to the VSRs who have views overlooking the project site. Bitumen/concrete finish will be temporarily applied to the traffic/construction decks to blend in with the surrounding. Bentonite silos will be with aesthetic painting. The undecked areas would be provided with dust screen/ mesh cover as far as practicable.	To minimize the landscape and visual impact on surrounding setting	The contractor	All works sites/areas	Construction Phase	EIAO-TM
Landscape and Visual Impact (Operation Phase)					
OM1 - Visual Sensitive Design for the Proposed Ventilation	To enhance the landscape	MTRCL	Proposed	Operation	-

Recommended Pollution Controls/Mitigation Measures	Objectives of the Recommended Measures & Main Concern to Address	Who to implement the measures?	Location of the measures	When to implement the measures?	Requirements
Building: The aboveground structure of the proposed ventilation building shall be visually compatible with the existing surround setting in consistent colour. Greenery shall be incorporated to soften the hard building edges and to complement with the surrounding green setting. Rooftop greening and vertical greenery shall be provided where space permits.	quality of the structures and mitigate any potential visual impact to adjacent VSRs.		ventilation building	Phase	
OM2 - Reinstatement of Hard and Soft Landscape: All the hard and soft landscape that are disturbed by the construction works and the corresponding temporary traffic arrangement shall be reinstated on like-to-like basis to the satisfaction of the relevant Government Departments.	To compensate the affected landscape	MTRCL	All works sites/areas	Operation Phase	-
OM3 - Compensatory Tree Planting Existing trees affected by the proposed construction works should be compensated in accordance with DEVB TC(W) 4/2020.	To compensate felled trees	MTRCL / HyD / LCSD (subject to the affected areas and related maintenance parties)	All works sites/areas	Operation Phase	DEVB TC(W) 4/2020 – Tree Preservation

Appendix 4.2 – Environmental Monitoring and Audit Programme

Appendix 4.2 Environmental Monitoring and Audit Programme

1. Introduction

This Appendix specifies the requirements of the Environmental Monitoring and Audit (EM&A) programme of the Project to check on compliance with the recommended mitigation measures as presented in this Project Profile; to assess the effectiveness of the recommended mitigation measures, and to identify any further need for additional mitigation measures or remedial actions.

For the purpose of this EM&A programme, the ER shall refer to the Engineer as defined in the Construction Contract, in cases where the Engineer's powers have been delegated to the ER, in accordance with the Construction Contract. The ET Leader, who shall be responsible for and in charge of the ET, shall refer to the person delegated the role of executing the environmental monitoring and audit requirements.

2. Environmental Team

The Permit Holder shall engage an Environmental Team (ET) to implement the EM&A programme. The ET shall be led and managed by an ET Leader. The ET Leader should possess at least 7 years of experience in EM&A or environmental management.

The ET and ET Leader should monitor the mitigation measures implemented by the Contractor on a regular basis to ensure the compliance with the intended aims of the measures. The ET shall:

- Carry out sampling, analysis and statistical evaluation of monitoring parameters;
- Carry out regular site inspections to investigate and audit the Contractor's site practice, equipment and work methodologies with respect to pollution control and environmental mitigation measures;
- Review the success of EM&A programme to confirm the adequacy of mitigation measures implemented and to identify any adverse environmental impacts arising;
- Liaise with Independent Environmental Checker (IEC) on all environmental performance matters, and timely submission of all relevant EM&A proforma for IEC's approval;
- Audit the relevant document(s)/record(s) and prepare reports on the environmental monitoring data and the site environmental conditions;
- Review the proposals of remedial measure from the Contractor in the case of exceedances of Action and Limit levels, in accordance with the Event and Action Plans;
- Advise the Contractor on environmental improvement, awareness, enhancement matters, etc., on site;
- Submit the EM&A report(s) to the Project Proponent and the Environmental Protection Department (EPD) timely.

3. Independent Environmental Checker

An Independent Environmental Checker (IEC) should be engaged by the Permit Holder before commencement of construction of the Project. The IEC should advise the Engineer or Engineer's Representative (ER) or Permit Holder on environmental issues related to the Project. The IEC should possess at least 7 years of experience in EM&A or environmental management. The IEC should be an independent party from the ET and the Contractor. The duties and responsibilities of the IEC are:

- Review and audit in all aspects of the EM&A programme;

- Validate and confirm the accuracy of monitoring results, monitoring equipment, monitoring locations, monitoring procedures and locations of sensitive receivers;
- Audit the recommendations and requirements against the status of implementation of environmental protection measures on site;
- Review the effectiveness of environmental mitigation measures and project environmental performance;
- On an as-needed basis, audit the construction methodology (both temporary and permanent works) of the project proponent and its Contractor and agree the least impact alternative;
- Verify the investigation results of environmental complaint cases and the effectiveness of corrective measures;
- Carry out random sample check and audit on monitoring data and sampling procedures, etc;
- Conduct random site inspection;
- Verify EM&A report that has been certified by the ET Leader; and
- Provide feedback on the audit results to the ET, the ER or the Permit Holder according to Event and Action Plans in the EM&A programme.

4. Air Quality

4.1 Construction Phase

This section presents the details for monitoring of air quality impacts during construction phase of the Project.

Monitoring Parameters and Equipment

Construction dust shall be measured in terms of the 1-hour average total suspended particulate (TSP) levels by following the standard method as set out in High Volume Method for Total Suspended Particulates, Part 50 Chapter 1 Appendix B, Title 40 of the Code of Federal Regulations of the USEPA (hereinafter referred to as "HVS method"). Upon approval of IEC, 1-hour TSP levels can be measured by direct reading method with using handheld dust particle measuring device which are capable of producing comparable results as that by the high volume sampling method, to indicate short event impacts.

Dust ladened air should be drawn through a high volume sampler (HVS) fitted with a conditioned, pre-weighed filter paper, at a controlled rate. After sampling, the filter paper with retained particles is collected and returned to the laboratory for drying in a desiccator followed by accurate weighing. 1-hour TSP levels are calculated from the ratio of the mass of particulates retained on the filter paper to the total volume of air sampled.

All relevant data including temperature, pressure, weather conditions, elapsed-time meter reading for the start and stop of sampler, identification and weight of the filter paper, and any other local atmospheric factors affecting or affected by site conditions, etc., should be recorded down in detail. A sample data sheet is shown in **Annex A of this Appendix**.

High volume sampler (HVS) in compliance with the following specifications should be used for carrying out the 1-hour TSP monitoring:

- 0.6 - 1.7 m^3/min (20 - 60 standard ft^3/min) adjustable flow range;
- equipped with a timing / control device with ± 5 minutes accuracy for 24 hours operation;
- installed with elapsed-time meter with ± 2 minutes accuracy for 24 hours operation;
- capable of providing a minimum exposed area of 406 cm^2;
- flow control accuracy: ± 2.5% deviation over 24-hour sampling period;
- equipped with a shelter to protect the filter and sampler;

- incorporated with an electronic mass flow rate controller or other equivalent devices;
- equipped with a flow recorder for continuous monitoring;
- provided with a peaked roof inlet;
- incorporated with a manometer;
- able to hold and seal the filter paper to the sampler housing at horizontal position;
- easy to change the filter; and
- capable of operating continuously for 24-hour period.

The ET shall be responsible for the provision of the monitoring equipment. He shall ensure that sufficient number of HVSs with appropriate calibration kit is available for carrying out the baseline, regular impacts monitoring and ad-hoc monitoring. The HVSs shall be equipped with an electronic mass flow controller and be calibrated against a traceable standard at regular intervals, in accordance with requirements stated in the manufacturers operating manual. All the equipment, calibration kit, filter papers, etc., shall be clearly labelled.

Initial calibration of HVSs with mass flow controller shall be conducted upon installation (where prior to commissioning) and thereafter at bi-monthly intervals. The transfer standard shall be traceable to the internationally recognized primary standard and be calibrated annually. The calibration data shall be properly documented for future reference by the concerned parties such as the IEC. All the data shall be converted into standard temperature and pressure condition.

The flow-rate of the sampler before and after the sampling exercise with the filter in position shall be verified to be constant and be recorded on the data sheet as shown in **Annex A of this Appendix**.

If the ET Leader proposes to use a direct reading dust meter to measure 1-hour TSP levels, he shall submit sufficient information to the IEC to prove that the instrument is capable of achieving a comparable result as that of the HVS before it may be used for the 1-hour sampling. The instrument shall also be calibrated regularly following the requirements specified by the equipment manufacturers, and the 1-hour sampling shall be determined periodically by HVS to check the validity and accuracy of the results measured by direct reading method.

Wind data monitoring equipment shall also be provided and set up at conspicuous locations for logging wind speed and wind direction near to the dust monitoring locations. The equipment installation location shall be proposed by the ET and agreed with the ER and the IEC. For installation and operation of wind data monitoring equipment, the following points shall be observed.

- The wind sensors shall be installed on masts at an elevated level 10m above ground so that they are clear of obstructions or turbulence caused by the buildings;
- The wind data shall be captured by a data logger. The data recorded in the data logger shall be downloaded periodically for analysis at least once a month;
- The wind data monitoring equipment shall be re-calibrated at least once every six months; and
- Wind direction should be divided into 16 sectors of 22.5 degrees each.

In exceptional situations, the ET may propose alternative methods to obtain representative wind data upon approval from the ER and agreement from the IEC.

If the ET Leader proposes alternative dust monitoring equipment / methodology (e.g. direct reading methods) after the approval of the Project Profile, agreement from the IEC should be sought. The instrument should also be calibrated regularly following the requirements specified by the equipment manufacturers.

<u>Laboratory Measurement / Analysis</u>

A clean laboratory with constant temperature and humidity control and equipped with necessary measuring and conditioning instruments to handle the dust samples collected, shall be available for sample analysis, and equipment calibration and maintenance. The laboratory shall be the Hong Kong Laboratory Accreditation Scheme (HOKLAS) accredited or other internationally accredited laboratory.

If a site laboratory is set up or a non-HOKLAS accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment shall be verified by the IEC and approved by the ER. Measurement performed by the laboratory shall be demonstrated to the satisfaction of the ER and the IEC.

The IEC shall conduct regular audit of the measurement performed by the laboratory so as to ensure the accuracy of measurement results. The ET shall provide the ER with one copy of the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B for his/her reference.

Filter paper of size 8"x10" shall be labelled before sampling. It shall be a clean filter paper with no pinholes and shall be conditioned in a humidity-controlled chamber for over 24-hour and be pre-weighed before use for the sampling.

After sampling, the filter paper loaded with dust shall be kept in a clean and tightly sealed plastic bag. The filter paper shall then be returned to the laboratory for reconditioning in the humidity-controlled chamber followed by accurate weighing by an electronic balance with a readout down to 0.1mg. The balance shall be regularly calibrated against a traceable standard.

All the collected samples shall be kept in a good condition for 6 months before disposal.

Monitoring Locations

The selected monitoring locations are the worst potentially affected air sensitive receivers located in the vicinity of construction site. The proposed air quality monitoring locations during construction phase are listed in **Table 1** below and shown in **Figure 2.1 of the Project Profile**.

Table 1: Proposed Dust Monitoring Stations

Monitoring Station ID	ASR ID in Project Profile	Location
AM1	A1	Waterfront Area near Central Piers
AM2	A4	Central Barracks Blake Block
AM3	A5	City Gallery
AM4	A7	New Central Harbourfront Site 3 Development – Site 3A

The status and locations of the air quality sensitive receivers may change after issuing the Project Profile. In such case, the ET shall propose alternative monitoring locations and seek agreement from ER and IEC on the proposal.

When alternative monitoring locations are proposed, the following criteria, as far as practicable, shall be followed:

- at the site boundary or such locations close to the major dust emission source;
- close to the air sensitive receivers as defined in the EIAO-TM;
- proper position/sitting and orientation of the monitoring equipment; and
- take into account the prevailing meteorological conditions.

The ET shall agree with the IEC on the position of the HVS for installation of the monitoring equipment. When positioning the samplers, the following points shall be noted:

- a horizontal platform with appropriate support to secure the samplers against gusty wind shall be provided;
- two samplers shall not be placed less than 2m apart;
- the distance between the sampler and an obstacle, such as buildings, must be at least twice the height that the obstacle protrudes above the sampler;
- a minimum of 2m of separation from walls, parapets and penthouses is required for rooftop samplers;
- a minimum of 2m of separation from any supporting structure, measured horizontally is required;

- no furnace or incinerator flue is nearby;
- airflow around the sampler is unrestricted;
- the sampler is more than 20m from the dripline;
- any wire fence and gate, to protect the sampler, shall not cause any obstruction during monitoring;
- permission must be obtained to set up the samplers and to obtain access to the monitoring stations; and
- a secured supply of electricity is needed to operate the samplers

Subject to site conditions and monitoring results, the ET Leader, may decide whether additional monitoring locations shall be included or any monitoring locations could be removed / relocated during the construction phase, upon the agreement from the IEC and reported in the EM&A report.

Baseline Monitoring

Baseline monitoring shall be carried out to determine the ambient 1-hour TSP levels at the monitoring locations prior to the commencement of major construction works of the Project. During the baseline monitoring, there shall not be any construction or dust generating activities in the vicinity of the monitoring stations as far as practicable. The baseline monitoring will provide data for the determination of the appropriate Action levels with the Limit levels set against statutory or otherwise agreed limits.

Before commencing the baseline monitoring, the ET shall inform the IEC of the baseline monitoring programme such that the IEC can conduct on-site audit to ensure accuracy of the baseline monitoring results.

TSP baseline monitoring should be carried out at all of the designated monitoring locations for at least 14 consecutive days prior to the commencement of major construction works of the Project. 1-hour TSP sampling shall be done at least three times per day at each monitoring station. During the baseline monitoring, there should not be any construction or dust generating activities in the vicinity of the monitoring stations. General meteorological conditions (wind speed, direction and precipitation) and notes regarding any significant adjacent dust producing sources should also be recorded throughout the baseline monitoring period. A summary of baseline monitoring is presented in **Table 2**.

In case the baseline monitoring cannot be carried out at the designated monitoring locations during the baseline monitoring period, the ET Leader shall carry out the monitoring at alternative locations which can effectively represent the baseline conditions at the impact monitoring locations. The alternative baseline monitoring location shall be agreed with the ER, IEC and EPD prior to commencement of baseline monitoring.

In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with the IEC to agree on an appropriate set of data to be used as a baseline reference and submit to EPD for approval.

If the ET Leader considers that significant changes in the ambient conditions have arisen, a repeat of the baseline monitoring may be carried out to update the baseline levels. The monitoring should be at times when the Contractor's activities are not generating dust and at the designate monitoring locations. The revised baseline levels, in turn, the air quality criteria, shall be agreed with the IEC and EPD.

Impact Monitoring

The ET shall carry out impact monitoring during major construction activity of the Project being undertaken within a radius of 500m from the monitoring stations. For 1-hour TSP monitoring, the sampling frequency of at least three times in every six-days should be undertaken when the highest dust impact occurs. The impact monitoring programme is summarised in **Table 2**.

The monthly schedule of the impact monitoring programme should be drawn up by the ET one month prior to the commencement of the scheduled construction period. Before commencement of the monitoring, the ET should inform the IEC of the impact monitoring programme such that the IEC can conduct an on-site audit.

Table 2: Summary of Construction Dust Monitoring Programme

Monitoring Period	Duration	Sampling Parameter	Frequency
Baseline Monitoring	Consecutive days of at least 14 days before commencement of major construction works	1 hour TSP	3 times per day
Impact Monitoring	Throughout the construction phase (1)	1 hour TSP	3 times in every 6 days

Note:
(1) Impact monitoring should be conducted at the monitoring stations for 1-hour TSP monitoring when construction activity of the Project being undertaken within a radius of 500m from the monitoring stations.

Event and Action Plan

The baseline monitoring results form the basis for determining the air quality criteria for the impact monitoring. The ET shall compare the impact monitoring results with air quality criteria set up for 1-hour TSP. **Table 3** shows the air quality criteria, namely Action and Limit levels to be used.

Table 3: Proposed Action and Limit Levels for Impact Monitoring

Parameter	Action Level (1)	Limit Level
1-hour TSP	• For BL $\leq$ 384μg/m^3, AL = (BL * 1.3 + LL)/2 • For BL > 384μg/m^3, AL = LL	500 μg/m^3

Note:
(1) BL = Baseline level, AL = Action level, LL = Limit level.

The Event and Action Plan prescribes procedures and actions associated with the outcome of the comparison of air quality monitoring data recorded and the agreed Action and Limit levels. In the cases where exceedances of these Action and Limit levels occurs, the ET, the IEC, the ER and the Contractor should strictly observe the relevant actions of the respective Event and Action Plan listed in **Table 4**.

Table 4: Event and Action Plan for Construction Dust Monitoring

Event	Action			
	ET	IEC	ER	Contractor
Action Level				
Exceedance for 1 sample	• Repeat measurement to confirm findings; • If exceedance is confirmed, inform the Contractor, IEC and ER; • Identify source(s), investigate the causes of exceedance and propose remedial measures; and • Increase monitoring frequency.	• Check monitoring data submitted by the ET; • Check Contractor's working method; and • Discuss with ET, ER and Contractor on possible remedial measures; and • Review and advise the ET and ER on the effectiveness of the proposed remedial measures.	• Confirm receipt of notification of exceedance in writing.	• Identify source(s), investigate the causes of exceedance and propose remedial measures; • Implement remedial measures; and • Amend working methods agreed with the ER as appropriate.
Exceedance for 2 or more consecutive samples	• Repeat measurements to confirm findings; • If exceedance is confirmed, inform Contractor, IEC and ER; • Identify source(s), investigate the causes of exceedance and propose remedial measures;	• Check monitoring data submitted by the ET; • Check Contractor's working method; • Discuss with ET, ER and Contractor on possible remedial measures; • Review and advise the ET and ER on the effectiveness of the proposed remedial measures.	• Confirm receipt of notification of exceedance in writing; • In consultation with the ET and IEC agree with the Contractor on the remedial measures to be implemented; and • Supervise implementation of remedial measures.	• Identify source(s) and investigate the causes of exceedance; • Submit proposals for remedial measures to the ER, ET and IEC within three working days of notification for agreement; • Implement the agreed proposals; and • Amend proposal as appropriate.

Event	Action			
	ET	IEC	ER	Contractor
Action Level				
	• Increase monitoring frequency to daily; • Advise the Contractor and ER on the effectiveness of the proposed remedial measures; • Discuss with IEC and Contractor on remedial actions required; • If exceedance continues, arrange meeting with Contractor, IEC and ER to discuss the remedial measures to be taken; and • If exceedance stops, cease additional monitoring.			

Event	Action			
	ET	IEC	ER	Contractor
Limit Level				
Exceedance for 1 sample	• Repeat measurement to confirm findings; • If exceedance	• Check monitoring data submitted by the ET; • Check Contractor's working method; • Discuss with the ET, ER and Contractor on possible remedial measures;	• Confirm receipt of notification of exceedance in writing; • Review and agree on the remedial measures	• Identify source(s) and investigate the causes of exceedance; • Take immediate action to avoid further exceedance;

Event	Action			
	ET	IEC	ER	Contractor
Action Level				
	is confirmed, inform the Contractor, IEC, EPD and ER; • Identify source(s), investigate the causes of exceedance and propose remedial; • Increase monitoring frequency to daily; and • Discuss with the ER, IEC and Contractor on the remedial measures and assess effectiveness.	• Review and advise the ET and ER on the effectiveness of the proposed remedial measures.	proposed by the Contractor; and • Ensure remedial measures properly implemented.	• Submit proposals for remedial measures to ER, ET and IEC within three working days of notification for agreement; • Implement the agreed proposals; and • Amend proposal if appropriate.
Exceedance for 2 or more consecutive samples	• Repeat measurement to confirm findings; • If exceedance is confirmed, inform IEC, ER, Contractor and EPD;	• Check monitoring data submitted by the ET; • Discuss amongst ER, ET, and Contractor on the potential remedial actions; • Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly.	• Confirm receipt of notification of exceedance in writing; • In consultation with the ET and IEC, agree with the Contractor on the remedial measures to be implemented; • Supervise the implementation of remedial measures; and	• Identify source(s) and investigate the causes of exceedance; • Take immediate action to avoid further exceedance; • Submit proposals for remedial measures to the ER, IEC and ET within three working days of notification for agreement; • Implement the agreed proposals; • Revise and resubmit proposals if problem still not under control; and

Event	Action			
	ET	IEC	ER	Contractor
Action Level				
	• Identify source(s), investigate the causes of exceedance and propose remedial measures; • Increase monitoring frequency to daily; • Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented; • Arrange meeting with IEC and ER to discuss the remedial actions to be taken; • Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and ER	• If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	• Consider to stop the relevant portion of works as determined by the ER until the exceedance is abated.	

Event	Action			
	ET	IEC	ER	Contractor
Action Level				
	informed of the results; and • If exceedance stops, cease additional monitoring.			

Audit Requirement

Regular site inspection and audit at least once per week should be conducted during the entire construction phase of the Project to ensure the relevant mitigation measures as detailed in **Appendix 4.1** are properly implemented.

4.2 Operation Phase

No adverse air quality impact is expected during operation phase of the Project, thus no associated monitoring and audit programme is required.

5. Noise

5.1 Construction Phase

This section presents the details for monitoring of airborne noise impacts during construction phase of the Project.

Monitoring Parameters

Airborne construction noise level shall be measured in terms of the A-weighted equivalent continuous sound pressure level (Leq). Leq (30min) shall be used as the monitoring parameter for the time period between 0700 and 1900 hours on normal weekdays. For all other time periods, Leq (5min) shall be employed for comparison with the Noise Control Ordinance (NCO) criteria. A sample data sheet is shown in **Annex A of this Appendix**.

As supplementary information for data auditing, statistical results such as L10 and L90 shall also be obtained for reference.

Monitoring Equipment and Methodology

As referred to the requirements of the Technical Memorandum (TM) issued under the NCO, sound level meters in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications should be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement the accuracy of the sound level meter should be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the difference between calibration levels obtained before and after the noise measurement is less than 1.0dB.

Noise measurements should be made in accordance with standard acoustic principles and practices in the relation to weather conditions. Noise measurements should not be made in fog, rain, wind with a steady speed exceeding 5m/s or wind with gusts exceeding 10m/s. The wind speed should be checked with a portable wind speed meter capable of measuring the wind speed in m/s.

The ET is responsible for the provision of the monitoring equipment and should ensure that sufficient noise measuring equipment and associated instrumentation are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation should be clearly labelled.

Noise Monitoring Location

The proposed construction noise monitoring location during construction phase is listed in **Table 5** below and shown in **Figure 2.2a of the Project Profile**.

Table 5: Proposed Construction Noise Monitoring Location

Monitoring Station ID	NSR ID in Project Profile	Location
CN1	CN1	New Central Harbourfront Site 3 development

The status and location of noise sensitive receivers (NSRs) may change after issuing the Project Profile. In such case, and if changes to the monitoring location is considered necessary, the ET should propose alternative monitoring station and seek approval from the ER and agreement from the IEC and EPD on the proposal. If alternative monitoring station is proposed, the station should be chosen based on the following criteria:

When alternative monitoring location is proposed, the monitoring location should be chosen based on the following criteria:

- At locations close to the major site activities which are likely to have noise impacts;
- Close to the most affected noise sensitive receivers; and
- For monitoring locations located in the vicinity of the sensitive receivers, care should be taken to cause minimal disturbance to the occupants during monitoring.

The monitoring station should normally be at a point 1m from the exterior of the noise sensitive facade and be at a position 1.2m above ground. If there is a problem with access to the normal monitoring position, an alternative position should be chosen, and a correction to the measurement results should be made. For reference, a correction of +3dB(A) should be made to free-field measurements. The ET should agree with the IEC on the monitoring position and the corrections adopted. Once the position for the monitoring station is chosen, the baseline monitoring and the impact monitoring should be carried out at the same positions. If changes to the monitoring stations are required upon commencing the baseline monitoring or thereafter, the ET should propose alternative locations based on the above-mentioned criteria and seek agreement from the ER and the IEC on the proposal.

Baseline Monitoring

The ET shall carry out baseline noise monitoring in identified monitoring station prior to the commencement of the major construction works of the Project. There shall not be any construction activities in the vicinity of the station during the baseline monitoring. As CN1 (New Central Harbourfront Site 3 development) as shown in **Figure 2.2a of the Project Profile** is planned development and located within construction sites during the baseline monitoring period, the baseline monitoring at the planned development shall refer to the nearby baseline monitoring location at the existing development, e.g. near the Hong Kong Observation Wheel. A schedule on the baseline monitoring shall be submitted to the ER and IEC for approval before the monitoring starts. Continuous baseline noise monitoring for the A-weighted levels Leq, L10 and L90 shall be carried out daily for a period of consecutive days at least two weeks before commencement of major construction works in a sample period of 30 minutes between 0700 and 1900, and 15 minutes (as three consecutive 5 minutes) for evening time (between 1900 and 2300 hours on normal weekdays), general holidays including Sundays (between 0700 and 2300 hours) and night-time (between 2300 and 0700 on all days). A schedule on the baseline monitoring shall be submitted to the ER and IEC for approval before the monitoring starts.

In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET shall liaise with the IEC and EPD to agree on an appropriate set of data to be used as a baseline reference.

Impact Monitoring

During normal construction working hours (0700-1900 Monday to Saturday), monitoring of Leq, (30min) noise levels shall be carried out at the monitoring location once every week in accordance with the methodology in the TM issued under NCO.

In case of non-compliance with the construction noise criteria, more frequent monitoring, as specified in the Event and Action Plan, shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.

The monthly schedule of the impact monitoring programme should be drawn up by the ET at least 2 weeks prior to the commencement of the scheduled construction period. Before commencing impact monitoring, the ET shall inform the IEC of the impact monitoring programme such that the IEC can conduct on-site audit. **Table 6** below summarised the monitoring parameters.

Table 6: Summary of Construction Noise Monitoring

Monitoring Period	Duration	Sampling Parameter	Frequency	Locations
Baseline Monitoring	Consecutive days of at least 2 weeks before commencement of major construction works	A-weighted levels Leq, L10 and L90	• 30 minutes between 0700 and 1900 hrs on normal weekdays • 15 minutes (as three consecutive Leq 5min) (between 1900 and 2300 hours on normal weekdays), general holidays including Sundays (between 0700 and 2300 hours) and night-time (between 2300 and 0700 on all days)	Close to CN1 as **Figure 2.2a**
Impact Monitoring	Throughout the construction phase (1)	A-weighted levels Leq, L10 and L90	• Once a week • 30-minute measurement between 0700 and 1900 hours on normal weekdays	Close to CN1 as **Figure 2.2a**

Note:
(1) Impact monitoring should be conducted at the monitoring station when construction activities of the Project being undertaken within a radius of 300m from the monitoring station.

Event and Action Plan

The ET shall compare the airborne construction noise monitoring results with noise criteria. **Table 7** shows the noise criteria, namely Action and Limit Levels to be used. Should non-compliance of the noise criteria occur actions in accordance with the Event and Action Plan in **Table 8** should be taken.

Table 7: Action and Limit Levels for Construction Noise

Time Period	Action Level	Limit Level
0700-1900 hours on normal weekdays	When one documented complaint is received	75 dB(A)

Note:
(1) If works are to be carried out during restricted hours, the conditions stipulated in the construction noise permit issued by the Noise Control Authority have to be followed.

Table 8: Event and Action Plan for Construction Noise Monitoring

Event	Action			
	ET	IEC	ER	Contractor
Action Level Exceedance	• Investigate the complaint and propose remedial measures; • Discuss with the ER and Contractor on the remedial measures required; and; • Increase monitoring frequency to check mitigation effectiveness.	• Review the investigation results submitted by the Contractor; and • Review and advise the ET and ER on the effectiveness of the remedial measures proposed by the Contractor.	• Notify the Contractor, ET, IEC and Confirm receipt of notification of complaint in writing; • Review and agree on the remedial measures proposed by the Contractor; and • Supervise implementation of remedial measures.	• Investigate the complaint and propose remedial measures; • Report the results of investigation to the IEC, ET and ER; • Submit noise mitigation proposals to the ER, IEC and ET within three working days of notification for agreement; and • Implement noise mitigation proposals.
Limit Level Exceedance	• Notify the Contractor, IEC, EPD and ER; • Repeat measurement to confirm exceedance; • Identify source and investigate the causes of exceedance; • Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented; • Arrange meeting with the IEC and ER to discuss the remedial measures to be taken; • Review the effectiveness of Contractor's remedial measures and keep IEC, EPD and ER informed of the results; and • If exceedance stops, cease additional monitoring.	• Check monitoring data submitted by the ET; • Check the Contractor's working method; • Discuss with the ER, ET and Contractor on the potential remedial measures; and • Review and advise the ET and ER on the effectiveness of the remedial measures proposed by the Contractor.	• Confirm receipt of notification of exceedance in writing; • 2In consultation with the ET and IEC, agree with the Contractor on the remedial measures to be implemented; • Supervise the implementation of remedial measures; and • If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	• Identify source and investigate the causes of exceedance; • Take immediate action to avoid further exceedance; • Submit proposals for remedial measures to the ER, IEC and ET within three working days of notification for agreement; • Implement the agreed proposals; • Revise and resubmit proposals if problem still not under control; and • Consider to stop the relevant portion of works as determined by the ER until the exceedance is abated.

Audit Requirement

Regular site inspection and audit at least once per week should be conducted during the entire construction phase of the Project to ensure the relevant mitigation measures as detailed in **Appendix 4.1** are properly implemented.

5.2 Operation Phase

No adverse noise impacts are expected during operation phase of the Project, thus no associated monitoring and audit programme is required.

6. Water Quality

6.1 Construction Phase

With the implementation of the recommended water quality mitigation measures, no adverse water quality impact would be expected at the WSRs located in the vicinity of the works site, thus no monitoring for water quality would be required. Regular site inspections should be undertaken to inspect the construction activities and works sites/areas in order to ensure the recommended mitigation measures are properly implemented.

6.2 Operation Phase

No adverse water quality impact associated with the operation of the Project are expected, thus no associated monitoring and audit programme is required.

7. Waste Management

7.1 Construction Phase

It would be the Contractor's responsibility to ensure that any wastes produced during the works are handled, stored and disposed of in accordance with good waste management practices and relevant regulations and other legislative requirements. The recommended mitigation measures as **Appendix 4.1** should form the basis of the site Waste Management Plan (WMP) to be developed by the Contractor. Routine site inspections and auditing would be conducted to check the implementation of the recommended good site practices and other waste management mitigation measures.

7.2 Operation Phase

Limited quantities of waste are expected to be generated from the operation of the Project and no adverse environmental impacts is anticipated with the implementation of good waste management practices. Thus, no associated monitoring and audit programme is required.

8. Cultural Heritage

8.1 Construction Phase

Monitoring of settlement, tilting and vibration for the declared monument, i.e., Hong Kong City Hall, has been proposed during construction phase of the Project. The monitoring proposal will be agreed with relevant government departments under the requirement of the Buildings Ordinance.

8.2 Operation Phase

Significant adverse impact on cultural heritage during operation phase of the Project is not expected, hence no associated monitoring and audit programme is required.

9. Landscape and Visual

9.1 Construction Phase

Site audits should be undertaken during the construction phase of the Project to check that the proposed landscape and visual mitigation measures are properly implemented and maintained as per their intended objectives. Site inspections should be undertaken by the ET at least once every month during the construction period.

9.2 Operation Phase

As the operation phase landscape and visual mitigation measures would be provided during the construction phase, no specific EM&A requirement is required during operation phase.

10. Other Environmental Aspects

For all other environmental aspects, namely, land contamination, ecology, fisheries and hazard to life, as no issues/ impacts are anticipated from the Project, no associated monitoring and audit programme is required.

11. Environmental Auditing

11.1 Site Inspection

Site inspection is one of the most effective tools to enforce the environmental protection requirements at the works sites and works areas by providing a direct mean to trigger and enforce specified environmental protection and pollution control measures. Site inspection should be undertaken regularly during the construction phase to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented for the activities associated with the Project.

The ET Leader should be responsible for formulating the environmental site inspection programme as well as the deficiency and remedial action reporting system, and for carrying out the site inspections. The proposal for rectification, if any, should be prepared and submitted to the ET Leader and IEC by the Contractor.

Regular site inspections should be carried out and led by the ER and attended by the Contractor and ET at least once per week during the construction phase. The areas of inspection should not be limited to the environmental conditions and the pollution control and mitigation measures within the works sites and works areas, it should also review the environmental conditions of locations that are beyond the boundary of the works sites and works areas but are likely to be affected directly or indirectly by the construction site activities of the Project. During the inspection, the following information should be referred to:

- The Project Profile and EM&A recommendations on environmental protection and pollution control mitigation measures;
- Ongoing results of the EM&A programme;
- Works progress and programme;

- Individual works methodology proposals (which should include the proposal on associated pollution control measures);
- Contract specifications on environmental protection and pollution prevention control;
- Relevant environmental protection and pollution control legislations; and
- Previous site inspection results undertaken by the ET and others.

The Contractor should keep the ER and ET Leader updated with all relevant environmental related information on the construction contract necessary for him/her to carry out the site inspections. Site inspection results and associated recommendations for improvements to the environmental protection and pollution control efforts should be recorded and followed up by the Contractor in an agreed time-frame. The Contractor should follow the procedures and time-frame stipulated in the environmental site inspection, and the deficiency and remedial action reporting system to be formulated by the ET Leader, to report on any remedial measures subsequent to the site inspections.

The ER, ET and the Contractor should also carry out ad hoc site inspections if significant environmental problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specified in the Event and Action Plan for the EM&A programme.

11.2 Compliance with Legal and Contractual Requirements

There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong with which construction activities must comply.

In order that the works are in compliance with the contractual requirements, relevant works method statements submitted by the Contractor to the ER for approval shall be sent to the ET Leader for vetting to see whether sufficient environmental protection and pollution control measures have been included. The implementation schedule of mitigation measures is summarized in **Appendix 4.1**.

The ET Leader shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, and that any foreseeable potential for violating laws can be prevented.

The Contractor shall regularly copy relevant documents to the ET Leader so that works checking could be carried out effectively. The document shall at least include the updated Works Progress Reports, updated Works Programme, any application letters for different licence / permits under the environmental protection laws, and copies of all valid licences / permits. The site diary and environmental records shall also be available for inspection by the relevant parties.

After reviewing the documentation, the ET shall advise the IEC and the Contractor of any non-compliance with contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the ET Leader's review concludes that the current status on licence / permit application and any environmental protection and pollution control preparation works may result in potential violation of environmental protection and pollution control requirements, he shall also advise the Contractor accordingly. If the follow-up actions may still result in violation of environmental protection and pollution control requirements, the ER and ET should provide further advice to the Contractor to take remedial action to resolve the problem.

Upon receipt of the advice, the Contractor shall undertake immediate action to remedy the situation. The ER and ET shall follow up to ensure that appropriate action has been taken in order to satisfy contractual and legal requirements.

11.3 Choices of Construction Methods

At times during the construction phase, the Contractor may submit method statements for various aspects of construction. This state of affairs would only apply to those construction methods that the Project Profile has not imposed conditions while for construction methods that have been assessed in the Project Profile, the Contractor is bound to follow the requirements and recommendations in the Project Profile. The Contractor's options for alternative construction methods may introduce adverse environmental impacts into the Project. It is the responsibility of the Contractor and ET, in accordance with established standards, guidelines and the recommendations and requirements given in the Project Profile, to review and determine the adequacy of the environmental protection and pollution control measures in the Contractor's proposal in order to ensure no unacceptable impacts would result. To achieve this end, the ET shall provide a copy of the Proactive Environmental Protection Proforma as shown in **Annex A of this Appendix** to the IEC for approval before commencement of work. The IEC should audit the review of the construction method and endorse the proposal on the basis of no adverse environmental impacts.

11.4 Environmental Complaints

The following procedures should be undertaken upon receipt of any environmental complaint:

- The Contractor to log complaint and date of receipt onto the complaint database and inform the ER, ET and IEC immediately;
- The Contractor to investigate, with the ER and ET, the complaint to determine its validity, and assess whether the source of the problem is due to construction works of the Project with the support of additional monitoring frequency and stations, if necessary;
- The Contractor to identify remedial measures in consultation with the IEC, ET and ER if a complaint is valid and due to the construction works of the Project;
- The Contractor to implement the remedial measures as required by the ER and to agree with the ET and IEC any additional monitoring frequency and stations, where necessary, for checking the effectiveness of the remedial measures;
- The ER, ET and IEC to review the effectiveness of the Contractor's remedial measures and the updated situation;
- The ET/Contractor to undertake monitoring and audit to verify the situation if necessary, and oversee that circumstances leading to the complaint do not recur;
- If the complaint is referred by the EPD, the Contractor to prepare interim report on the status of the complaint investigation and follow-up actions stipulated above, including the details of the remedial measures and monitoring identified or already taken, for submission to EPD within the time frame assigned by the EPD; and
- The ET to record the details of the complaint, results of the investigation, subsequent actions taken to address the complaint and updated situation including the effectiveness of the remedial measures, supported by regular and additional monitoring results in the monthly EM&A reports.

12. Reporting

12.1 Introduction

Types of reports that the ET should prepare and submit include Baseline Monitoring Report, Monthly EM&A Reports and Final EM&A Review Report. In accordance with Annex 21 of the EIAO-TM, a copy of the monthly and final EM&A review reports should be made available to the Director of Environmental Protection.

Reports can be provided in an electronic medium upon agreeing the format with the ER and EPD. All the monitoring data (baseline and impact) should be submitted in electronic medium.

12.2 Baseline Monitoring Report

The ET should prepare and submit a Baseline Monitoring Report at least two weeks before commencement of construction of the Project. Copies of the Baseline Environmental Monitoring Report should be submitted to the IEC, ER and EPD. The ET should liaise with the relevant parties on the exact number of copies required.

The baseline monitoring report shall include at least the following:

1. Up to a half-page executive summary;
2. Brief project background information;
3. Drawings showing locations of the baseline monitoring stations;
4. Monitoring results (in both hard and soft copies) together with the following information:
   - Monitoring methodology;
   - Name of laboratory and types of equipment used and calibration details;
   - Parameters monitored;
   - Monitoring locations (and depth);
   - Monitoring date, time, frequency and duration; and
   - quality assurance (QA) / quality control (QC) results and detection limits.
5. Details of influencing factors, including:
   - Major activities, if any, being carried out on the site during the period;
   - Weather conditions during the period; and
   - Other factors which might affect the results.
6. Determination of the Action/ Limit levels for each monitoring parameter and statistical analysis of the baseline data, the analysis will conclude if there is any significant difference between control and impact stations for the parameters monitored;
7. Revisions for inclusion in the EM&A programme; and
8. Comments and conclusions.

12.3 Monthly EM&A Report

The results and findings of all EM&A works required in the Project Profile should be recorded in the monthly EM&A reports prepared by the ET and endorsed by the IEC. The Monthly EM&A Reports should be prepared and submitted within 10 working days of the end of each reporting month. Copies of each monthly EM&A report should be submitted to each of the three parties: ER, IEC and EPD. Before submission of the first monthly EM&A Report, the ET should liaise with the parties on the exact number of copies and format of the monthly reports in both hard copy and electronic copies.

The ET should review the number and location of monitoring stations and parameters every six months, or on as needed basis, in order to cater for any changes in the surrounding environment and the nature of works in progress.

12.4 First Monthly EM&A Report

The first monthly EM&A report shall include at least the following, where applicable:

1. Executive Summary (1-2 pages)
   - Breaches of Action/ Limit levels;
   - Complaint Log;
   - Notifications of any summons and successful prosecutions;
   - Reporting Changes; and
   - Future key issues.
2. Basic Project Information
   - Project organisation including key personnel contact names and telephone numbers;
   - Programme with fine tuning of activities showing the inter-relationship with environmental protection/mitigation measures for the month;
   - Management structure; and
   - Work undertaken during the month.
3. Environmental Status
   - Works undertaken during the month with illustrations (such as location of works); and
   - Drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations.
4. Summary of EM&A requirements including:
   - All monitoring parameters;
   - Environmental quality performance limits (Action/ Limit levels);
   - Event/Action Plans;
   - Environmental mitigation measures, as recommended in the Project Profile;
   - Environmental requirements in contract documents;
5. Implementation Status
   - Advice on the implementation status of environmental protection and pollution control/ mitigation measures as recommended in the Project Profile, summarised in the updated implementation schedule.
6. Monitoring Results (in both hard and soft copies) together with the following information
   - Monitoring methodology;
   - Name of laboratory and types of equipment used and calibration details;
   - Parameters monitored;
   - Monitoring locations;
   - Monitoring date, time, frequency, and duration;
   - Weather conditions during the period;
   - QA/QC results and detection limits; and

- Any other factors which might affect the monitoring results.

7. Report on Non-compliance, Complaints, Notifications of Summons and Successful Prosecutions
   - Record of all non-compliance (exceedances) of the environmental quality performance limits (Action/ Limit levels);
   - Record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;
   - Record of all notifications of summons and successful prosecutions for breaches of the current environmental protection/ pollution control legislation, including locations and nature of the breaches, investigation, follow-up actions taken, result and summary;
   - Review of the reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and
   - Description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance.
8. Comments, Recommendations and Conclusions
   - An account of the future key issues reviewed from the works programme and work method statements;
   - Advice on the solid and liquid waste management status; and
   - Comments (for example, effectiveness and efficiency of the mitigation measures), recommendations (for example, any improvement in the EM&A programme) and conclusions.

12.5 Subsequent Monthly EM&A Report

The subsequent monthly EM&A reports shall include the following:

1. Executive Summary (1-2 pages)
   - Breaches of Action/ Limit levels;
   - Complaint log;
   - Notifications of any summons and successful prosecutions;
   - Reporting changes;
   - Future key issues.
2. Environmental Status
   - Programme with fine tuning of activities showing the inter-relationship with environmental protection/mitigation measures for the month;
   - Work undertaken during the month with illustrations including key personnel contact names and telephone numbers; and
   - Drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations.
3. Monitoring Results (in both hard and electronic copies) together with the following information
   - Monitoring methodology;

- Types of equipment used and calibration details;
- Parameters monitored;
- Monitoring locations;
- Monitoring date, time, frequency, and duration;
- Weather conditions during the period;
- QA/QC results and detection limits; and
- Any other factors which might affect the monitoring results.

4. Implementation Status
   - Advice on the implementation status of environmental protection and pollution control/mitigation measures as recommended in the Project Profile, summarised in the updated implementation schedule.
5. Report on Non-compliance, Complaints, Notifications of Summons and Successful Prosecutions
   - Record of all non-compliance (exceedances) of the environmental quality performance limits (Action/ Limit levels);
   - Record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;
   - Record of all notifications of summons and successful prosecutions for breaches of the current environmental protection/pollution control legislation, including locations and nature of the breaches, investigation, follow-up actions taken, result and summary;
   - Review of the reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and
   - A description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance.
6. Comments, Recommendations and Conclusions
   - An account of the future key issues reviewed from the works programme and work method statements;
   - Advice on the solid and liquid waste management status; and
   - Comments (for example, effectiveness and efficiency of the mitigation measures), recommendations (for example, any improvement in the EM&A programme) and conclusions.
7. Appendices
   - Action/ Limit Levels;
   - Graphical plots of trends of monitored parameters at key stations over the past four reporting periods for representative monitoring stations annotated against the following:
     - Major activities being carried out on Site during the periods;
     - Weather conditions during the period; and
     - Any other factors which might affect the monitoring results
   - Monitoring schedule for the present and next reporting period;
   - Cumulative statistics on complaints, notifications of summons and successful prosecutions; and

- Outstanding issues and deficiencies.

12.6 Final EM&A Report - Construction Phase

The EM&A program should be terminated upon completion of those construction activities that have the potential to result in a significant environmental impact.

Prior to the proposed termination, the proposed termination should be implemented after the proposal has been endorsed by the IEC, the ER and the Project Proponent followed by final approval from the Director of Environmental Protection.

The ET Leader should prepare and submit the Final EM&A Report which should contain at least the following information:

1. An executive summary;
2. Basic project information including a synopsis of the project organisation, contacts of key management, and a synopsis of work undertaken during the entire construction phase of the works;
3. A brief summary of EM&A requirements including:
   - Monitoring parameters;
   - Environmental quality performance limits (Action/ Limit levels);
   - Event and Action Plans; and
   - Environmental mitigation measures, as recommended in the Project Profile
4. Summary of the implementation status of environmental protection and pollution control/ mitigation measures, as recommended in the Project Profile, summarised in the updated implementation status proformas, including waste generation and disposal records;
5. Drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
6. Compliance status with the EP under the EIAO and any EP submissions;
7. Graphical plots of the trends of monitored parameters over the period of construction (of the project) for representative monitoring stations annotated against;
   - The major activities being carried out on site during the period;
   - Weather conditions during the period; and
   - Any other factors which might affect the monitoring results
8. A summary of non-compliance (exceedances) of the environmental quality performance limits (Action/ Limit levels);
9. A review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures as appropriate;
10. A summary description of the actions taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;
11. A summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;
12. A summary record of all notification of summons and successful prosecutions for breaches of the current environmental protection/pollution control legislation, locations and nature of the breaches, investigation, follow-up actions taken and results;
13. Review the practicality and effectiveness of the EM&A programme (e.g. effectiveness and efficiency of the mitigation measures);
14. Recommend any improvement in the EM&A programme;

15. Review of the validity of assessment predictions and identification of shortcomings of the recommendations proposed in Project Profile; and
16. A conclusion to state the return of ambient and/or the predicted scenario as per Project Profile.

12.7 Data Keeping

No site-based documents (such as monitoring field records, laboratory analysis records, site inspection forms, etc.) are required to be included in the EM&A reporting documents. However, any such document should be properly maintained by the ET and be ready for inspection upon request. All relevant information should be clearly and systematically recorded in the document. Monitoring data should also be recorded in magnetic media form, and the software copy must be available upon request. All documents and data should be kept for at least one year following the completion of the construction phase EM&A for each construction contract.

12.8 Interim Notifications of Environmental Quality Limit Exceedances

With reference to the Event and Action Plans, when the environmental quality performance limits are exceeded and if they are proven to be valid, the ET should immediately notify the IEC, ER and EPD, as appropriate. The notification should be followed up with advice to the IEC, ER and EPD on the results of the investigation, proposed actions and success of the actions taken, with any necessary follow-up proposals. A sample template for the interim notification is presented in **Annex B of this Appendix**.

Annex A Sample Record Sheets

Sample Data Record Sheet for TSP Monitoring

Monitoring Location		
Details of Location		
Sampler Identification		
Date & Time of Sampling		
Elapsed-time Meter Reading	Start (min.)	
	Stop (min.)	
Total Sampling Time (min.)		
Weather Conditions		Sunny / Fine / Cloudy / Rainy
Site Conditions		
Initial Flow Rate, Qsi	Pi (mmHg)	
	Ti (°C)	
	Hi (in.)	
	Qsi (Std. m^3)	
Final Flow Rate, Qsf	Pf (mmHg)	
	Tf (°C)	
	Hf (in.)	
	Qsf (Std. m^3)	
Average Flow Rate (Std. m^3)		
Total Volume (Std. m^3)		
Filter Paper Identification No.		
Initial Wt. of Filter Paper (g)		
Final Wt. of Filter Paper (g)		
Measured TSP Level ($\mu g/m^3$)		
Other Dust Emission Source(s) Observed		
Remarks /Other Observations		

	Name & Designation	Signature	Date
Field Operator:	_____	_____	_____
Laboratory Staff:	_____	_____	_____
Checked by:	_____	_____	_____

Construction Noise Monitoring Field Record Sheet

Monitoring Location		
Description of Location		
Date of Monitoring		
Measurement Start Time (hh:mm)		
Measurement Time Length (min.)		
Noise Meter Model/Identification		
Calibrator Model/Identification		
Measurement Results	L_{90} (dB(A))	
	L_{10} (dB(A))	
	L_{eq} (dB(A))	
Major Construction Noise Source(s) During Monitoring		
Other Noise Source(s) During Monitoring		
Remarks / Other Observations		

	Name & Designation	Signature	Date
Recorded by:			
Checked by:			

Proactive Environmental Protection Proforma – Review of Construction Method

Log No.:_____

Ref*	Proposed Construction Method**	Location/ Working Period	Anticipated Impacts	Recommended Mitigation Measures

** EIA Ref/EM&A Log Ref/Design Document Ref*

*** Details of equipment, vehicles, plants, processes, technologies for the option of construction method*

Reviewed by Environmental Team Leader: _____

Date: _____

Approved by Independent Checker (Environment): _____

Date: _____

Proactive Environmental Protection Proforma – Review of Mitigation Measures

Log No.:_____

Ref*	Recommended Mitigation Measures	Proposed Alternative Mitigation Measures	Location and/or Period	Same Performance of the Alternative Measures (Y/N)?

** EIA Ref/EM&A Log Ref/Design Document Ref*

Reviewed by Environmental Team Leader: _____
Date: _____

Approved by Independent Checker (Environment): _____
Date: _____

Annex B Sample of the Interim Notification

Sample of the Interim Notification

Incident Report on Action Level or Limit Level Exceedance

Project	
Date	
Time	
Monitoring Location	
Parameter	
Action & Limit Levels	
Measured Level	
Type of Exceedance	
Possible reason for Exceedance	
Actions taken / to be taken	
Remarks / Other Observations	

Prepared by: _____

Designation: _____

Signature: _____

Date: _____