

Appendix D

Preliminary Environmental Review Report

(Part 1 of 2)

Agreement No. CE 79/2023 (GE)

**Underground Quarrying at Tsing Yi North –
Investigation, Design and Construction**

**Preliminary Environmental Review Report (Final)
(Ref. B19-07)**

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1 INTRODUCTION

1.1 Project Background

- 1.1.1 Rock, principally as aggregates in concrete, is the most predominantly used construction material for buildings and infrastructure developments in Hong Kong. Local quarries, where rock is sourced for such uses, are strategically important to the construction industry in Hong Kong. Apart from the extraction of virgin rock, surplus rock generated from local construction projects can be processed and recycled at quarries for beneficial reuse. In addition, the quarries are suitable sites for housing manufacturing facilities of rock-derived construction materials such as ready-mixed concrete and asphalt. Historically, rock has been quarried in Hong Kong by way of surface quarrying – open/pit extraction at the ground surface. By doing this, the quarries have been operating as self-financing business entities rather than government-funded facilities.
- 1.1.2 Currently, Lam Tei Quarry (LTQ) at Tuen Mun is the only active local quarry, for which the current quarry contract is scheduled for completion in 2025. Recognising the importance of local quarries in minimizing the risk of irregularities in the supply of imported rock, the Government has been searching for suitable sites to set up new surface quarries in order to maintain local rock supply, with a view to have at least one new quarry to dovetail with the closure of LTQ.
- 1.1.3 Apart from rock materials, Hong Kong is also desperately in need of developable land to meet socio-economic needs. Creating spaces in underground rock caverns is one of the solutions in boosting land supply in the medium to long-term. To create land in this manner, the cavern formation will not only generate a large amount of good quality rock, but this process is also a source of rock materials which could be an integral part of the local rock supply in future. This is the underlying concept of the initiative of underground quarry-cum-cavern development, which is unprecedented in Hong Kong. There are, nevertheless, successful examples of this approach in other countries, e.g. Switzerland, Norway and the United States of America, where the entire operation combining quarrying and subsequent uses of the cavern spaces created (e.g. cold storage, data centres, warehousing and recreational complexes) is confirmed to be commercially viable.
- 1.1.4 Preliminary reviews under the Strategic Cavern Study identified the prospect of this concept and thereby proposed it as one of the initiatives under the long-term strategy for cavern developments in Hong Kong. Accordingly, in November 2018, when formulating the local quarry strategy for maintaining the local rock supply, the Government also recognized this initiative as a potential long-term solution that is complementary to new surface quarries. In other words, underground quarrying in Hong Kong is being pursued as a dual-benefit policy initiative contributing to enhanced land supply and sustainable use of local rock resources.
- 1.1.5 In 2017, Civil Engineering and Development Department (CEDD) commissioned the Underground Quarry Study to evaluate the feasibility of this initiative, covering various aspects including technical acceptability, statutory and regulatory requirements, business model analyses and implementation mechanisms. Based on the results of a systematic territory-wide site search, the hillside at Tsing Yi North, which is one of the 48 Strategic Cavern Areas (SCVAs) as delineated in the Cavern Master Plan jointly promulgated by CEDD and Planning Department (PlanD) in 2017, was recommended to take forward.
- 1.1.6 In 2019, the CEDD and PlanD jointly commissioned the *Pilot Planning and Engineering Study on Development of Selected Strategic Cavern Areas – Feasibility Study* (hereinafter referred to as the “Pilot Study”) to enable the Government to earmark sites for cavern development and to facilitate the implementation of cavern development. The findings of the Pilot Study concluded that it is worthwhile launching a scheme of underground quarrying at Tsing Yi North. It is envisioned as an integral part of the long-term local quarry strategy. Shortage of rock import from the mainland China due to lockdown arising from COVID-19 outbreak in early 2020 caused substantial impacts across the construction industry in Hong Kong, heightening the importance of local quarries in the supply chain. To enhance crisis preparedness, it is timely to proceed with the scheme, along with other quarry related initiatives to maintain local rock supply.

- 1.1.7 Following the commencement of the Investigation, Design and Construction (IDC) assignment for developing and designing the pilot underground quarry at Lam Tei, Tuen Mun in 2021, CEDD launched an IDC assignment for developing a new underground quarry at Tsing Yi North (hereinafter referred to as “the Project”) in 2023.
- 1.1.8 To implement the proposed underground quarry-cum-cavern development at Tsing Yi North, it is necessary to conduct a site-specific investigation and design for the scheme, building on the work completed under the Underground Quarry Study and the Pilot Study.
- 1.1.9 This Project aims to complete all the tasks necessary and sufficient to undertake the assignments including statutory procedures, public consultation, detailed technical assessments, broad design for potential facilities, formulation of implementation arrangement etc. at the investigation, design and early construction phases, in order to enable commencement of the underground quarrying tentatively targeted in 2027. The scope under the IDC assignment includes various impact assessments, reference design of caverns and the underground quarrying-related activities (e.g. the materials processing/manufacturing facilities and their operations) coordinated or implemented by the Government, business case analyses, implementation strategy and procurement arrangements. Consultation within the Government and with public and relevant stakeholders/industry players will also be carried out.
- 1.1.10 This IDC assignment will also look into any works potentially required by the quarry operators during the operation phase of the proposed underground quarrying. Given its pilot nature, the underground quarrying operation will be subject to the prevailing and/or new implementation mechanisms such as contract form, site supervision and any independent audits required. These will be examined and tailor-designed under this Project. Depending on the findings, it may call for works or tasks for which the Government may procure consultancy services separately during the operation phase.
- 1.2 Objectives of the IDC Assignment
- 1.2.1 AECOM Asia Company Limited (the “Consultant”) has been appointed by Mines Division, Geotechnical Engineering Office, CEDD (the “Employer”) to undertake the IDC assignment of the Project. The overall objective of the assignment is to carry out investigation and design of the Tsing Yi North Underground Quarry (TYNUQ) as described under the Brief of the IDC assignment in accordance with the agreed programme and to the satisfaction of the Employer, with due and proper regard to achieving the following:
- (a) early completion and commissioning of the project;
 - (b) cost-effectiveness and financial viability;
 - (c) avoidance of extensive modification and maintenance for future land use;
 - (d) minimization and mitigation to physical, environmental, social and economic impacts;
 - (e) quality and reliability of works, robustness in performance;
 - (f) proper risk control and management;
 - (g) public / stakeholders consultation and gaining support;
 - (h) safety and health in quarry operation and maintenance;
 - (i) compatibility to the interfacing projects, future land uses and town planning;
 - (j) sustainability of the project, such as heritage, energy and waste management; and
 - (k) innovation for the benefits of the project throughout its delivery, operation and maintenance.
- 1.3 Scope of this updated Preliminary Environmental Review Report

1.3.1 The proposed scope of the Project includes the following principal works elements:

- Site clearance (e.g., vegetation removal and erection of fences/hoarding);
- Site investigation works;
- Erection of workshops and site office;
- Reception of imported rocks and stockpiling;
- Underground quarrying in the form of cavern/tunnelling works by drill-and-blast and mechanical breaking methods;
- Ancillary activities for quarry operation, such as concrete batching, asphalt production, and rock processing;
- Installation of tunnel/cavern support;
- Blasting-related mitigation measures;
- Site formation works and geotechnical works for portals and slopes;
- Road works, including potential widening of the existing access road;
- Drainage infrastructural works comprising surface drainage system, etc.
- Environmental mitigation measures;
- Landscaping works;
- Water supply works;
- Fire safety installation works; and
- Utilities diversion and installation works.

1.3.2 The Project consists of underground quarrying works, ancillary operations and associated infrastructural works. The Project Site falls within the area zoned "Green Belt (GB)", "Area shown as Road" and Other Specified Uses (OU)" annotated "Recreation and Tourism Related Uses" ("OU(RTRU)") and "OU" annotated "Boatyard and Marine-oriented Industrial Uses" ("OU(BMIU)") in the approved Tsing Yi Outline Zoning Plan No. S/TY/32 and is not partly or wholly located in any environmentally sensitive areas as stipulated under Item Q.1 of Part I of Schedule 2 of the EIAO. There is no on-site magazine setup and overnight storage of explosives. The total silo capacity of the proposed concrete production facility will not be more than 10,000 tonnes, in which cement is handled and manufactured. According to the latest design, there will be 5 production lines for concrete production. The road works which involve widening of an existing unnamed road (not an expressway/trunk road/primary distributor road/district distributor road) is required to provide vehicular access to the Project Site. No surface quarrying activities will be carried out under the Project. The Environmental Protection Department (EPD) confirmed on 16 October 2024 that this Project does not constitute a Designated Project (DP) under Environmental Impact Assessment Ordinance (EIAO). The scope of works under this IDC assignment generally remains unchanged after EPD's confirmation on the non-DP status. Under Clause 6.14 of the Project Brief, the Consultant shall review the findings, recommendations and conclusions from the previous Preliminary Environmental Review (PER) undertaken under the Pilot Study (hereinafter referred to as "the previous PER"), which serves as the basis for the subsequent environmental submission.

1.3.3 This updated PER, based on the latest available information, has evaluated the Project's environmental acceptability, established the existing baseline conditions, identified key environmental issues/constraints, examined the environmental acceptability of the Project, and recommended practicable mitigation measures for adverse environmental impacts.

1.4 Structure of the PER

1.4.1 In this PER, description of the Project, the identified key issues associated with the construction and operation of the Project are addressed in the following sections.

- Section 2: Site Location and Project Description
- Section 3: Study Approach
- Section 4: Air Quality
- Section 5: Noise
- Section 6: Water Quality
- Section 7: Waste Management

- Section 8: Land Contamination
- Section 9: Terrestrial Ecology
- Section 10: Landscape and Visual
- Section 11: Cultural Heritage
- Section 12: Hazard to Life
- Section 13: Overall Conclusions

2 SITE LOCATION AND PROJECT DESCRIPTION

2.1 Site Location

2.1.1 The Project Site of TYNUQ, covering an area of about 39 hectares, is located in the northern part of Tsing Yi Island, encompassing Wok Tai Wan and Yau Kom Tau. The proposed construction and quarrying activities will primarily take place within the designated works areas, including portals, underground cavern, access tunnels, access road, potential site formation areas, and Wok Tai Wan Works Area. An area at the southeastern corner of the proposed cavern has been reserved for potential future expansion of the underground quarry. The Project Boundary, which encloses a larger area beyond the proposed works areas, has been delineated to provide flexibility for future design refinement and potential adjustments to the layout during subsequent design stages. The location of the Project is shown in **Figure 2.01**.

2.1.2 The proposed TYNUQ consists of three components. Firstly, there is an underground area (i.e. the Underground Quarry Site) beneath Yau Kom Tau, currently zoned “Green Belt” (“GB”) and area shown as ‘Road’ on the approved Tsing Yi Outline Zoning Plan No. S/TY/32 (the OZP). Secondly, there are two portal areas for access to the underground area, namely 1) the proposed Tam Kon Shan Portal at the north-eastern corner zoned “Other Specified Uses” annotated “Boatyard and Marine-oriented Industrial Uses” (“OU(BMIU)”), “Green Belt” (“GB”) and area shown as ‘Road’; and 2) the proposed Ngau Kok Wan Portal including areas for surface ancillary operations (i.e. concrete production, asphalt production and rock processing) located at the north where is currently zoned “Other Specified Uses” annotated “Recreation and Tourism Related Uses” (“OU(RTRU)”), “GB” and area shown as ‘Road’. Lastly, Wok Tai Wan Works Area will be used for stockpiling with a conveyor belt system, which connects to the access road, to support the operation of the Project. This Wok Tai Wan Works Area is zoned “GB” and “OU(RTRU)”.

2.1.3 Drainage Services Department (DSD) had applied for a Temporary Government Land Allocation (TGLA) at Ngau Kok Wan and Wok Tai Wan under the *Relocation of Sha Tin Sewage Treatment Works to Caverns* project, to temporarily stockpile good-quality rock material for local reuse. According to the information provided by DSD at the current stage, the period of TGLA at Ngau Kok Wan is from 1 July 2021 to 30 June 2026. The TGLA may potentially be extended to the end of 2026.

2.2 Construction Phase

2.2.1 The Project Site is proposed to be developed into an underground quarry, contributing to future land supply. The construction phase will involve site establishment works for the quarry, including site formation, slope stabilization, utility works, and the installation of ancillary operations. Two portal areas, i.e. Ngau Kok Wan Portal and Tam Kon Shan Portal, will be established to support TYNUQ operations, as illustrated in **Figure 2.01**.

2.2.2 Ngau Kok Wan Portal, located immediately north of the TYNUQ, will be the main entrance of TYNUQ. Approximately 2.1 hectares of flat land at this portal area for material processing and to accommodate essential construction equipment and associated facilities, such as site offices and workshops. Initial setup for ancillary operations (i.e. concrete production, asphalt production, and rock processing) will also be provided here and will only operate upon the operation of TYNUQ.

2.2.3 Located northeast of the TYNUQ, the Tam Kon Shan Portal will serve as an alternative entrance and exit to the Underground Quarry during the operation phase, facilitating the transport of materials and quarry operations.

2.2.4 The Wok Tai Wan Works Area has been planned to function as an ancillary operation zone for TYNUQ. A conveyor belt system will be installed at the sloping works area to allow transportation of imported rocks between Wok Tai Wan Works Area (current Government Land GLA-TKT1939) and TYNUQ. The conveyor belt system could unleash the potential connection and facilitate rock transportation between the Wok Tai Wan Works Area and Ngau Kok Wan Portal, thereby supporting the ancillary operations.

- 2.2.5 Excavation of the tunnel portals will be executed through slope cutting, accompanied by stabilization works. The initial sections of the Main Access Tunnel, which are expected to be less than 30m long from the portals, leading to the Underground Quarry Site will be excavated using mechanical breaking methods. Drill-and-blast (D&B) method and the use of explosives will not be adopted for these initial sections during the construction phase.
- 2.2.6 The Project will not involve the development of a new barging point or any marine works. Watercourses located within the portal areas will either be removed or diverted. The watercourse within the Wok Tai Wan Works Area will be preserved as far as practicable through careful design of the conveyor belt system. Watercourse diversion works, if required, will only commence once the new flow paths are fully established, ensuring that all modifications occur within a dry zone and remain physically separated from downstream watercourses.
- 2.2.7 The construction phase is estimated to last approximately 1.5 years. This timeline includes the procurement, delivery, installation, and licensing processes for ancillary operations. Construction activities are anticipated to begin in Q2 2027 for completion by Q3 2028.
- 2.3 Operation Phase
- 2.3.1 The operation phase of the Project covers both quarrying activities and associated ancillary operations.
- 2.3.2 Upon completion of construction, quarrying activities will be primarily conducted by employing the D&B method for rock excavation within the remaining sections of the Main Access Tunnel and the Underground Quarry Site. All blasting operations will be conducted underground and will involve drilling, explosive charging, blasting, and rock removal processes.
- 2.3.3 Delivery of explosives to the Underground Quarry Site will be coordinated with the Mines Division of the CEDD (Mines/CEDD) on a daily basis, subject to further discussions and detailed designs of blasting cycles. No magazine site or overnight storage of explosives will be required for the Project.
- 2.3.4 Ancillary operations will include stockpiling, rock processing, and associated activities such as concrete production and asphalt production. Blasted rocks will undergo on-site crushing to achieve suitable aggregate sizes. Some aggregates will be further processed for concrete production or asphalt production at Ngau Kok Wan Portal before being transported off-site to construction locations by land. When imported rock is required, rocks from other projects will be delivered to Ngau Kok Wan Portal either by trucks via the access road, by barge via an existing barging point at Ngau Kok Wan, or by barge via an existing barging point at Wok Tai Wan, through the proposed conveyor belt at Wok Tai Wan Works Area and then by trucks through the access road. Subject to the land availability for stockpiling, TYNUQ will import and recycle surplus rock generated from the local construction projects. The quarry operator will flexibly utilize the underground spaces created by quarrying for stockpiling and housing rock processing activities throughout the quarry's operational lifespan. All ancillary activities are not permanent in nature and will cease upon completion of quarrying. Revenues generated from the sale of aggregates, concrete, and/or asphalt products will support the cost of rock extraction to be borne by the quarry operator.
- 2.3.5 The operation phase of the Underground Quarry Site is tentatively scheduled to commence in Q4 2028, following the establishment of the Site, and may continue after the rock reserves are depleted, subject to contract provisions and/or local market demand for rock aggregates. Thus, the decommissioning of the Site is indeterminate.
- 2.3.6 Underground quarrying is solely a means to form the underground space. The proposed Main Access Tunnel is approximately 16m wide and 10m high, whereas the individual production cavern is approximately 20m wide and 20m high. Both tunnels and caverns are generally horseshoe-shaped. Upon completion of the quarrying activities, approximately 6 hectares of the underground space (excluding the potential cavern expansion area and rock pillars between individual production cavern) will be formed in Tsing Yi North and owned by

the Government. Such valuable underground space will contribute to the future land supply for further development. The exact future land use will be determined in due course. The environmental impact of the construction of the cavern (potential expansion) (See **Figure 2.01**) has been assessed in this PER. Technical assessment of the environmental impacts by the after-use will be conducted under a separate study in the future.

3 STUDY APPROACH

3.1 General Approach for PER

3.1.1 Preliminary assessment of the environmental impacts has been conducted for the Project based on the best available information during the preparation of this PER. The approach of this PER in general follows the criteria and guidelines stipulated in Hong Kong Planning Standards and Guidelines (HKPSG) and other relevant legislation, standards, guidelines and criteria, with details presented in **Sections 4 to 12**.

3.2 Project Interface

3.2.1 Based on the tentative project programme as stated in **Section 2**, the concurrent projects have been identified in **Table 3.1** with their locations illustrated in **Figure 3.01**.

Table 3.1 Potential Concurrent Projects

Concurrent Project	Project Proponent	Tentative Construction Programme	
		Start	Complete
Public Housing Development at Tsing Yi Road West, Tsing Yi	CEDD / HD	2024 ⁽¹⁾	2034/35 ⁽²⁾
Tsing Yi – Lantau Link	HyD	2027 ⁽³⁾	2033 ⁽³⁾

Notes:

(1) Source: <https://www.cedd.gov.hk/eng/our-projects/major-projects/index-id-172.html>

(2) Source: <https://www.legco.gov.hk/yr2024/english/fc/pwsc/papers/P24-5-e.pdf>

(3) Source: https://www.epd.gov.hk/eia/files/applications/en/pp_359/eia_6190/progress/action_176300/Html_Clean_2025_0929/index.htm

(4) The proposed development under Planning Application Y/TY/2 has a physical overlap with part of the TYNUQ Project area. As such, it remains uncertain whether the development proposed under Y/TY/2 could be implemented concurrently and in full with the TYNUQ Project. Furthermore, at the time of preparation of this PER, Planning Application Y/TY/2 had not yet been approved by the Town Planning Board. Given the uncertainty in both its implementation feasibility and programme, it is considered premature to include the proposed development under Y/TY/2 as a concurrent project in this assessment.

(5) Other potential projects, such as Advanced Construction Industry Building (ACIB) and green fuel bunkering, will be located at Tsing Yi South and outside the assessment areas of the Project; therefore, cumulative environmental impacts are not anticipated.

3.2.2 Any cumulative impact from the concurrent project(s) has been addressed in this PER, subject to the availability of information for assessment and appropriateness.

4 AIR QUALITY

4.1 Introduction

4.1.1 This section presents an assessment of the potential air quality impact associated with the construction and operation of the Project. The potential air quality impact from the construction of the Project is addressed qualitatively while that from the operation phase is addressed quantitatively. Recommendations for mitigation measures have been provided, where necessary, to minimise the identified air quality impacts to an acceptable level.

4.1.2 Reference has been made to previous *Final Technical Report on Preliminary Assessment of the Selected Underground Quarry Site - Preliminary Environmental Review* under Agreement No. CE 21/2016 Technical Study on Underground Quarrying in Hong Kong – Investigation (hereinafter referred to as “the CE 21/2016 Study”).

4.2 Environmental Legislation, Standards and Assessment Criteria

Air Quality Objectives

4.2.1 The *Air Pollution Control Ordinance* (APCO) provides the statutory authority for controlling air pollutants from a variety of sources. The Hong Kong Air Quality Objectives (AQOs), which stipulate the maximum allowable concentrations over specific periods for typical pollutants, should be met. The prevailing AQOs are listed in **Table 4.1**.

Table 4.1 Hong Kong Air Quality Objectives

Pollutants	Averaging Time	Concentration Limit ($\mu\text{g}/\text{m}^3$) ⁽¹⁾	Number of Exceedance Allowed per Year
Sulphur Dioxide (SO_2)	10-min	500	3
	24-hour	40	3
Respirable Suspended Particulates (RSP or PM_{10}) ⁽²⁾	24-hour	75	9
	Annual ⁽⁴⁾	30	N/A
Fine Suspended Particulates (FSP or $\text{PM}_{2.5}$) ⁽³⁾	24-hour	37.5	18
	Annual ⁽⁴⁾	15	N/A
Nitrogen Dioxide (NO_2)	1-hour	200	18
	24-hour	120	9
	Annual ⁽⁴⁾	40	N/A
Ozone	8-hour	160	9
	Peak season	100	N/A
Carbon Monoxide (CO)	1-hour	30,000	0
	8-hour	10,000	0
	24-hour	4,000	0
Lead (Pb)	Annual ⁽⁴⁾	0.5	N/A

Notes:

(1) Gaseous pollutant measured at 293 K and 101.325 kPa.

(2) Suspended particulates in air with a nominal aerodynamic diameter of 10 μm or less.

(3) Suspended particulates in air with a nominal aerodynamic diameter of 2.5 μm or less.

(4) Arithmetic mean.

Air Pollution Control (Construction Dust) Regulation

4.2.2 Notifiable and regulatory works are under the control of *Air Pollution Control (Construction Dust) Regulation*. This Project is expected to include notifiable works (i.e. works inside tunnel, superstructure construction and demolition, and site formation) and regulatory works (i.e. slope stabilization works, dusty material handling and excavation, and blasting). Contractors and site agents are required to inform EPD and adopt dust reduction measures to minimize dust emission, while carrying out construction works, to the acceptable level.

Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation

4.2.3 The *Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation* comes into

effect on 1 June 2015. Under the Regulation, non-road mobile machinery (NRMMS), except those exempted, are required to comply with the prescribed emission standards. From 1 September 2015, all regulated machines sold or leased for use in Hong Kong must be approved or exempted with a proper label in a prescribed format issued by EPD. Starting from 1 December 2015, only approved or exempted NRMMS with a proper label are allowed to be used in specified activities and locations including construction sites. The Contractor is required to ensure the adopted machines or non-road vehicle under the Project could meet the prescribed emission standards and requirement.

Best Practice Means (BPM) and Associated Guidance Note

- 4.2.4 Under the APCO, “A Guidance Note on the Best Practicable Means for Mineral Works (Stone Crushing Plants) BPM 11/1 (95)” issued by EPD requires that the particulates emission concentration limit of 50mg/m³ (expressed at reference condition, 0°C, 101.325kPa) should be met.
- 4.2.5 *A Guidance Note on the Best Practicable Means for Specified Process – Cement Works (Concrete Batching Plant) BPM 3/2 (2025)* issued by EPD sets out definition for cement works, which are works where cement is handled, argillaceous and calcareous materials are used in the production of cement clinker or clinker is ground, and for which the total bulk storage capacity exceeds 50 tonnes, the total installed capacity of concrete mixers exceeds 3m³ or the total hourly concrete production rate exceeds 20m³. It requires that the particulates emission concentration limit of 10mg/m³ (expressed at reference condition, 0°C, 101.325kPa) should be satisfied. Furthermore, the premises covered by the BPM include a ship or barge connected to the ancillary operation area as storage.
- 4.2.6 *A Guidance Note on the Technical, Management and Monitoring Requirements for Specified Process – Tar and Bitumen Works (Asphalt Concrete Plants)* issued by EPD dated January 2017 requires that the particulates emission concentration limit of 10mg/m³ for arrestment equipment of filler silos (expressed at reference condition, 0°C, 101.325kPa) should be satisfied by January 2018. The bitumen fumes emission concentration limit is at 5mg/m³, while the particulates emission concentration limit for other arrestment equipment is at 50mg/m³.
- 4.2.7 *Air Pollution Control (Fuel Restriction) Regulations* issued by EPD requires that the limit of 0.001% on the sulphur content of liquid fuel for industrial and commercial use should be satisfied.

Technical Memorandum on EIA Process

- 4.2.8 The criteria for evaluating air quality impacts and the guidelines for air quality assessment are laid out in Annex 4 and Annex 12 of the EIAO-TM.
- 4.2.9 In accordance with Annex 4 of EIAO-TM, the limit of 5 odour units based on an averaging time of 5 seconds for odour prediction assessment should not be exceeded at any air sensitive receiver (ASR).

Non-Criteria Pollutants (Bitumen, Heavy Metals)

- 4.2.10 Apart from criteria pollutants, non-criteria pollutants such as Polycyclic Aromatic Hydrocarbons (PAHs) and Bitumen Fumes (Polycyclic Organic Matter) are commonly generated from batch mix, and bitumen heating processes emitted from the chimney of the asphalt production operation. Types of non-criteria pollutants emitted and selected for assessment are made reference to the United States Environmental Protection Agency (USEPA) Compilation of *Air Pollution Emission Factors (AP-42)*, 5th edition¹. As there is no relevant standard for these pollutants in Hong Kong, other relevant guidelines were reviewed to identify the assessment criteria. According to the criteria for health risk impacts due to the potential non-criteria pollutants, the assessment criteria related to Inhalation Unit Risk (IUR),

¹ Reference to USEPA AP-42, section 11.1, 3/04ed. Table 11.1-9 (No. 2 fuel oil-fired dryer, hot screens, and mixer with fabric filter)

European Commission, Acute Reference Exposure Level (REL) for non-Carcinogenic and Reference Concentration (RfC) for chronic non-Carcinogenic have been made reference to the standards laid out by WHO, Integrated Risk Information System (IRIS) of USEPA and Office of Environmental Health Hazard Assessment (OEHHA). Relevant criteria are summarized in **Table 4.2**.

Table 4.2 Assessment Criteria of Various Non-Criteria Air Pollutants by Asphalt Production

Pollutants	Inhalation Unit Risk (IUR) (Carcinogenic) ^[2]		Non-Carcinogenic Risk – Reference Value							
			Acute (Hourly)		Acute (8-hour)		Acute (Daily)		Chronic (Annual)	
	(µg/m³) ⁻¹	REF.	(µg/m³)	REF.	(µg/m³)	REF.	(µg/m³)	REF.	(µg/m³)	REF.
Acetaldehyde	2.20E-06	IRIS	470	OEHHA	300	OEHHA	-	-	9	IRIS
Benzene	6.00E-06	WHO	27	OEHHA	3	OEHHA	-	-	3	OEHHA
Ethylbenzene	2.50E-06	OEHHA	-	-	-	-	-	-	1000	IRIS
Formaldehyde	1.10E-05	IRIS	98.1 (hourly) /100 (30min.)	HPCL / WHO	-	-	-	-	9	OEHHA
Quinone	-	-	-	-	440	OSHA	-	-	-	-
Toluene	-	-	5000	OEHHA	830	OEHHA	-	-	420	OEHHA
Xylene ^[8]	-	-	22000	OEHHA	435000	OSHA	-	-	100	IRIS
Bitumen	-	-	-	-	-	-	7	[6]	-	-
2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-
Acenaphthene	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	-	-	-
Anthracene	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	1.10E-04	OEHHA	-	-	-	-	-	-	-	-
Benzo(a)pyrene	6.00E-04	IRIS	0.387	HPCL	-	-	0.000873	[5]	0.002	IRIS
Benzo(b)fluoranthene	1.10E-04	OEHHA	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	1.10E-04	OEHHA	-	-	-	-	-	-	-	-
Chrysene	1.10E-05	OEHHA	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	1.20E-03	OEHHA	-	-	-	-	-	-	-	-
Fluoranthene	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	1.10E-04	OEHHA	-	-	-	-	-	-	-	-
Naphthalene	3.40E-05	OEHHA	-	-	50000	OSHA	-	-	10	WHO
Phenanthrene	-	-	-	-	-	-	-	-	-	-
Pyrene	-	-	-	-	-	-	-	-	-	-
Benzaldehyde	-	-	-	-	-	-	-	-	-	-

Pollutants	Inhalation Unit Risk (IUR) (Carcinogenic) ^[2]		Non-Carcinogenic Risk – Reference Value							
			Acute (Hourly)		Acute (8-hour)		Acute (Daily)		Chronic (Annual)	
	(µg/m³) ⁻¹	REF.	(µg/m³)	REF.	(µg/m³)	REF.	(µg/m³)	REF.	(µg/m³)	REF.
Butyraldehyde/ Isobutyraldehyde	-	-	-	-	-	-	-	-	-	-
Crotonaldehyde	-	-	-	-	860	OSHA	-	-	-	-
Hexanal	-	-	-	-	-	-	-	-	-	-
Volatile Organic Compounds (VOCs)	-	-	300	[7]	-	-	-	-	-	-

Notes:

[1] Reference sources:

IRIS – Integrated Risk Information System (IRIS), USEPA

WHO – World Health Organization (WHO) air quality guidelines (AQGs)

HPCL – Air Pollutants and Health Protection Concentration Levels, Technical Memorandum for Issuing Air Pollution Abatement Notices to Control Air Pollution from Stationary Polluting Processes, HKEPD

OEHHA – The Office of Environmental Health Hazard Assessment

OSHA – Occupational Safety and Health Administration, Department of Labour, USA

[2] With reference to USEPA, Inhalation Unit Risk (IUR) is an estimate of the increased cancer risk from inhalation exposure to a concentration of 1µg/m³ for a lifetime. The lifetime cancer risk can be estimated by multiplying the IUR by an estimate of lifetime exposure (in µg/m³).

[3] Acute exposure refers to short-term exposures for humans to the pollutants. Hourly, 8-hour, and daily average concentration are adopted for assessing acute exposure impact to human.

[4] Chronic exposure refers to long-term exposures for humans to the pollutants. Annual average concentration is adopted for assessing chronic exposure impact to human.

[5] Benzo(a)pyrene 24-hour concentration limit made reference to Guidelines for Ventilation Requirement in Buildings

[6] Bitumen Fume (Polycyclic Organic Matter) 24-hour concentration limit made reference to Acceptable Ambient Concentration Standards of USEPA's National Air Toxics Information Clearinghouse (NATICH) - Data Base Report on State, Local and EPA Air Toxics Activities (September 1993).

[7] Volatile Organic Compounds (VOCs) 1-hour concentration limit made reference to Guidelines for Ventilation Requirement in Buildings, EUR 14449, EN

[8] Xylenes: technical mixture and o-xylene, m-xylene and p-xylene isomers.

[9] Dashed entries represent no related information is found.

[10] List of Non-Criteria Pollutants refers to USEPA AP-42, Section 11.1 Hot Mix Asphalt Plants, 3/04ed. Table 11.1-9 (No. 2 fuel oil-fired dryer, hot screens, and mixer with fabric filter)

4.2.11 Apart from the above non-criteria pollutants, metals, which are noxious pollutants, are expected to be emitted from batch mix, and bitumen heating processes in this Project. Types of heavy metals emitted and selected for assessment are made reference to the United States Environmental Protection Agency (USEPA) *Compilation of Air Pollution Emission Factors (AP-42)*, 5th edition². The concentration limits for the metals made reference either from available standards in Hong Kong or other relevant recognized international standards. The 8-hour Time-Weighted Average (TWA) Permissible Exposure Limits of OSHA are the averages for every 8 hours (i.e. three data sets for every 24-hour period). For a smoother reflection of a more continuous trend of metal concentrations without short-term fluctuation, a moving average was adopted for the estimation of the metal concentration. **Table 4.3** summarizes the concentration limits for the metals.

Table 4.3 Assessment Standards for Noxious Pollutants (Heavy Metals) by Asphalt Production

Pollutants	Inhalation Unit Risk (IUR) (Carcinogenic) ^{[1] [2]}		Concentration limits for Heavy Metals ^{[1] [2]}					
			Hourly		8-hour		Annual	
	($\mu\text{g}/\text{m}^3$) ⁻¹	REF.	($\mu\text{g}/\text{m}^3$)	REF.	($\mu\text{g}/\text{m}^3$)	REF.	($\mu\text{g}/\text{m}^3$)	REF.
Arsenic (As)	3.30E-03	OEHHA	0.2	OEHHA	0.015	OEHHA	0.015	OEHHA
Beryllium (Be)	2.40E-03	OEHHA	0.53	HPCL	0.2	OSHA	-	-
Barium (Ba)	-	-	-	-	500	OSHA	-	-
Cadmium (Cd)	4.20E-03	OEHHA	-	-	5	OSHA	0.005	WHO
Chromium (Cr)	-	-	-	-	500	OSHA	-	-
Hexavalent Chromium (Cr(VI))	1.50E-01	OEHHA	0.0085	HPCL	5	OSHA	0.1	IRIS
Copper (Cu)	-	-	100	OEHHA	100	OSHA	-	-
Lead (Pb)	-	-	-	-	50	OSHA	0.5	HPCL/W HO
Manganese (Mn)	-	-	-	-	0.17	OEHHA	0.09	OEHHA
Mercury (Hg)	-	-	0.6	OEHHA	0.06	OEHHA	0.03	OEHHA
Nickel (Ni)	2.60E-04	OEHHA	0.2	OEHHA	0.06	OEHHA	0.02	WHO
Selenium (Se)	-	-	-	-	200	OSHA	20	OEHHA
Zinc (Zn)	-	-	-	-	5000	OSHA	-	-

Notes:

[1] Reference sources:

IRIS – Integrated Risk Information System (IRIS), USEPA

WHO – World Health Organization (WHO) air quality guidelines (AQGs)

HPCL – Air Pollutants and Health Protection Concentration Levels, Technical Memorandum for Issuing Air Pollution Abatement Notices to Control Air Pollution from Stationary Polluting Processes, HKEPD

OEHHA – The Office of Environmental Health Hazard Assessment

OSHA – Occupational Safety and Health Administration, Department of Labour, USA

[2] Dashed entries represent that no related information was found.

[3] List of Non-Criteria Pollutants refers to USEPA AP-42, Section 11.1 Hot Mix Asphalt Plants, 3/04ed. Table 11.1-9 (No. 2 fuel oil-fired dryer, hot screens, and mixer with fabric filter)

4.3 Description of Baseline Condition

4.3.1 The Project is located at the northwest of Tsing Yi Island, occupying the areas of Wok Tai Wan, Yau Kom Tau, and Cheung Shue Tau. The location of the Project and its 500m assessment area are shown in **Figure 4.01**. The northeastern Tsing Yi is mainly residential area zoned “Residential (Group A)” (“R(A)”), “Village Type Development” (“V”) and “Open

² Reference to USEPA AP-42, section 11.1, 3/04ed. Table 11.1-9 (No. 2 fuel oil-fired dryer, hot screens, and mixer with fabric filter)

Space” (“O”), while western and southern Tsing Yi are mainly industrial areas zoned “Industrial” (“I”) and “Other Specified Uses” (“OU”) annotated “Container Related Uses”. Various existing shipyards, an existing cement work and two existing concrete batching plants are located at the north of the Project; nearest residential areas such as Cheung Wang Estate, Cheung Hang Estate and Cheung On Estate are located at the east of the Project.

- 4.3.2 The nearest EPD Air Quality Monitoring Station (AQMS) is the Tsuen Wan AQMS. The monitoring data recorded at EPD’s Tsuen Wan AQMS has shown that the air quality complies with the respective AQOs. The recent 5-year (2021-2025) monitoring results of air pollutants measured at Tsuen Wan AQMS are summarized in **Table 4.4**.

Table 4.4 Average Concentrations of Pollutants in the Recent Five Years (Year 2021 – 2025) at Tsuen Wan EPD Air Quality Monitoring Station

Pollutant	Avg Time	AQO ⁽¹⁾	Data Summary	Pollutant Concentration (µg/m ³) ⁽²⁾⁽³⁾				
				2021	2022	2023	2024	2025
Sulphur Dioxide (SO ₂)	10-min	500 (3)	4 th Highest	23	32	36	22	29
	24-hr	40 (3)	4 th Highest	8	12	10	8	6
Respirable Suspended Particulates (RSP)	24-hr	75 (9)	10 th Highest	60	52	53	53	58
	Annual	30	-	24	22	24	22	22
Fine Suspended Particulates (FSP)	24-hr	37.5 (18)	19 th Highest	34	32	29	33	32
	Annual	15	-	16	14	15	15	14
Nitrogen Dioxide (NO ₂)	1-hr	200 (18)	19 th Highest	151	140	158	129	140
	24-hr	120 (9)	10 th Highest	77	63	70	66	76
	Annual	40	-	44	39	40	39	39

Notes:

- (1) Values in () mean the number of exceedances allowed per year.
(2) **Bolded** values mean exceedance of the AQOs.
(3) All concentration units are in microgram per cubic metre (µg/m³).

- 4.3.3 Apart from the air quality monitoring data, EPD has released a set of background levels from “Pollutants in the Atmosphere and their Transport over Hong Kong” (PATH v3.0) model. According to the PATH v3.0 data published by EPD, the concentrations of SO₂, RSP, FSP and NO₂ at various averaging times would be lower than the AQOs in Year 2028 within the assessment area. The air pollutant concentrations within the Project Boundary, in reference to the PATH data in Year 2028, are summarized in **Table 4.5**.

Table 4.5 Background Air Pollutants in Year 2028 Extracted from the PATH v3.0 Model

Pollutant	Avg Time	AQO ⁽¹⁾	Data Summary	PATH v3.0 Grid in Year 2028 ⁽²⁾⁽³⁾			
				30,38	31,38	32,38	33,38
Sulphur Dioxide (SO ₂)	10-min	500 (3)	4 th Highest	29.62	28.18	23.58	22.89
			No. of Exceedance(s)	0	0	0	0
	24-hr	40 (3)	4 th Highest	7.63	7.34	7.29	7.28
			No. of Exceedance(s)	0	0	0	0

Pollutant	Avg Time	AQO ⁽¹⁾	Data Summary	PATH v3.0 Grid in Year 2028 ⁽²⁾⁽³⁾			
				30,38	31,38	32,38	33,38
Respirable Suspended Particulates (RSP)	24-hr	75 (9)	10 th Highest	54.67	54.19	53.88	54.82
			No. of Exceedance(s)	0	0	0	0
	Annual	30	-	20.73	20.35	20.32	20.86
Fine Suspended Particulates (FSP)	24-hr	37.5 (18)	19 th Highest	31.08	30.57	30.32	31.89
			No. of Exceedance(s)	9	6	6	7
	Annual	15	-	13.05	12.71	12.68	13.18
Nitrogen Dioxide (NO ₂)	1-hr	200 (18)	19 th Highest	99.76	92.89	94.35	98.64
			No. of Exceedance(s)	0	0	0	0
	24-hr	120 (9)	10 th Highest	48.9	40.72	40.32	42.3
			No. of Exceedance(s)	0	0	0	0
	Annual	40	-	26.74	23.66	23.85	24.4

Pollutant	Avg Time	AQO ⁽¹⁾	Data Summary	PATH v3.0 Grid in Year 2028 ⁽²⁾⁽³⁾			
				30,37	31,37	32,37	33,37
Sulphur Dioxide (SO ₂)	10-min	500 (3)	4 th Highest	29.68	30.07	28.5	22.5
			No. of Exceedance(s)	0	0	0	0
	24-hr	40 (3)	4 th Highest	7.66	7.65	7.39	7.26
			No. of Exceedance(s)	0	0	0	0
Respirable Suspended Particulates (RSP)	24-hr	75 (9)	10 th Highest	54.49	55.64	56.08	56.48
			No. of Exceedance(s)	0	0	0	0
	Annual	30	-	20.9	20.95	20.84	20.82
Fine Suspended Particulates (FSP)	24-hr	37.5 (18)	19 th Highest	32.02	32.48	32.52	32.04
			No. of Exceedance(s)	8	10	10	9
	Annual	15	-	13.19	13.21	13.11	13.12
Nitrogen Dioxide (NO ₂)	1-hr	200 (18)	19 th Highest	103.31	96.5	94.56	97.17
			No. of Exceedance(s)	0	0	0	0
	24-hr	120 (9)	10 th Highest	55.54	45.96	41.09	43.23
			No. of Exceedance(s)	0	0	0	0
	Annual	40	-	30.2	26.12	23.85	25.02

Notes:

- (1) Values in () mean the number of exceedances allowed per year.
- (2) **Bolded** values mean exceedance of the AQOs.
- (3) All concentration units are in microgram per cubic metre ($\mu\text{g}/\text{m}^3$).

4.3.4 The nearest EPD air quality monitoring station with available data of non-AQO pollutants and heavy metals is Tsuen Wan and Tuen Mun respectively. The maximum concentrations of non-AQO pollutants and heavy metals in the recent five years (i.e. Year 2020 - 2024) are summarized in **Table 4.6** and **Table 4.7** respectively. For the concentrations of pollutants which are not available in the data, the ambient concentrations of these pollutants are not included in the assessment.

Table 4.6 Ambient Concentrations of Non-AQO Pollutants at Tsuen Wan EPD Air Quality Monitoring Station (2020-2024)

Non-AQO Pollutants	Maximum Ambient Concentrations ^{[1] [2] [3] [4]}	
	Daily ($\mu\text{g}/\text{m}^3$)	Annual ($\mu\text{g}/\text{m}^3$)
Bitumen	N.A.	N.A.
Acetaldehyde	1.2000E+01	4.4071E+00
Benzene	1.8000E+00	8.0208E-01
Ethylbenzene	1.9000E+00	4.4300E+00
Formaldehyde	1.4000E+01	6.4636E+00
Quinone	N.A.	N.A.
Toluene	3.1000E+01	5.2138E+00
Xylene ^[4]	4.7000E+01	2.1776E+01
2-Methylnaphthalene	N.A.	N.A.
Acenaphthene	5.5989E-02	1.9520E-02
Acenaphthylene	1.1997E-02	6.2200E-03
Anthracene	2.3500E-03	7.5000E-04
Benzo(a)anthracene	1.0030E-03	1.4273E-04
Benzo(a)pyrene	2.6000E-04	6.6364E-05
Benzo(b)fluoranthene	2.7629E-04	9.1793E-05
Benzo(g,h,i)perylene	3.4000E-04	1.0039E-04
Benzo(k)fluoranthene	5.9753E-04	9.0675E-05
Chrysene	8.4600E-03	1.5655E-03
Dibenz(a,h)anthracene	3.9646E-05	1.3144E-05
Fluoranthene	4.0000E-03	1.7600E-03
Fluorene	5.8000E-03	2.4100E-03
Indeno(1,2,3-cd)pyrene	2.6390E-04	7.8521E-05
Naphthalene	4.4822E-01	2.9195E-01
Phenanthrene	1.9180E-02	7.6900E-03
Pyrene	5.5000E-03	2.0900E-03
Benzaldehyde	5.5000E+00	2.2464E+00
Butyraldehyde/ Isobutyraldehyde	8.3000E-01	3.5893E-01
Crotonaldehyde	7.0000E-02	2.7143E-02
Hexanal	1.6000E+00	6.0357E-01

Notes:

- [1] The ambient concentrations of non-AQO pollutants refer to "Summary of Toxic Air Pollutants Concentration" ([EPD AQHI: Toxic Air Pollutant Concentration](#)).
- [2] The highest ambient concentrations of the non-AQO pollutants among Year 2020 – 2024 from monitoring data at Tsuen Wan AQMS are adopted. As VOC and carbonyl data are not available for 2020, the highest ambient concentrations of the respective pollutants are taken from the monitoring data from Year 2021-2024. Daily maximum ambient concentration is taken from the highest data recorded, while annual maximum ambient concentration is taken from the maximum annual average data recorded.
- [3] N.A. represents that no related information is found.
- [4] Xylenes: technical mixture and o-xylene, m-xylene, and p-xylene isomers.

Table 4.7 Ambient Concentrations of Heavy Metals at Tuen Mun EPD Air Quality Monitoring Station (2020-2024)

Heavy Metals	Maximum Ambient Concentrations ^{[1] [2]}	
	Daily ($\mu\text{g}/\text{m}^3$)	Annual ($\mu\text{g}/\text{m}^3$)
Arsenic (As)	1.1000E-02	1.9429E-03
Barium (Ba)	3.1000E-01	2.0877E-02
Beryllium (Be)	4.0000E-05	2.9426E-05
Cadmium (Cd)	2.5000E-03	4.7377E-04
Chromium (Cr)	1.4000E-02	3.5885E-03
Copper (Cu)	1.4000E-01	3.4641E-02
Hexavalent Chromium (Cr(VI))	1.1000E-04	1.1000E-04
Lead (Pb)	4.6000E-02	1.0974E-02
Manganese (Mn)	6.9000E-02	1.7648E-02
Mercury (Hg)	1.9000E-04	1.7082E-04
Nickel (Ni)	9.3000E-03	3.8041E-03
Selenium (Se)	2.2000E-03	6.3525E-04
Zinc (Zn)	2.3000E-01	6.7967E-02

Notes:

- [1] The ambient concentration refer to "Summary of Daily Concentration of Airborne Species Derived from RSP" ([EPD AQHI: Airborne Species Concentration in Respirable Suspended Particulates](#)), except Hexavalent Chromium (Cr(VI)) which refers to data from Tsuen Wan AQMS from "Summary of Toxic Air Pollutants Concentration" ([EPD AQHI: Toxic Air Pollutant Concentration](#)).
- [2] The highest ambient concentration among the recent 5 years (i.e. Year 2020 – 2024) is adopted. Daily maximum ambient concentration is taken from the highest data recorded, while annual maximum ambient concentration is taken from the maximum annual average data recorded.

4.4 Representative Air Sensitive Receivers

4.4.1 The assessment area for preliminary air quality assessment covers 500m from the Project Boundary. The existing air sensitive receivers (ASRs), which would likely be affected by the Project are identified as representative ASRs with reference to *Annex 12 of the EIAO-TM*, Outline Zoning Plans (OZPs), OZP Plan No. S/TY/32 and are confirmed with surveys conducted on 18 September 2023, 17 and 19 March 2025. The details of the representative ASRs are listed in **Table 4.8**. The locations of these ASRs are shown in **Figure 4.01**.

4.4.2 There are existing public housing, primary school, and shopping mall located in the eastern part of the study area; however, they are located uphill and are sheltered from the Project Site by the hills with no direct line of sight with the Project, hence no direct impact is anticipated. These ASRs in the eastern part of the study area are therefore not included in the assessment.

Table 4.8 Representative Air Sensitive Receivers

ID	Description	Use	Approximate Distance from the Project Boundary (m)	Assessment Height (mAG)
A01	Administration Building of Hong Kong United Dockyards Limited ⁽¹⁾	Office	415	N/A
A02	Lantau Link Administration Building	Office	110	1.5, 5, 10, 15
A03	Interchange Vehicle Maintenance Workshops ⁽²⁾	Workshop	80	1.5, 5, 10
A04	Lantau Link Visitors Centre	Recreational	90	1.5, 5, 10

ID	Description	Use	Approximate Distance from the Project Boundary (m)	Assessment Height (mAG)
A05	The Hong Kong Shipyard Ltd Administrative Office	Office	<5	1.5, 5, 10, 15, 20
A06	Store	Commercial	425	1.5, 5, 10
A07	Hobby Nana Café (Coffee Shop)	Commercial	45	1.5, 5
A08	Hobby Nana Café (Model Train Shop)	Commercial	40	1.5, 5

Remarks:

- (1) A01 will be removed under Tsing Yi – Lantau Link before construction commencement in Year 2027 according to its approved EIA (AEIAR-269/2025). No construction and operation air quality impact assessment for the ASR are required for the Project.
- (2) Long-term air quality impact is not applicable to A03 due to its transient nature of use.
- (3) The full range of assessment heights of each ASR has been covered.

4.5 Identification of Air Quality Impact

Construction Phase

- 4.5.1 Potential construction air quality impact would arise from the construction activities, including site formation of portal areas, construction of tunnel portals and construction of the Main Access Tunnel (initial sections) at Ngau Kok Wan Portal and Tam Kon Shan Portal, utility works, erection of equipment for ancillary facilities and installation of a conveyor belt system at Wok Tai Wan Works Area. These construction activities would involve site formation works, slope cutting works, excavation, spoil handling, haul roads and movement of construction vehicles. The construction is expected to begin in Q2 2027 for completion by Q3 2028.
- 4.5.2 The above construction activities would generate potential fugitive dust and gaseous emissions. Given the site formation area of both Ngau Kok Wan Portal and Tam Kon Shan Portal is only about 0.68ha and 0.15ha, respectively, the fugitive dust and gaseous emission due to site formation works of portal areas would be limited with the implementation of suppression measures. Tunnel portals will be constructed through slope cutting. The initial sections of the Main Access Tunnel will be excavated by mechanical excavation, and will be installed with blast doors for subsequent blasting works during the operation phase. Since most of this works occurs underground in enclosed spaces, dust emissions would mainly come from the portals (i.e. portal emission), including those from spoil handling and transport. The maximum number of construction truck trips is estimated to be 8 per hour. Construction dust suppression measures such as regular watering, provision of blast doors, dust filtering at exhaust as suggested in *Air Pollution Control (Construction Dust) Regulation* will be implemented to abate the potential construction dust impacts. Construction vehicles accessing/leaving the works area at portals would also cause potential air quality impact on the ambient. A comprehensive air quality monitoring and audit programme is recommended during the construction phase to ensure the proper implementation of measures and the compliance of AQOs.
- 4.5.3 The erection of equipment for the three types of ancillary operations, i.e. rock processing, concrete production and asphalt production, would involve minor construction activities such as minor excavation for foundation works and facility fabrication works. These construction activities would pose a potential dust impact on the ambient air, but are considered as minor works owing to their small scale. With the implementation of construction dust mitigation measures as suggested in *Air Pollution Control (Construction Dust) Regulation*, no adverse construction dust impact due to the erection of equipment would be expected.
- 4.5.4 On-site use of diesel-powered engines is the potential source for other gaseous pollutants such as NO₂, SO₂, RSP, FSP, CO and smoke. The *Air Pollution Control (NRMM) (Emission)*

Regulation came into effect in June 2015 to control emissions from diesel-powered engines. The actual no. of NRMMs would be subject to the future contractor. Fuel with sulphur content not exceeding 0.001% by weight will be used to minimize SO₂ emission in accordance with *Air Pollution Control (Fuel Restriction) Regulations*. In addition, the use of NRMMs with exempted label under *Air Pollution Control (NRMM) Regulation* will be avoided as far as practicable.

Operation Phase

- 4.5.5 During the operation phase of the Project, tentatively commencing in Q4 2028, the underground quarrying will take place inside the cavern, while ancillary operations (including rock processing, concrete production, and asphalt production) and rock handling would be conducted at Ngau Kok Wan Portal and stockpiling at Wok Tai Wan Works Area, with reference to **Section 2.3**. D&B method would be used for the excavation of rocks. The blasted rocks will be crushed into suitable-sized aggregates. Concrete batching and asphalt production would consume some of the aggregates from rock processing for production. These rock products (aggregates, concrete and asphalts, etc.) would then be delivered off-site via enclosed conveyor for land transport. The ancillary activities will be operated upon the operation of the Underground Quarry. There would be two options for ancillary activities, namely Option 1 with rock processing, concrete batching with five production lines, and asphalt production; and Option 2 with rock processing and concrete batching with six production lines, replacing the asphalt production. The operation details of the underground quarry are summarized in **Table 4.9**. The operation details of the ancillary operations in Options 1 and 2 are summarized in **Table 4.10** and **Table 4.11**.
- 4.5.6 The underground quarrying would involve dusty activities including blasting, excavation, and mucking, and haul road emission by vehicle movement (paved or unpaved), therefore, potential air quality impact is expected during the operation phase of the Underground Quarry. Mitigation measures as suggested in *Air Pollution Control (Construction Dust) Regulation* should be implemented to abate the potential air quality impacts. Water sprayers will be provided to control the likely particulate emissions from the transport and handling of spoil.
- 4.5.7 The three proposed ancillary activities, namely rock processing, concrete production and asphalt production, will use electricity as the power supply for their operations in general, and no air pollutant emissions are anticipated from the electric mechanical equipment. However, the drying and mixing process in asphalt production would require heat generated by diesel fuel burners. Emissions of NO_x, SO₂ and particulate matters are expected from the fuel combustion processes, while the D&B and excavation works, as well as the ancillary operations would cause dust emission.
- 4.5.8 Based on the design and operational practices of the rock processing, concrete batching operation, and asphalt production works, as reviewed and confirmed by the Project Engineer, the activities considered as major potential dust emission sources are identified as follows in accordance with the specification given in *Compilation of Air Pollutant Emission Factors (AP-42)*, 5th Edition issued by U.S. Environmental Protection Agency.
- (a) Rock Processing
 - (i) Aggregate handling;
 - (ii) Loading of rock to the crushers and screens;
 - (iii) Wind erosion at stockpiles;
 - (iv) Loading of rock product to conveyor and dump trucks to subsequent production legs of ready-mix concrete and asphalt concrete; and
 - (v) Paved haul roads with vehicular movement.
 - (b) Concrete Batching
 - (i) Aggregate handling;
 - (ii) Loading of raw material to the storage silos;
 - (iii) Loading of raw material to weigh hoppers;
 - (iv) Loading of weighed raw material to mixers; and
 - (v) Paved haul roads with vehicular movement.

- (c) Asphalt Production
- (i) Aggregate handling;
 - (ii) Loading of raw material to the storage silos;
 - (iii) Loading of raw material to weigh hoppers;
 - (iv) Loading of weighed raw material to drummers;
 - (v) Loading of asphalt concrete to storage silos and vehicles; and
 - (vi) Paved haul roads with vehicular movement.
- (d) Wok Tai Wan Works Area
- (i) Loading/Unloading of rock to/from stockpiles;
 - (ii) Wind erosion at stockpiles.

Table 4.9 Operation Details of Underground Quarry

Operation Parameter	Underground Quarry
Approx. Area of Blasting Face	200 m ²
Frequency of Blasting	1 per day
Approx. Blasting period of the day	12:00 – 15:00
Approx. Rock generated per Blasting	3120 t

Table 4.10 Operation Details of Ancillary Operations (Option 1)

Operation Parameter	Option 1		
	Rock Processing	Concrete Batching	Asphalt Production
Maximum Hourly Processing Capacity	800 t/hr	500 m ³ /hr	208 t/hr
Mode of Operation	N/A	Batch	Batch
Total Cementitious Material Storage Silos Capacity (tonnes)	N/A	7500 t	N/A
Proposed Ancillary Operation Period	07:00 – 19:00		24 hours

Table 4.11 Operation Details of Ancillary Operations (Option 2)

Operation Parameter	Option 2	
	Rock Processing	Concrete Batching
Maximum Hourly Processing Capacity	800 t/hr	550 m ³ /hr
Mode of Operation	N/A	Batch
Total Cementitious Material Storage Silos Capacity (tonnes)	N/A	7500 t
Proposed Ancillary Operation Period	07:00 – 19:00	07:00 – 19:00 max. 550m ³ /hr concrete production 19:01 – 06:59 max. 50 m ³ /hr concrete production

- 4.5.9 Dust suppression and fugitive emissions control as recommended in relevant BPMs have been considered in the design of the ancillary operations and their equipment. According to the characteristics of works involved in the specified process (SP) and the Underground Quarry Site, control measures to minimize potential emission should be implemented where applicable. Dust collectors, enclosures and water sprayers are the general measures to control the likely particulates emission arising from the transport and handling of aggregates and cementitious materials. Nevertheless, the cavern with quarry inside provide a natural enclosure to avoid immediate release of pollutants to ambient and facilitate further control measures inside the cavern, for example, provision of blasting door and a dust collection system inside the cavern or at the exhaust of the cavern.
- 4.5.10 During heating of the bitumen, mixing process and load out of hot mix asphalt, bitumen fume and odourous gas are to be released. Bitumen fume would comprise Polycyclic Aromatic Hydrocarbon (PAH) Hazardous Air Pollutants (HAPs), non-PAH HAPs and non-HAP organic compound. For the bitumen heating, precise temperature control is an effective mean to reduce bitumen fume and odourous gas emission. High temperature cutoff device would be implemented to avoid bitumen temperature exceeding the corresponding temperature limit that would cause fume emission. Furthermore, the exhaust from these concerned processes would be vented to the dryer drum for combustive destruction and subsequently treated by baghouse before release to the ambient. Bitumen emission and odour are assessed in the modelling assessment.
- 4.5.11 Heavy metal emission is also expected from the batch mix and bitumen heating process. The emission will be vented to the dryer drum and subsequently treated by baghouse before release at the exhaust stack. Metals are emitted either as vapour or particulate or both, subject to the type of metals used in the processes. The particulates removal by the baghouse would help capture some of the heavy metal emission.
- 4.5.12 Excavated rocks from Underground Quarry will be transported by trucks to the barging point at Ngau Kok Wan, then by barge to Wok Tai Wan for storage at stockpiles. Unprocessed rocks in demand will be transported by barge back to the rock processing operation area in Ngau Kok Wan. Import rock or surplus rock from other local construction projects will be delivered by barge to Ngau Kok Wan for rock processing or to Wok Tai Wan for storage, subject to the demand. A cement barge is also expected for the delivery of cement, PFA, and GGBS to the concrete batching operation area. Marine emissions from these vessels induced by the Project are expected.
- 4.5.13 After crushing and screening, graded rock products will be transferred to the areas for concrete batching by conveyor belt and by trucks to the areas for asphalt production, respectively. Other cementitious materials required for concrete batching will be delivered by cement barge or tanker truck via the Tam Kon Shan Portal, cavern, to Ngau Kok Wan. Raw materials required for asphalt production, such as bitumen, fillers, etc. will also be delivered by trucks via the abovementioned route. Haul road and tailpipe emissions from these trucks are anticipated, which constitutes mainly NO_x and particulates.

Concurrent Projects

- 4.5.14 *Public Housing Development at Tsing Yi Road West*, Tsing Yi involves site formation, construction of retaining wall and slope, footbridge and junction construction, and ancillary works such as provision of drainage, sewerage, water supply and landscaping works. Construction began in 2024 with expected completion in 2034/35. Since it is located at more than 500m away from the Project Site, it was not considered in the assessment.
- 4.5.15 *Tsing Yi – Lantau Link* will provide a connection between Tsing Yi and North Lantau to meet the future traffic demands induced by the developments in North Lantau and Northwest New Territories. The construction will tentatively commence in 2027. Operation of the Tsing Yi – Lantau Link is expected by no later than 2033. Its cumulative air quality impact during construction and operation phases was considered in the assessment.

- 4.5.16 The proposed development under Planning Application Y/TY/2 has a physical overlap with part of the TYNUQ Project area. As such, it remains uncertain whether the development proposed under Y/TY/2 could be implemented concurrently and in full with the TYNUQ Project. Furthermore, at the time of preparation of this PER, Planning Application Y/TY/2 had not yet been approved by the Town Planning Board. Given the uncertainty in both its implementation feasibility and programme, it is considered premature to include the proposed development under Y/TY/2 as a concurrent project in this assessment.

Existing Emission Sources

- 4.5.17 Vehicular emission from existing roads within 500m assessment area also contributes to the ambient air quality. Major roads include Tam Kon Shan Road, Tsing Yi North Coastal Road, Ting Kau Bridge, Tsing Long Highway, North West Tsing Yi Interchange, Tsing Sha Highway, Cheung-Tsing Highway and Tsing Ma Bridge. The vehicular emission sources were also considered in the modelling assessment.
- 4.5.18 Facilities with frequent operation associated with vehicles also contribute to ambient air quality by vehicular running, idling, and start emissions within the facilities of concern. Parking sites for heavy goods vehicles (HGVs) and coaches have been identified within the assessment area and no public transport interchange is identified within the assessment area. The locations of these identified parking sites are illustrated in **Appendix 4.6**. The vehicular emissions of these parking sites were considered in the modelling assessment by a precise approach. 24-hour site surveys were conducted at the parking sites, referring to the Traffic and Transport Impact Assessment Report endorsed by Transport Department (TD). Information, including the observations in engine start frequency and soak time, as well as the detailed calculation of start emission according to start emission factors of concerned vehicles at various soak times extracted from EMFAC-HK v4.3 is presented in **Appendix 4.6**. The information regarding the facilities with potential vehicular emissions is current as of the time of preparation of this PER.
- 4.5.19 According to the best available information from Hong Kong Environmental Database by EPD, there are several existing specified processes (SPs) identified within the 500m assessment area and illustrated in **Figure 4.02**. These SPs involve cement works, concrete batching and asphalt production. All of these were considered in the quantitative assessment. Moreover, there are no other existing or planned industrial chimneys within the 500m assessment area, based on the best available information.
- Hong Kong Cement Company Limited (SP Licence No.: L-3-034(7));
 - Quon Hing Concrete Company Limited (SP Licence No.: L-3-039(7));
 - Hong Kong Concrete Company Limited (SP Licence No.: L-3-259(2));
 - Alliance Construction Materials Limited (SP Licence No.: L-3-213(6));
 - Anderson Concrete Limited (SP Licence No.: L-3-247(2)); and
 - Asphalt Surfaces (International) Limited (SP Licence No.: L-15-027(5)).
- 4.5.20 Apart from the above specified processes, major point sources within 4 km from the Site, which may contribute to the ambient air quality in the study area, is reviewed as well. Two more SPs are identified, including:
- Chemical Waste Treatment Centre by Ecospace Limited under SP Licence No. L-20-004(5); and
 - Kwai Chung Crematorium by the Food & Hygiene Department under SP Licence No. L-12-003(5).
- 4.5.21 CWTC and Kwai Chung Crematorium are sheltered by hills such that the wake effect by the hilly terrain enhances its dispersion before reaching the study area. No direct impact from these sources on the study area is expected. Hence, they are not considered in the cumulative air quality impact.

Identification of Key Air Pollutants of Emission during Operation Phase

- 4.5.22 Major dusty activities of underground quarrying, including blasting, excavation and spoil handling cause potential fugitive emissions in particulates. On-site use of diesel-powered engines is also the potential source for gaseous and particulate pollutants, such as NO₂, SO₂, RSP, FSP, CO and smoke. The emission of NO₂, CO and particulates are regulated under the *Air Pollution Control (NRMM) (Emission) Regulation*. Fuel with sulphur content not exceeding 0.001% by weight will be used to minimise SO₂ emission in accordance with the *Air Pollution Control (Fuel Restriction) Regulations*. Based on the current engineering design as confirmed by the Project Engineer, approximately 2 drilling jumbos, 2 concrete lorries, 2 dump trucks, 2 excavators with hydraulic break, 2 air compressors, 2 mobile generators, 2 cherry pickers, 4 ventilation fans, 2 loaders, 2 breakers, 2 bulldozers, 1 shotcrete robot, 1 rock bolting rig and 1 folk lift are expected to operate at the Project Site during the operation phase. The use of NRMMs with an exempted label under the *Air Pollution Control (NRMM) (Emission) Regulation* will be avoided as far as practicable. The equipment would also be properly maintained to minimise any emissions. The use of NRMMs is unlikely to cause significant smoke, gaseous and particulates emissions. In view of the impact by NRMMs is controlled, particulates from underground quarrying would be the major air pollutant during the operation phase. Ventilation with exhaust at portals should be provided in the Underground Quarry Site. A dust collection system with overall dust removal efficiency of 85% for the entire excavated space should be installed at the ventilation exhaust to minimise the air quality impacts.
- 4.5.23 RSP and FSP are the major air pollutants from ancillary operations. The activities will generally run on electricity, and no air pollutant emissions are anticipated from the electric mechanical equipment. However, the drying and mixing process in asphalt production would require heat generated by diesel fuel burners. Emissions of NO_x, SO₂, CO, and particulate matters are the major air pollutants from the fuel combustion processes. During heating of the bitumen, mixing process and load out of hot mix asphalt, bitumen emission (including bitumen fume, PAH and non-PAH HAPs, and non-PAH organic compounds) and odourous gas are to be released. Heavy metal emission is also expected from the batch mix and bitumen heating process. The emission is vented to the dryer drum and subsequently treated by baghouse before being released through the exhaust stack. Metals are emitted either as vapour or particulate or both, subject to the type of trace metals present in the raw material.
- 4.5.24 CO is a typical pollutant emitted from fossil fuel combustion and comes mainly from vehicular emissions. With reference to the “*Air Quality in Hong Kong 2024*”, the highest 1-hour average (1,950µg/m³) and the highest 8-hour average (1,778µg/m³) CO concentrations were recorded at Causeway Bay monitoring station and Yuen Long monitoring station respectively; these values were around one-tenth and one-fifth of the respective AQO limits. Given this substantial margin below the AQOs, CO would not be a critical air pollutant of concern, and was excluded from the modelling assessment.

4.6 Assessment Methodology

Construction Phase

- 4.6.1 As discussed in **Section 2.2.5**, the construction of the initial sections of the Main Access Tunnel will involve mechanical excavation and spoil handling. The erection of the equipment for the three types of ancillary operations will involve minor excavation and fabrication works. Other construction works, such as site clearance, site formation, access road modification and slope works are considered minor and localized. Given the limited construction works to be carried out, minor construction air quality impacts are anticipated from the Project during the construction phase when appropriate control measures are implemented. Therefore, the potential construction air quality impact was assessed qualitatively. In addition, a comprehensive air quality monitoring and audit programme is recommended during the construction phase to ensure the proper implementation of measures and the compliance of AQOs.

Operation Phase

- 4.6.2 During operation phase, the concrete batching operation, rock processing, and asphalt

production should follow the requirements stipulated in SP Licences and implement the dust control measures as stipulated in their Air Pollution Control Plan submitted for SP Licence application as well as *BPMs for Mineral Works (Stone Crushing Plants)/Cement Works (Concrete Batching Plant)/Tar and Bitumen Works (Asphaltic Concrete Plants)*. Ambient RSP monitoring (and odour patrol for asphalt production only) at the facilities' boundary and/or any other locations acceptable to the EPD would also be conducted under the requirement of the SP Licences during the ancillary operations.

4.6.3 (not used)

Emission by Underground Quarrying

4.6.4 Based on the latest engineering design, the underground cavern will be quarried by D&B method. Major dusty activities would include blasting, spoil handling and transport of quarried rocks out of the caverns. Dust control measures would be incorporated into the design, as presented in **Table 4.12**. These dust control measures were taken into account in the assessment.

4.6.5 Emission rates of quarrying related activities were estimated based on emission factors of United States Environmental Protection Agency (USEPA) *Compilation of Air Pollution Emission Factors (AP-42)*, 5th edition and activity data from the engineer design. Activity data includes, but not limited to, excavation rate, material handling rate, percentage active area, moisture content, silt content, number of construction trucks and truck speed. Detailed calculations of dust emission sources were presented in **Appendix 4.2**.

Table 4.12 Emission Source of Underground Quarrying and Corresponding Control Measures

Emission Description	Pollutant	Control Measures
Blasting and in the Cavern	Particulates	- Blasting door to remain shut during blasting - Wet suppression with water sprinklers to facilitate dust settlement - Ventilation resumes after settlement of dust - Release at portal by ventilation
Spoil Handling at Mucking-Out Area	Particulates	- Wet suppression with water sprinklers - Release at portal by ventilation
Unpaved Haul Road inside the Cavern	Particulates	- Regularly wetting with water sprays - Speed limit of all vehicles at 8km/hr - Release at portal by ventilation - Paving inside the cavern is subject to the progress of cavern construction⁽¹⁾
Vehicular Emission on Unpaved Haul Road inside the Cavern (V101-V107, V201-V207)	Particulates, Sulphur Dioxide, Nitrogen Oxides	Release at portal by ventilation
Exhaust at Portals (BP01-BP02)	Particulates, Sulphur Dioxide, Nitrogen Oxides	Ventilation system equipped with dust collection system at overall 85% dust removal efficiency for the entire excavated space

Remark:

(1) All the roads with active quarrying activities would be paved at the end of construction phase. However, haul roads near blasting and mucking-out area is infeasible to be paved when works are carrying out.

- 4.6.6 A ventilation system equipped with dust collection system at overall 85%³ dust removal efficiency for the entire excavated space will be provided. Most air emissions generated from the processes inside the Underground Quarry Site will be vented and released at the Ngau Kok Wan portals to the ambient. According to the Project Engineer, fresh air will be vented into the Underground Quarry Site from the portal areas, while the air extraction is situated near the blasting face for the purpose of fume extraction after blasting. The general air flow within the Underground Quarry Site would be from the portals towards the blasting face. The exhaust was assumed to be well-mixed, therefore the emission source was modelled as a volume source at the portals. Given that there are no details on the ventilation system available for assessment yet, the emission was evenly distributed as volume source among two portals at the Ngau Kok Wan portals. The emission strength was estimated to be the total emission inside the excavated space by all processes. The spatial distribution of effective dust emission source outside the cavern was presented in **Appendix 4.2**.

Vehicular Emission from Cavern Haul Roads

- 4.6.7 The 24-hour traffic flow, which only consists of HGV9, and the relevant traffic information was presented in **Appendix 4.2**. The hourly emission factor of each cavern haul road was determined by summation of emission by each vehicle class which is the product of traffic flow and emission factor at specific speed and ambient condition. The hourly emissions factors of NO, NO₂, RSP and FSP were further divided by the hourly flow to obtain a composite emission rate in gram per kilometer per vehicle, ready for input to the dispersion model. The Smart Air Modelling Platform (SAMP v2.1) by EPD, was used for the calculation and model setup of vehicular emission. The detailed calculation of vehicular emission source from cavern haul roads was presented in **Appendix 4.2**.

Emission by Ancillary Operations

Option 1

- 4.6.8 According to the preliminary engineering design, air pollution generating activities by ancillary operations and their corresponding air quality control measures were identified. As confirmed by the CEDD and the Project Engineer, the total production capacity of the concrete production and asphalt production from the Project would be 500m³ per hour and 208 tonnes per hour, respectively.
- 4.6.9 Air quality control measures specified in the associated BPMs would be incorporated into the design. Descriptions of each emission source and the corresponding control measures are tabulated in **Table 4.13** to **Table 4.16**. These control measures were taken into account in the assessment.
- 4.6.10 Emission rates by processes were estimated in accordance with the USEPA *Compilation of Air Pollution Emission Factors (AP-42)*, 5th Edition. Detailed calculations of emission rates and the spatial distribution of air emission sources were presented in **Appendix 4.2**.

Table 4.13 Emission Points at Portal for Rock Processing Operation and Corresponding Control Measures

Emission Description	Pollutant	Control Measures
Unloading of Rocks into Feed Hopper of Primary Crusher, Stone Crushing at Primary Crusher, Screening after Primary Crushing (SCP02)	Particulates	- Wet suppression - Housed inside rigid enclosure structure with dust collector at overall 90% dust removal efficiency
Stone Crushing at Secondary Crusher	Particulates	Wet suppression

³ According to the factsheet of dust collector issued by USEPA, dust collection system such as bagfilter can generally achieve more than 99% of dust removal. However, as the great pressure drop at filter is concerned by the Project Engineer, a lower rate such as 85% is recommended for the entire excavated space, which was also adopted under other projects with similar nature.

Emission Description	Pollutant	Control Measures
(SCP04)	Particulates	Enclosed crushing train
Screening after Secondary Crushing (SCP05)		
Stone Crushing at Tertiary Crusher (SCP06, SCP07)		
Screening after Tertiary Crushing (SCP08, SCP09)		
Aggregate handling and storage of excavated and imported rock & Wind Erosion during non-working hours (Stkp01)	Particulates	- Wet suppression - Free falling transfer point fitted with flexible curtain or enclosed with chutes to minimize the drop height - Transfer points to be housed by enclosure structure - Delivering conveyors to be enclosed with windshield on top and 2 sides - Tarpaulin cover
Material handling of rejects & Wind Erosion during non-working hours (Stkp03)	Particulates	
Paved Haul Road inside the Facilities	Particulates	- Haul roads are paved - Regularly wetting with water sprays for every hour - Speed limit of all vehicles at 8km/hr

Table 4.14 Emissions for Stockpiles at Wok Tai Wan Works Area and Corresponding Control Measures

Emission Description	Pollutant	Control Measures ⁽¹⁾
Unloading Rock Products to Stockpiles (Stkp06-08)	Particulates	- Wet suppression - Free falling transfer point fitted with flexible curtain or enclosed with chutes to minimize the drop height
Wind Erosion during non-working hours (Stkp04-05)	Particulates	Tarpaulin cover

Note:

(1) The control measures would be subject to the design of the stockpiling area in later stage, i.e. whether stockpile would be placed within 3-sided and top enclosure or in open air.

Table 4.15 Emissions for Concrete Batching Operation at Ngau Kok Wan Portal and Corresponding Control Measures

Emission Description	Pollutant	Control Measures
Dust Collector on Silica Fume Silo (CBP01-02, CBP23-25)	Particulates	- Pumped pneumatically through cement pipes - Dust tight silo - Equipped with a fabric dust collector at 99% dust removal efficiency - Emission concentration less than 9 mg/m³ (more stringent than the requirement of 10 mg/m³ stipulated in BPM)
Dust Collector on Pulverised Fuel Ash Silo (CBP03-04, CBP20-22)		
Dust Collector on GGBS Silo (CBP05-06, CBP17-19)		
Dust Collector on Cement Silo (CBP07-16)		

Emission Description	Pollutant	Control Measures
Dust Collector on Mixers (CBP26-30)		
Unloading of Aggregate to Hopper by Conveyor Belt (CBP31-32)	Particulates	3-side and top enclosure - Wet Suppression - Aggregate bins and its associated delivering conveyors to be housed inside a fully cladded structure
Paved Haul Road inside the Facilities	Particulates	- Haul roads are paved - Regularly wetting with water sprays for every hour - Speed limit of all vehicles at 8km/hr
Discharge of Concrete to Concrete Mixer Truck	Particulates	- No dust emission is anticipated because of its moist nature - Loading points enclosed on 2 sides and roof

Table 4.16 Emission for Asphalt Production Operation at Ngau Kok Wan Portal and Corresponding Control Measures

Emission Description	Pollutant	Control Measures
Loading of Aggregate to Aggregate Receiving Hopper (AP01)	Particulates	- Wet suppression - Fully enclosed structure
Aggregate handling at enclosed virgin aggregate silos	Particulates	- Wet suppression - Fully enclosed structure - Exhaust vented to Dust Emission System (AP02)
Dust collector on Recovered Filler Silos	Particulates	- Emission concentration less than 9 mg/m³ (more stringent than the requirement of 10 mg/m³ stipulated in BPM) - Exhaust vented to Dust Emission System (AP02)
Exhaust from Dryer Drum with Burner	Particulates, Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide, Methane, VOC, Heavy Metals	- Exhaust vented to baghouse at 99% dust removal efficiency - Ultra-low-sulfur diesel (sulfur content ≤ 0.001% w/w) - Exhaust vented to Dust Emission System (AP02)
Enclosed Mixing Tower	Particulates, Bitumen Fume or Odourous Substance	- Exhaust vented to dryer drum for combustion - Exhaust vented to Dust Emission System (AP02)
Bitumen Heating System	Particulates, Sulphur Dioxide, Nitrogen Oxides, Bitumen Fume or Odourous Substance	- Equipped with high temperature cutoff device to ensure bitumen temperature not to exceed the corresponding temperature limit - Exhaust vented to Dryer Drum via the Mixing Tower for combustion - Ultra-low-sulfur diesel (sulfur content ≤ 0.001% w/w) - Exhaust vented to Dust Emission System (AP02)
Truck Load out from Hot Mix Asphalt Storage Silo	Particulates, Bitumen Fume or Odourous Substance	- Enclosed 2-side and top with dust curtains at openings - Bitumen fume for the loading out

Emission Description	Pollutant	Control Measures
		- vented to dry drum for combustion - Exhaust vented to Dust Emission System (AP02)
Dust Emission System (AP02)	Particulates, Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide, Methane, VOC, Heavy Metals, Bitumen Fume or Odourous Substance	- Selective catalytic reduction (SCR) for diesel fuel burners, assumed at 80% NO_x removal efficiency - Equipped with a fabric dust collector at 99% dust removal efficiency
Loading of RAP and Rejected Aggregate to Storage and Hopper inside RAP storage area (AP03)	Particulates	- Fully enclosed structure - Emission concentration less than 9 mg/m³ (more stringent than the requirement of 10 mg/m³ stipulated in BPM)
Aggregate Handling at Aggregate Reject Bin (AP04)	Particulates	- Wet suppression - Fully enclosed structure
Load-out to Foul Batch Hopper (AP05)	Particulates	Control measures are considered not necessary as the loading rate is low
Loading of aggregates to Dump Trucks at Rock Processing Operation Area (AP31-34)	Particulates	Wet suppression
Paved Haul Road inside the Facilities	Particulates	- Haul roads are paved - Regularly wetting with water sprays for every hour - Speed limit of all vehicles at 8km/hr

- 4.6.11 Based on the latest design, the proposed concrete batching and asphalt production would only achieve 90% and 40% of their maximum hourly production capacity per annum, respectively. Therefore, such annual factors are applied to their emissions when considering long-term air quality impact, i.e. annual average.

Option 2

- 4.6.12 Alternatively, the asphalt production is replaced by an additional concrete batching production line with concrete production of 50 m³ per hour, operating 24 hours a day. The total production capacity of the concrete production from the Project would become 550m³ per hour in total for a maximum of 6 concrete batching production lines. The concrete batching operation primarily involves dust emission. There would be no more air pollutants due to the fuel combustion process in asphalt production, including NO₂, SO₂, heavy metals, as well as odorous emissions such as bitumen fumes and PAHs. The air pollutant emissions from Option 2 are expected to be less than those from Option 1.
- 4.6.13 The particulate emission inventories for asphalt production and the concrete batching operation have been compared, with detailed calculations presented in **Appendix 4.11**. Based on the comparison results, the particulate emissions of the asphalt production would be equivalent to a CBP production line operating for 24 hours a day, with an hourly production rate of around 52.4 m³/hour, and around 88.9% of the maximum hourly production capacity (46.5 m³/hour) per annum. Replacing concrete batching with a production rate of 50 m³ per hour, operating 24 hours a day, would have lower emissions in particulates. Therefore, the assessment results for Option 1 should be applicable to Option 2.

Vehicular Emission and Start Emission from Open Roads

- 4.6.14 The key air pollutants associated with vehicular emission during the operation phase are RSP, FSP, and NO₂. Major open road emission sources within 500m assessment area include haul roads supporting underground quarry and ancillary operations, Tam Kon Shan Road, Tsing Yi North Coastal Road, Ting Kau Bridge, Tsing Long Highway, North West Tsing Yi Interchange, Tsing Sha Highway, Cheung-Tsing Highway, Tsing Ma Bridge, and the planned Tsing Yi-Lantau Link.
- 4.6.15 EMFAC-HK v4.3 was adopted to estimate the vehicular emission factors in NO, NO₂, RSP and FSP in various travelling speeds and ambient conditions with reference to weather research and forecast (WRF) meteorological data extracted from PATH v3.0. For short-term cumulative impacts, an approach of using a daily profile of the lowest temperature and relative humidity data in each hour for each month was adopted. For long-term cumulative impacts, an approach of using a daily profile of averaged temperature and relative humidity data in each hour for each month was adopted. The Smart Air Modelling Platform (SAMP v2.1) with the ZEV scenario is used for the calculation of the composite vehicular emission factor and emission rates.
- 4.6.16 The traffic data for each road in 500m assessment area comprises 24-hour traffic flow with vehicle percentage, travelling speed in 18 vehicle classes was presented in **Appendix 4.5**. TD agreement on the adopted traffic data was presented in **Appendix 4.5**. The induced traffic due to the Project has been taken into account in the traffic data. With reference to the traffic data, the hourly emission factor of each open road was determined by summation of emission by each vehicle class which is the product of traffic flow and emission factor at specific speed and ambient condition. The hourly emissions factors of NO, NO₂, RSP and FSP were further divided by the hourly flow to obtain a composite emission rate in gram per kilometer per vehicle, ready for input to the dispersion model. The Smart Air Modelling Platform (SAMP v2.1) by EPD, was used for the calculation and model setup of vehicular emission. The detailed calculation of vehicular emission source was presented in **Appendix 4.5**.
- 4.6.17 Start emission refers to the air pollutants generated due to the ignition of the vehicle engines which are released at vehicle tailpipes. Start emission generally occurs on the local road where there is potential trip start, while no start emission along district distributor or expressway is anticipated. For the assessment purpose, a broad-brush approach was adopted except for parking spaces where the start emission at all local roads were assumed irrelevant to the actual location of engine start. Also, vehicle classes (including private cars, light goods vehicles (LGV3, LGV4, LGV6, and motor cycles) were assumed to have a potential trip start on a local road.
- 4.6.18 Most of the HGVs along the local roads within the assessment area are working vehicles travelling to/from the Project, other industrial buildings and dockyards, which includes concrete mixer trucks and cement tankers. These working vehicles are not supposed to park along these roads, i.e. no engine start is expected. There will be no parking of the HGVs within the Project Site. Furthermore, non-franchised buses (NFBs) are unlikely to appear in the assessment area as the area near the Project Site is of industrial uses and offices. Hence, no start emission was assumed for HGVs and NFBs at the local roads within the assessment area.
- 4.6.19 On the other hand, public transports (including PLBs, FB (single deck) and FB (double deck)) usually starts its engine at its termini throughout its service routes. Start emissions within the identified parking sites were assessed with a precise approach as discussed in **Section 4.5.18**.
- 4.6.20 For the broad-brush approach of start emission calculations, vehicle classes except public light buses (PLBs), NFBs, franchised buses (FBs) and HGVs were adopted. Start emission factors of the relevant vehicle classes at various soak times were extracted from EMFAC-HK v4.3, among which the highest factor was adopted for a vehicle class. Start emissions for each vehicle class are assumed directly proportional to Trips per Vehicle-kilometre-travelled ratio (Trip/VKT) with consideration of the proportion of local and rural roads within

Hong Kong based on the latest *Annual Traffic Census (ATC)* prepared by the TD. For SAMP v2.1, default trip and VKT values from EMFAC-HK v4.3 model are used in the calculations and the proportion of local and rural roads within Hong Kong (3.74%) derived from *ATC 2024*, which is detailed in **Appendix 4.5**.

Vehicular Emission Associated with Parking Sites

- 4.6.21 Running, idling and start emissions within the existing parking sites described in **Section 4.5.18** were assessed with a precise approach. According to desktop research, there are several parking sites that are open space sites with no ventilation system. Data concerning engine start at these concerned locations, such as the frequency and soak time, was collected in 24-hour site survey conducted on 27 May 2025, a normal working day and is presented in **Appendix 4.6**. The start emissions calculation was conducted according to the “*Technical Note on the Calculation of Start Emissions in Air Quality Impact Assessment*”. Start emission factors of vehicle types at various soak times were extracted from EMFAC-HK v4.3. An approach of using the lowest temperature and relative humidity data in the year among the four PATH grids (i.e. 9°C and 16%) was adopted. The detailed calculation of start emission is presented in **Appendix 4.6**.

Determination of Assessment Year of Vehicular Emission

- 4.6.22 According to the latest planning, the operation period (Operation Phase) of the Project is expected to commence in Year 2028, yet the decommissioning of the Site is indeterminate. The assessment year for open road vehicular emission was determined by the year with the highest vehicular emission burden within the assessment area during the operation period, assuming 15 years after the commencement year. The vehicular emission burdens of NO_x, RSP, FSP in Year 2028, Year 2030, Year 2033, Year 2038, and Year 2043 were estimated with EMFAC-HK v4.3 and are presented in **Table 4.17**. The traffic data and the assumption adopted in EMFAC-HK are presented in **Appendix 4.5**. The planned Tsing Yi-Lantau Link will be commissioned in Year 2033, thus it has been included in the traffic data in Year 2033 and after. An approach of using the lowest temperature and relative humidity data in each hour of the year was adopted. Year 2028 was selected as the assessment year, which had the highest vehicular emission burden for NO_x, RSP, and FSP.

Table 4.17 Vehicular Emission Burden in the Assessment Area

Year	Vehicular Emission Burden (Tonne Per Year)					
	RSP		FSP		NO _x	
2028	2.60		2.39		62.82	
2030	2.11		1.94		49.07	
Traffic Scenario [2]	A	B	A	B	A	B
2033	1.27	1.29	1.17	1.19	29.78	30.52
2038	0.68	0.70	0.62	0.64	18.54	19.17
2043	0.60	0.62	0.55	0.57	14.47	14.98

Note:

[1] **Bolded** value indicates the highest value among the assessed years.

[2] Please refer to **Appendix 4.13** for different potential traffic scenarios (Scenarios A & B) from Year 2033.

Marine Emission

- 4.6.23 The operation of the Project would induce marine traffic. Marine emission is expected and would pose a potential air quality impact on the ASRs. Major air pollutants associated with marine emissions include particulates, NO₂, and SO₂. The stack parameters of marine traffic induced were provided by the Project Engineer, and the emission inventory is summarized in **Appendix 4.4**.
- 4.6.24 With reference to the Study on Marine Vessels Emission Inventory (MVEIS) by HKUST, the marine emission is estimated using an activity-based approach. The emission factors were derived in units of works (gram per kilowatt-hour), dependent on the fractional load of the equipment during different vessel activity modes. The calculation is summarized as below:

$$Emission = P \times FL \times T \times EF$$

where *P* is the installed power of equipment;
FL is fractional load of equipment in a specific mode;
T is operation time-in-mode; and
EF is fractional load emission factor of equipment.

4.6.25 Typical power equipment installed on marine vessels are Main Engine (ME) for propulsion, Auxiliary Engine (AE) for electricity and Auxiliary Boiler (AB) for fuel pre-heating and pumping. Subject to the vessel types, different combinations of engines are equipped on a vessel.

4.6.26 The vessel types identified within the assessment area are matched with equivalent vessel types considered in MVEIS. Typical engine power rating, engine type, fuel type of each vessel type are adopted from MVEIS. The detailed assumptions are presented in **Appendix 4.4**. The vessel type considered in the assessment include:

- Dry Bulk Carrier (category RTV)

4.6.27 Typical engine load factor by vessel type and by operation mode refers to MVEIS. Engine load factor of marine source was then determined according to its vessel type and its operation mode, which is defined according to the vessel speed with reference to MVEIS and shown in **Table 4.18**.

Table 4.18 Operation Mode of Marine Vessels

Operation Mode	Vessel Speed
Cruise / Fairway Cruise	Over 12 knots
Slow Cruise	8 to 12 knots
Maneuvering	1 to below 8 knots
Hotelling	Below 1 knot

4.6.28 The time-in-mode is estimated by the distance and vessel speed travelled in the corresponding mode.

4.6.29 Emission factors of RSP and FSP by vessel type and by operation mode refers to MVEIS and IMO Fourth Greenhouse Gas Study 2020. According to the *Air Pollution Control (Fuel for Vessels) Regulation* stipulates the use of fuel with sulphur content of 0.5% for all vessels within Hong Kong waters. As such, fuel with sulphur content of 0.5% is assumed to be used by River Trade Vessels (RTV) for modelling purpose as a conservative approach. Together with the parameters discussed above, the emission of a marine source is estimated with the equation discussed above.

4.6.30 The stack parameters exit temperature and release height are determined by desktop review and site surveys whenever possible, and the other stack parameters (exit velocity and stack diameter) refer to previous studies concerning nearby waters, such as the approved EIA Report of Route 11 (Section between Yuen Long and North Lantau) (AEIAR-255/2023). The emission inventory is summarized in **Appendix 4.4**.

Bitumen and Odour Emission

4.6.31 Bitumen emission (including bitumen fume, PAH and non-PAH HAPs, and non-PAH organic compounds) from the mixer and the bitumen tanks would cause air quality and odour emission impact to the ambient⁴. The exhaust from the mixer is fed to the rotary dryer drum and undergone combustion by burner. The odourous pollutants are subject to combustive destruction before being released to the ambient. Activated carbon filters should be equipped to reduce the bitumen and odour emission from the bitumen tanks. The potential odour

⁴ There is only 1 exhaust point collectively for the mixer and bitumen tanks.

emission is expected to be controlled with these control measures.

- 4.6.32 Bitumen fumes of 5mg/m³ was assumed to be emitted at the exhaust vent, with reference to concentration limit of bitumen fume stipulated in *BPM for Asphalt Concrete Plant*. The odour emission strength was determined by the species in the bitumen fume and their odour thresholds. The species in the bitumen fume refer to *USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-9 (No.2 fuel oil-fired dryer, hot screens and mixer with fabric filter)*. Detailed calculations of bitumen and odour emission rates are presented in **Appendix 4.2**. The concentration limits for bitumen fume, emission rates for PAH and non-PAH HAPs and odour to be used for assessment should be monitored at the exhaust upon commissioning and during the operation phase to demonstrate the assumed concentration limits and emission rates and assessment results are valid.

Heavy Metal Emission

- 4.6.33 The emission factors of heavy metal emissions from the mixer and the bitumen tanks refer to *USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-11*. Detailed calculations of individual heavy metal emission rate are presented in **Appendix 4.2**. The heavy metal emission rates to be used for assessment should be monitored at the exhaust upon commissioning and during the operation phase to demonstrate the assumed emission rates and assessment results are valid.

Dispersion Modelling & Modelling Approach

Dispersion Modelling & Modelling Approach for Underground Quarrying and Associated Ancillary Operations

- 4.6.34 According to *Guidelines on Assessing the 'TOTAL' Air Quality Impacts* by EPD, integrated modelling system PATH v3.0, which are developed and maintained by EPD were applied to provide background pollutant concentrations in assessing the total impact in the assessment area. In addition, WRF meteorological data was adopted for modelling.
- 4.6.35 American Meteorological Society and USEPA Regulatory Model (AERMOD), the EPD approved air dispersion model, was applied to predict the air quality impacts due to emission from underground quarrying and associated ancillary operations. Air pollutants concentrations, including criteria pollutants and odour, were predicted at each identified ASRs at various assessment heights, 1.5 metres aboveground (mAG), 5mAG, 10mAG and so on, every 10 metres up to its physical height.
- 4.6.36 Hourly meteorological conditions, including wind data, temperature, relative humidity, pressure, cloud cover and mixing height of Year 2019 were extracted from the WRF meteorological data and adopted in the PATH system. The dataset by WRF should be intact and consistent among parameters. In order to avoid any hours misidentified as missing data by AERMOD and its associated components, the WRF meteorological data were handled manually to set wind direction between 0° – 0.1° to be 360°. The height of the input data was assumed to be 8.5mAG for the first layer of the WRF data as input.
- 4.6.37 The wind speed and mixing heights in the WRF data were further adjusted before meteorological pre-processing by AERMET. The minimum wind speed was capped at 0.5 metre per second. The mixing height was capped between 119 metres and 2009 metres according to the observation by HKO in Year 2019. After pre-processed by AERMET, the mixing height was verified once again and adjusted to the capped range if necessary.
- 4.6.38 Surface characteristic parameters such as albedo, Bowen ratio and surface roughness are required in the AERMET. The parameters were determined according to land use classified for the surroundings and the latest AERMOD Implementation Guide. The determination of the surface characteristics parameter is presented in **Appendix 4.7**. Elevated terrain option was applied in AERMOD, to where the base elevation of receptors and sources were input.
- 4.6.39 As particulates are concerned, dry deposition was applied in the model run. Particle size distribution was assigned for particles with aerodynamic diameters smaller than 10 µm to

each type of source in the AERMOD in order to account for the particle deposition. The particle size distribution for each process is summarized in **Appendix 4.2**.

Dispersion Modelling and Modelling Approach for Vehicular Emission from Open Roads

4.6.40 According to *Technical Note for Modelling Vehicular Emission Using AERMOD* by EPD, AERMOD was used to assess the vehicular emission from open road.

4.6.41 The mixing zone of a road source was defined in the AERMOD. The top of plume was defined as 1.7 times of the average height of vehicle fleet on the road. The average height of vehicle fleet was determined for each road and was weighted by the total daily traffic flow of each vehicle class. The suggested average vehicle height of each 18-vehicle classes refers to the same technical note.

Dispersion Modelling and Modelling Approach for Marine Emission

4.6.42 AERMOD was applied to assess the marine emission in the nearby waters. Marine emission is line source in nature because of the mobile vessels along the route. However, the emission also resembles point source for its high exhaust temperature, exhaust velocity and higher release height. In consideration of these similarities, the marine emission along a route was modelled by numerous of point sources along the route with an interval of 20m and its emission strength is equally allocated to these point sources.

Cumulative Impact of Criteria Air Pollutants

4.6.43 Cumulative AQO pollutant concentration at ASR was derived by the sum of contributions by various sources, and background contribution from PATH v3.0 on a hour-by-hour basis. Averaging results, namely 10-min, hourly, daily, and annual, were derived from the cumulative hour-by-hour results in accordance with Title 40, Code of Federal Regulations, US Environmental Protection Agency (USEPA 40 CFR) Part 51 “Revision to the Guideline on Air Quality Models, January 2017”. For annual average, the sum of all valid hourly concentrations was divided by the number of valid hours during the year. For daily average, cumulative results at each ASR amongst 365 days were ranked by highest concentration and compared with the maximum allowable concentration to determine the number of exceedance throughout a year. The air quality impact on ASRs was evaluated by number of exceedance per annum against the criteria of EIAO-TM and AQOs.

4.6.44 Ozone Limiting Method (OLM) was adopted for the conversion of short-term NO_x to NO₂ based on the ozone background concentration from PATH v3.0. Regarding vehicular emission, NO₂ and NO was predicted separately in AERMOD. Following the principle of OLM, the total predicted vehicular NO₂ was estimated as below:

$$[\text{NO}_2]_{\text{vehicular}} = [\text{NO}_2]_{\text{predicted}} + \text{MIN} \{ [\text{NO}]_{\text{predicted}}, \text{ or } (46/48) \times [\text{O}_3]_{\text{PATH}} \}$$

where

[NO₂]_{vehicular} is the total predicted vehicular NO₂ concentration

[NO₂]_{predicted} is the predicted NO₂ concentration

[NO]_{predicted} is the predicted NO concentration

MIN means the minimum of the two values within the bracket

[O₃]_{PATH} is the representative O₃ PATH concentration (from other contributions)

(46/48) is the molecular weight of NO₂ divided by the molecular weight of O₃

4.6.45 NO₂-to-NO_x ratio of 5% was adopted for the emission from boiler of an asphalt production operation area, with reference to *Table 1.3-1, Section 1.3, 5/10 ed., AP-42, USEPA*. Following the principle of OLM, the total predicted NO₂ due to boiler of asphalt production was estimated as below:

$$[\text{NO}_2]_{\text{stack}} = f \times [\text{NO}_x]_{\text{predicted}} + \text{MIN} \{ (1 - f) \times [\text{NO}_x]_{\text{predicted}}, \text{ or } (46/48) \times [\text{O}_3]_{\text{PATH}} \}$$

where

- f is the NO₂-to-NO_x ratio
 $[\text{NO}_2]_{\text{stack}}$ is the total predicted NO₂ concentration
 $[\text{NO}_x]_{\text{predicted}}$ is the predicted NO_x concentration
 MIN means the minimum of the two values within the bracket
 $[\text{O}_3]_{\text{PATH}}$ is the representative O₃ PATH concentration (from other contribution)
 (46/48) is the molecular weight of NO₂ divided by the molecular weight of O₃

- 4.6.46 With reference to the *Guidance on Choice of Models and Model Parameters*, Jenkin method was adopted for the conversion of cumulative annual average NO_x to NO₂ by using the empirical relationship in observed annual mean of NO_x and NO₂ concentrations. The empirical relationship is derived from the annual mean observed data by relevant EPD's AQMSs including Tsuen Wan (the closest station), Tap Mun (background station with no vehicular emission), and Mong Kok roadside station (station dominated by vehicular emission). The resulting curve was adopted for the cumulative annual average NO_x to NO₂ conversion. A detailed derivation of NO_x-to-NO₂ conversion equation using Jenkin method was presented in **Appendix 4.8**.
- 4.6.47 According to *Guidelines on the Estimation of 10-min average SO₂ Concentration for Air Quality Assessment in Hong Kong*, SO₂ concentration in 10-min average due to the stack emissions was estimated by applying stability-dependent multiplicative factor to 1-hour average model prediction by AERMOD.
- 4.6.48 All odour emission sources (point sources) from the proposed operation are wake-affected point sources, and the 1-hour to 1-second conversion factors from *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW Approved Method)* for wake-affected point sources were adopted. The conversion factors for wake-affected point sources converting 1-hour average to 1-second average concentration stipulated in the NSW Approved Method were adopted directly to convert the 1-hour concentration predicted by the AERMOD model to 5-second concentration as a conservative approach. The conversion factors for different types of source and stability classes are listed in **Table 4.19** below. Pasquill-Gifford stability refers to the dataset based on the WRF meteorological data.

Table 4.19 Conversion Factors to 5-second Mean Concentration

Pasquill Stability Class	Conversion Factor	
	Wake Affected Point Sources	Area
A	2.3	2.5
B	2.3	2.5
C	2.3	2.5
D	2.3	2.5
E	2.3	2.3
F	2.3	2.3

- 4.6.49 For the estimation of formaldehyde, 1-hour to 30-minute conversion factors were calculated via a power law relationship with reference to Duffee et al., 1991⁵. Such that the 1-hour average concentrations predicted by the AERMOD model were converted to 30-minute average concentrations. The conversion factors for different Pasquill stability classes are listed in **Table 4.20** below.

$$C_1 = C_s(t_s/t_i)^p$$

⁵ Richard A. Duffee, Martha A. O'Brien and Ned Ostojic, 'Odor Modeling - Why and How', Recent Developments and Current Practices in Odor Regulations, Controls and Technology, Air & Waste Management Association, 1991

where

C_l = concentration for the longer time-averaging period;

C_s = concentration for the shorter time-averaging period;

t_s = shorter averaging time;

t_l = longer averaging time; and

p = power law exponent in **Table 4.20**.

Table 4.20 Conversion Factors from 1-hour to 30-minute Averaging Time

Pasquill Stability Class	Power Law Exponent	1-hour to 30-minute Conversion Factor
A	0.5	1.41
B	0.5	1.41
C	0.333	1.26
D	0.2	1.15
E	0.167	1.12
F	0.167	1.12

- 4.6.50 As a conservative approach, the AERMOD predicted maximum 1-hour average formaldehyde concentration at each ASRs was converted to 30-minute average using the highest conversion factor of 1.41 presented in **Table 4.20**.

4.7 Prediction and Evaluation of Environmental Impacts

Construction Phase

- 4.7.1 The major construction works would be the site formation works with an approximate total area of around 0.83ha. The potential construction air quality impact would arise from the construction activities including site formation of portal areas, slope cutting for tunnel portal, excavation of the Main Access Tunnel (less than 30m long) by mechanical breaking method, spoil handling and haul roads. The erection of equipment for the three ancillary operations would involve minor construction activities such as minor excavation for foundation works and fabrication works and the works are similar for both Option 1 and 2. A maximum of approximately 49,000m³ of soil and approximately 38,000m³ of rock will be excavated during the construction period (Q3 2027 – Q3 2028). While the excavated rock would be stockpiled on site for further processing and reuse in the operation phase, the excavated soil will be disposed of at the Public Fill Reception Facilities (PFRFs). A maximum daily traffic of 40 dump trucks will be expected from each portal.
- 4.7.2 Air quality mitigation measures stipulated in *Air Pollution Control (Construction Dust) Regulation* should be implemented as far as practicable to abate the air emission from the construction activities. Regular watering should be provided at the excavation works, spoil handling and exposed areas. Stockpiling area should be covered with impervious sheets, as far as practicable. Haul roads should be paved as far as practicable, and regularly wetted to suppress the fugitive dust and gaseous emissions caused by the travelling construction vehicles. Vehicles transporting dusty spoil should be properly covered with a mechanical cover or tarpaulin sheets to avoid any dust pickup by gust during travel. Wheel washing facility should also be provided at the exit of construction site such that no residue on the body of construction vehicles would cause dust emission on public roads. With the implementation of appropriate air quality mitigation measures and good site practices, the air emission from the construction works would be reduced to minimum.
- 4.7.3 On-site use of diesel-powered engines is also the potential source for gaseous and particulate pollutants, such as NO₂, SO₂, CO, RSP, FSP and smoke. The actual no. of NRMMs would be subject to the future contractor. Fuel with sulphur content not exceeding 0.001% by weight should be used to minimise SO₂ emission in accordance with *Air Pollution Control (Fuel Restriction) Regulations*. The use of NRMMs with exempted label under *Air Pollution Control (NRMM) (Emission) Regulation* should be avoided as far as practicable. The equipment should also be properly maintained to minimize any emissions. Furthermore, the use of electric NRMMs would be explored. On-site power supply will be provided and

the use of diesel generators and machinery should be avoided as far as practicable.

- 4.7.4 The nearest ASR A05 is located less than 5m away from the nearest Project Site. Dusty activities should be located away from this ASR as far as practicable. Dust monitoring at the nearest ASR A05 will be carried out to ensure the potential dust impact complying with AQOs during the construction phase.
- 4.7.5 Major construction works of *Tsing Yi – Lantau Link* within the assessment area are mostly site formation works and construction of superstructure. The associated construction works of *Tsing Yi – Lantau Link* will tentatively commence in Year 2027 and will be completed by Year 2033, which would be concurrent with the construction period of the Project. It is anticipated that appropriate air quality mitigation measures stipulated in *Air Pollution Control (Construction Dust) Regulation*, such as regularly watering and paved haul road, would also be implemented by the contractors of this concurrent project, resulting in minimum air emission from their construction activities. It is also anticipated that the use of NRMMs with exempted label under *Air Pollution Control (NRMM) (Emission) Regulation* will be avoided as far as practicable and the use of electric NRMMs will be explored by the contractors of this concurrent project. Furthermore, on-site power supply will be provided and the use of diesel generators and machinery will be avoided as far as practicable to minimize air quality impact arising from construction machinery. Close liaison with the contractors of *Tsing Yi – Lantau Link* will be taken place during the construction phase to minimize concurrent construction activities in the proximity.
- 4.7.6 The excavated materials are anticipated to be handled over a one-year period (Q3 2027 to Q3 2028). The average daily volume of materials to be handled is relatively small and the works are therefore considered to be of a limited scale. Given the limited site formation works and minor works for facility erections, in addition to the implementation of effective air quality mitigation measures, no adverse air quality impact on nearby ASRs is anticipated. A comprehensive air quality monitoring and audit programme and regular site audits would be conducted during construction phase to ensure proper implementation of air quality mitigation measures and the compliance of AQOs.

Operation Phase (Air Quality Impact)

- 4.7.7 The cumulative air quality impact due to proposed underground quarry and above-ground ancillary operations, all other relevant emission sources, including existing and planned open roads, marine emissions, and parking sites within 500m assessment area and background concentration at representative ASRs in the operation phase have been evaluated. The predicted cumulative air pollutant concentrations at representative ASRs were predicted and are summarised in **Table 4.21** and **Table 4.22**. The detailed prediction results are presented in **Appendix 4.9**. The predictions showed that the cumulative RSP, FSP, NO₂ and SO₂ concentrations at representative ASRs would comply with the respective AQOs, except A02.

Table 4.21 Worst Predicted Cumulative RSP and FSP Concentrations at Representative ASRs in Operation Phase in Year 2028

ASR ID	10 th Highest Daily Average RSP Conc. (µg/m ³)	Annual RSP Conc. (µg/m ³)	19 th Highest Daily Average FSP Conc. (µg/m ³)	Annual FSP Conc. (µg/m ³)
	(AQO: 75 µg/m ³)	(AQO: 30 µg/m ³)	(AQO: 37.5 µg/m ³)	(AQO: 15 µg/m ³)
A02	58.40	23.27	33.98	14.95
A03	59.98	N.A. ^[1]	34.25	N.A. ^[1]
A04	63.95	23.65	34.77	14.75
A05	57.74	22.48	32.60	13.77
A06	54.68	21.07	30.79	13.17
A07	61.43	23.58	34.63	14.60
A08	60.77	23.49	34.31	14.55

Notes:

(1) Long-term impact is not applicable to A03 because it is transient in nature.

Table 4.22 Worst Predicted Cumulative NO₂ and SO₂ Concentrations at Representative ASRs in Operation Phase in Year 2028

ASR ID	19 th Highest Hourly average NO ₂ Conc. (µg/m ³)	10 th Highest Daily average NO ₂ Conc. (µg/m ³)	Annual average NO ₂ Conc. (µg/m ³)	4 th Highest 10-min average SO ₂ Conc. (µg/m ³)	4 th Highest Daily average SO ₂ Conc. (µg/m ³)
	(AQO: 200 µg/m ³)	(AQO: 120 µg/m ³)	(AQO: 40 µg/m ³)	(AQO: 500 µg/m ³)	(AQO: 40 µg/m ³)
A02	167.18	77.95	38.20 ^[1]	38.80	8.29
A03	178.83	78.73	N.A. ^[2]	33.53	8.55
A04	156.02	66.34	37.95	32.56	8.38
A05	152.25	55.47	30.92	25.05	7.48
A06	142.79	52.40	28.11	25.03	7.43
A07	149.59	64.43	35.91	32.45	8.42
A08	145.12	64.58	35.30	32.43	8.42

Notes:

(1) Air purification system (APS) with at least 10% NO₂ removal efficiency will be provided.

(2) Long-term impact is not applicable to A03 because it is transient in nature.

4.7.8 According to the discrete results of representative ASRs, the worst affected level is 1.5 metres above ground (mAG) for daily and annual RSP and FSP. The contour plots of daily and annual RSP and FSP at 1.5 mAG are illustrated in **Figure 4.03** to **Figure 4.06**. According to the contour results, exceedance was predicted within Project Site and adjacent SPs for daily and annual RSP and FSP. Exceedance in annual FSP was also predicted at sections of local roads and highways, including Sai Tso Wan Road, North West Tsing Yi Interchange and Cheung Tsing Highway. There is no existing or planned air sensitive use in these exceedance zones, except Lantau Link Administration Building (ASR A02). Appropriate dust control measures are expected to be provided at the office or workshops, if any, of the adjacent SPs by their operators due to their own dusty operations. In the Project Site, any air sensitive uses, e.g. office or workshop of the proposed ancillary operation area, shall avoid being located within exceedance zones to avoid any adverse air quality impact. It is noted that the predicted 10th highest daily RSP, annual RSP, 19th highest daily FSP and annual FSP concentrations within the Project Site is around 203 µg/m³, 108 µg/m³, 56 µg/m³ and 30 µg/m³ respectively. Should any office or workshop be located in the exceedance area, centralized air conditioning and air filtering system of at least 73% RSP removal efficiency and at least 51% FSP removal efficiency should be installed to minimize the air quality impacts and achieve AQO compliance at all air sensitive uses within the Project Site. The air filtering system and its dust removal efficiency will be further reviewed at the detailed design stage to ensure that the air quality impacts at all sensitive uses within the Project Site could comply within the AQOs.

4.7.9 According to the discrete results of representative ASRs, the worst affected level is 1.5 mAG for hourly, daily and annual NO₂. The contour plots of hourly, daily and annual NO₂ at 1.5 mAG are illustrated in **Figure 4.07** to **Figure 4.09**. According to the contour results,

exceedance in hourly NO₂ and daily NO₂ were predicted at 1.5mAG within the Project Site. Exceedance in annual NO₂ were also predicted at 1.5 mAG within Project Site, sections of local roads and highways, including Sai Tso Wan Road, North West Tsing Yi Interchange and Cheung Tsing Highway. There is no existing or planned air sensitive use in these exceedance areas, except Lantau Link Administration Building (ASR A02). Any air sensitive uses within the Project Site, e.g. office or workshop of the proposed ancillary operation areas, shall avoid being located within exceedance zones to avoid any adverse air quality impact. It is noted that the predicted maximum hourly, daily and annual NO₂ concentrations within the Project Site were around 364 µg/m³, 123 µg/m³ and 56 µg/m³ respectively. Should any office or workshop be located in the exceedance area, centralized air conditioning and air filtering system of at least 46% NO₂ removal efficiency should be installed at all air sensitive uses within the Project Site. The air filtering system and its NO₂ removal efficiency will be further reviewed at the detailed design stage to ensure that the air quality impacts at all sensitive uses within the Project Site could comply within the AQOs.

- 4.7.10 Exceedances in annual NO₂ and annual FSP were predicted at the Lantau Link Administration Building (ASR A02). Thus, a further assessment has been conducted for these pollutants at A02, and is presented in **Appendix 4.12**. The predicted annual concentrations of NO₂ and FSP at the fresh air intakes (FAIs) of A02 for the assessment years 2028 and 2030, as well as contour plots of annual NO₂ concentrations at different assessment heights, are presented in the appendices. The exceedance in annual NO₂ and FSP concentrations was predicted in Year 2028 at the fresh air intake of G/F, which were around 44.2 µg/m³ and 15.1 µg/m³, respectively. In Year 2030, the predicted annual NO₂ and annual FSP complied with the AQOs at all FAIs of A02. Therefore, APS with at least 10% NO₂ removal efficiency and 1% FSP removal efficiency will be provided on the G/F of A02 in order to achieve AQO compliance. The APS and its removal efficiencies in NO₂ and FSP will be further reviewed at the detailed design stage to ensure that the air quality impacts at A02 would comply with the AQOs.
- 4.7.11 According to the discrete results of representative ASRs, the worst affected level is 1.5 mAG in general and 5 mAG at A02 for 10-min average SO₂. For daily SO₂, the worst affected level is predicted at 1.5mAG. The contour plots of 10-min average SO₂ at 1.5 mAG and 5 mAG, and daily SO₂ at 1.5 mAG are illustrated in **Figure 4.10** to **Figure 4.12**. According to the contour results, no exceedance of 10-min and daily SO₂ is predicted in the study area.
- 4.7.12 As discussed in above **Section 4.7.7** to **Section 4.7.11**, it is anticipated that there would be no adverse air quality impact in AQO criteria pollutants due to the operation of the Project after implementing an APS with at least 10% NO₂ removal efficiency and 1% FSP removal efficiency at A02.

Operation Phase (Bitumen Emission (including bitumen fume, PAH and non-PAH hazardous air pollutants, and non-PAH organic compounds) and Odour Impact)

- 4.7.13 The 5-second odour and daily bitumen fume concentrations at the representative ASRs are predicted and are summarized in **Table 4.23**. The predictions showed that the odour and bitumen fume concentrations would comply with the respective international criteria and EIAO-TM criterion. The detailed prediction results are presented in **Appendix 4.9**.
- 4.7.14 According to the detailed results in **Appendix 4.9**, the maximum 5-second odour would occur at 5 mAG. The contour plots of the predicted highest cumulative 5-second odour concentration at different levels are illustrated in **Figure 4.24** to **4.28**. Based on these contour plots, exceedances of odour are predicted within the projected site. Any air sensitive uses within the Project Site, including the office and workshop of the proposed ancillary operation area, shall avoid being located within the exceedance zones at 1.5, 5, 10, 15, and 20 mAG shown in **Figure 4.24** to **4.28** to avoid any adverse air quality impact. It is anticipated that there is no adverse air quality impact in terms of odour due to the operation of the Project.
- 4.7.15 According to the detailed results in **Appendix 4.9**, the maximum daily bitumen fume concentration would occur at 10 mAG. The contour plots of the predicted maximum daily bitumen fume concentration at different levels are illustrated in **Figure 4.29** to **4.33**. Exceedance of bitumen fume concentration was predicted within the Project Site at 10mAG,

as shown in **Figure 4.31**. Any air sensitive uses within the Project Site, including the office and workshop of the proposed ancillary operation area, shall avoid being located within the exceedance zone of bitumen fume at 10 mAG shown in **Figure 4.31** to avoid any adverse air quality impact. It is anticipated that there is no adverse air quality impact in terms of bitumen fume due to the operation of the Project.

4.7.16 The cumulative concentrations of each individual PAH and non-PAH hazardous air pollutant and non-PAH organic compound at the representative ASRs were also predicted and are presented in **Appendix 4.9**. The predictions showed that the cumulative concentrations of each pollutant would comply with its respective concentration criteria if available according to **Table 4.2**. For each averaging period, the pollutant with the cumulative concentration closest to its respective assessment criterion, i.e. the pollutant with the highest cumulative concentration-to-criterion ratio, was selected the representative pollutant. According to the detailed results in **Appendix 4.9**, the hourly formaldehyde, 8-hour benzene, daily benzo(a)pyrene and annual formaldehyde are the representative pollutants for different averaging periods. The cumulative concentrations of the representative pollutants are summarized in **Table 4.24**. The worst affected level for hourly formaldehyde would be 5 mAG, while that for 8-hour benzene, daily benzo(a)pyrene and annual formaldehyde would be 10 mAG. The contour plots of the representative pollutants at different levels are illustrated in **Figure 4.34** to **Figure 4.44**.

4.7.17 No exceedance of hourly and annual formaldehyde and daily benzo(a)pyrene was predicted. Exceedance in cumulative concentration for 8-hour benzene was predicted at the proposed asphalt production operation area within the Project site at 10 mAG, 15 mAG, and 20 mAG as shown in **Figure 4.40** to **4.42**. There is no existing or planned air sensitive use in the exceedance zone. Any air sensitive uses within the Project Site, e.g. office or workshop of the proposed ancillary operation area, shall avoid being located within exceedance zones. It is anticipated that there is no adverse air quality impact in PAH and non-PAH hazardous air pollutants and non-PAH organic compounds due to the operation of the Project.

Table 4.23 Worst Predicted Odour and Bitumen Fume Concentrations at Representative ASRs

ASR ID	Maximum 5-second Average Odour Conc. (OU/m ³)	Maximum Daily Bitumen Fume Conc. (µg/m ³)
	(EIAO-TM: 5 OU/m ³)	(Criterion: 7 µg/m ³)
A02	0.58	0.03
A03	0.80	0.04
A04	1.03	0.06
A05	0.60	0.03
A06	0.37	0.01
A07	1.81	0.07
A08	1.42	0.07

Notes:

(1) **Bolded** value shows exceedance in the relevant criterion.

Table 4.24 Worst Predicted Representative Pollutants (Formaldehyde, Benzene and Benzo(a)pyrene) Concentrations at Representative ASRs

ASR ID	Maximum 30-min Formaldehyde Conc. (µg/m ³)	Maximum Hourly Formaldehyde Conc. (µg /m ³)	Maximum 8-hour Benzene Conc. (µg/m ³)	Maximum Daily Benzo(a)pyrene Conc. (µg/m ³)	Maximum Annual Formaldehyde Conc (µg/m ³)
	(Criterion: 100 µg/m ³)	(Criterion: 98.1 µg/m ³)	(Criterion: 3 µg/m ³)	(Criterion: 0.000873 µg/m ³)	(Criterion: 9 µg/m ³)
A02	20.6	14.6	1.92	0.000260	6.47
A03	21.0	14.9	1.95	0.000260	N.A. ^[1]
A04	21.3	15.1	2.03	0.000260	6.49
A05	20.7	14.7	1.91	0.000260	6.47
A06	20.3	14.4	1.86	0.000260	6.47
A07	22.5	16.0	2.04	0.000260	6.49
A08	21.9	15.5	2.01	0.000260	6.49

Notes:

(1) Long-term impact is not applicable to A03 because it is transient in nature.

Operation Phase (Heavy Metal)

- 4.7.18 The cumulative concentrations of each individual heavy metal at the representative ASRs were also predicted and are presented in **Appendix 4.9**. The predictions showed that the cumulative concentrations of each heavy metal would comply with its respective concentration criteria according to **Table 4.3**. For each averaging period, the pollutant with the cumulative concentration closest to its respective assessment criterion, i.e. the pollutant with the highest cumulative concentration-to-criterion ratio, was selected as the representative pollutant. According to the detailed results in **Appendix 4.9**, the hourly nickel, 8-hour Arsenic and annual nickel are the representative pollutants for different averaging periods. The cumulative concentrations of the representative pollutants are summarized in **Table 4.25** and the worst affected level for hourly nickel would be 5 mAG, while that for 8-hour arsenic and annual nickel would be 10 mAG. The contour plots of the representative heavy metals at different levels are illustrated in **Figure 4.45** to **Figure 4.56**.
- 4.7.19 Exceedances in cumulative hourly nickel concentration at 1.5 and 5 mAG, cumulative 8-hour arsenic concentration at 10, 15, and 20 mAG and cumulative annual nickel concentration at 10 and 15 mAG were predicted within or adjacent to the Project site. No existing or planned air sensitives uses exist in these exceedance zones. Any air sensitive uses within the Project Site, e.g. office and workshop of the proposed ancillary operations shall avoid being located within exceedance zones, as shown in **Figure 4.45** to **Figure 4.46**, **Figure 4.49** to **Figure 4.51**, and **Figure 4.54** to **Figure 4.55**. It is anticipated that there is no adverse air quality impact from heavy metals due to the operation of the Project.

Table 4.25 Worst Predicted Representative Pollutants (Nickel and Arsenic) Concentrations at Representative ASRs

ASR ID	Maximum Hourly Nickel Conc. ($\mu\text{g}/\text{m}^3$)	Maximum 8-hour Arsenic Conc. ($\mu\text{g}/\text{m}^3$)	Maximum Annual Nickel Conc. ($\mu\text{g}/\text{m}^3$)
	(Criterion: $0.2 \mu\text{g}/\text{m}^3$)	(Criterion: $0.015 \mu\text{g}/\text{m}^3$)	(Criterion: $0.02 \mu\text{g}/\text{m}^3$)
A02	0.026	0.011	0.004
A03	0.032	0.011	N.A. [1]
A04	0.038	0.012	0.004
A05	0.026	0.011	0.004
A06	0.020	0.011	0.004
A07	0.060	0.012	0.004
A08	0.049	0.012	0.004

Notes:

(1) Long-term impact is not applicable to A03 because it is transient in nature.

4.8 Mitigation of Adverse Environmental Impacts

Construction Phase

- 4.8.1 Air quality mitigation measures stipulated in *Air Pollution Control (Construction Dust) Regulation* and good site practices listed below should be carried out to further minimise construction air quality impact.
- Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather;
 - Use of frequent watering for particularly dusty construction areas and areas close to ASRs;
 - Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering should be applied to aggregate fines;
 - For the work sites close to the ASRs with a separation distance less than 10m, provide hoardings of not less than 3.5m high from ground level along the site boundary; for the other work sites in general, provide hoarding not less than 2.4m high from ground level along site boundary except for site entrance or exit;

- Avoid position of material stockpiling areas, major haul roads and dusty works within the construction site close to concerned ASRs;
- Avoid unnecessary exposed earth;
- Locate all the dusty activities away from any nearby ASRs as far as practicable;
- Open stockpiles should be avoided or covered. Where possible, prevent placing dusty material storage piles near ASRs;
- Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations;
- Establishment and use of vehicle wheel and body washing facilities at the exit points of the site;
- Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs;
- Imposition of speed controls for vehicles on site haul roads; and
- Instigation of an air quality monitoring and audit program to monitor the construction process in order to enforce controls and modify method of work if dusty conditions arise, and to ensure that no nearby ASRs will be subject to adverse air quality impact.

4.8.2 Guidelines stipulated in EPD's Recommended Pollution Control Clauses for Construction Contracts shall be incorporated in the contract document to abate air quality impacts. These clauses include:

- The Contractor shall observe and comply with APCO and its subsidiary regulation, particularly the *Air Pollution Control (Construction Dust) Regulation*.
- The Contractor shall undertake at all times to prevent air nuisance as a result of the construction activities.
- The Contractor shall ensure that there will be adequate water supply / storage for air quality mitigation measures.
- The Contractor shall devise and arrange methods of working and carrying out the works in such a manner so as to minimise air quality impact on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented properly.
- Before the commencement of any work, the Contractor may be required to submit the methods of working, plant, equipment and air pollution control system to be used on the site for the Engineer's inspection and approval.

4.8.3 To minimize the exhaust emission from NRMMS during the construction phase, the following measures should be applied as far as practicable:

- Connect construction plant and equipment to main electricity supply and avoid the use of diesel generators and diesel-powered equipment;
- Avoid exempted NRMMS as far as practicable; and
- Deploy electrified NRMMS as far as practicable.

Operation Phase (Air Quality Impact)

4.8.4 Blast doors and water sprayers should be provided to control the likely particulate emission from the underground quarrying. Ventilation with exhaust at the portal should also be provided in the caverns. A dust collector with dust removal efficiency of at least 85% for the excavated space should be installed at the ventilation exhaust.

4.8.5 Air quality mitigation measures stipulated in *Air Pollution Control (Construction Dust) Regulation*, good site practices, guidelines stipulated in EPD's *Recommended Pollution Control Clauses for Construction Contracts* and measures for NRMMS emissions described in **Section 4.8.1** to **Section 4.8.3** should be carried out to further minimise operation air quality impact.

4.8.6 Control measures (e.g. water sprinklers, enclosures, baghouses, SCR for fuel burner, ultra-low-sulphur diesel etc.) described in **Table 4.12** to **Table 4.16** should be incorporated in the design of underground quarrying and ancillary operations to further minimise the air quality impact.

- 4.8.7 Centralized air conditioning and air filtering system with recommended NO₂ removal efficiency of at least 46%, RSP removal efficiency of at least 73% and FSP removal efficiency of at least 51% shall be installed to minimize the air quality impacts and achieve AQO compliance for any air sensitive uses, including the office and workshop of the proposed ancillary operation areas, to be located within the exceedance zones of RSP, FSP and NO₂ as shown in **Figure 4.03** to **Figure 4.09**. The air filtering system and its air pollutant removal efficiencies will be further reviewed at the detailed design stage to ensure compliance with AQOs.
- 4.8.8 An APS with at least 10% NO₂ removal efficiency and 1% FSP removal efficiency should be provided on the G/F of A02. The APS shall be kept in place until AQO compliance at A02 can be demonstrated by a quantitative air quality impact assessment. However, APS is not required for rooms with fresh air intake located outside the exceedance zone, plant rooms, storerooms and rooms intended for transient / short-term occupancy. The APS and its NO₂ and FSP removal efficiencies will be further reviewed by the Contractor at the detailed design stage to ensure that the air quality impacts at this building could comply with the AQOs. The Contractor shall review and demonstrate the effectiveness of mitigation measures to CEDD for agreement.
- 4.8.9 With reference to **Section 4.7.7** to **Section 4.7.11**, no adverse residual air quality impact is anticipated due to the Project during the operation phase. The indicative locations of emission points as presented in **Appendix 4.2** are suggested by the Project Engineer. It is recommended to relocate emission points AP02 (Batch mix dryers, hot screen and mixer, and bitumen heating system) in the subsequent design in a manner that separation distance from each nearby ASRs is maximized.

Operation Phase (Bitumen Emission (including bitumen fume, PAH and non-PAH HAPs, and non-PAH organic compounds) and Odour Impact)

- 4.8.10 Precise temperature control, baghouse, and activated carbon filter should be incorporated in the design of asphalt production to control the bitumen and odour emission. With reference to **Section 4.7.13** to **Section 4.7.17**, there is no existing or planned air sensitive use in the exceedance zones. Any air sensitive uses within the Project Site, e.g. office or workshop of the proposed ancillary operation area, shall avoid being located within exceedance zones. No adverse impact in odour and bitumen is anticipated due to the Project during the operation phase. Thus, further mitigation measure is deemed not necessary.

Operation Phase (Heavy Metal)

- 4.8.11 Baghouse should be connected to the exhaust of the asphalt production to control the heavy metal emission. With reference to **Section 4.7.18** and **Section 4.7.19**, there is no existing or planned air sensitive use in the exceedance zone. Any air sensitive uses within the Project Site, e.g. office or workshop of the proposed ancillary operation area, shall avoid being located within exceedance zones. No adverse impact in heavy metal is anticipated due to the Project during the operation phase. Thus, further mitigation measure is deemed not necessary.

4.9 Evaluation of Residual Impacts

Construction Phase

- 4.9.1 With the implementation of control measures and the proposed air quality monitoring and auditing programme with real-time dust monitoring described in **Section 4.10**, no adverse residual impact would be expected from the construction of the Project.

Operation Phase (Air Quality Impact)

- 4.9.2 With the implementation of measures described in **Section 4.8**, no adverse residual impact would be expected from the Operation Phase of the Project.

Operation Phase (Bitumen Emission (including bitumen fume, PAH and non-PAH hazardous air pollutants, and non-PAH organic compounds) and Odour Impact)

4.9.3 No adverse residual impact is expected during the Operation Phase of the Project.

Operation Phase (Heavy Metal)

4.9.4 No adverse residual impact is expected during the Operation Phase of the Project.

4.10 Air Quality Monitoring and Audit

Construction Phase

4.10.1 Real-time dust monitoring of RSP and FSP shall be conducted during the construction phase so as to check compliance with the legislative requirements. The locations of dust monitoring will be confirmed with EPD by the Contractor at a later stage.

4.10.2 Regular site audits are recommended to be conducted during the entire construction phase of the Project so as to ensure the air quality mitigation measures, including those stipulated in *Air Pollution Control (Construction Dust) Regulation*, are implemented in order.

Operation Phase (Air Quality Impact)

4.10.3 Real-time dust monitoring of RSP and FSP shall be conducted for the first three years after the commencement of the Project so as to check compliance with the legislative requirements. Agreement with the EPD shall be sought to review if further monitoring works are required after three years of monitoring.

4.10.4 The dust monitoring of RSP and FSP shall cover the ventilation system exhaust and the cavern portals upon full capacity of the quarry operation during the operation phase. The total of these two monitoring results (i.e. concentration at exhaust and concentration at portal) shall be reviewed to confirm the validity of the adopted emission rates of cavern in the assessment. Emission rates in terms of gram per second at both exhaust and portal shall also be determined so that the validity of the adopted emission rates for assessment can be checked.

4.10.5 The details of the monitoring concerning the ancillary operations, including but not limited to the locations of monitoring, monitoring frequencies, and duration, will be confirmed with EPD under the Air Pollution Control Plan (APCP) to be prepared by the Contractor in a later stage. The monitoring shall include the exhaust(s) and/or stack(s) of the proposed asphalt production operation.

4.10.6 Regular site audits for potential air quality impact are recommended to be conducted during the entire operation phase of the Project so as to ensure the air quality mitigation measures, including those stipulated in *Air Pollution Control (Construction Dust) Regulation* are implemented in order.

4.10.7 Air quality monitoring of NO₂ and FSP concentrations at A02 shall be conducted by the Contractor after the commencement of the Project to verify the desired NO₂ and FSP removal efficiencies achievable by the APS and ensure the indoor NO₂ & FSP concentrations complying with the respective AQOs. Agreement with the EPD shall be sought at the early stage of the Project on the monitoring approach and the frequency of monitoring. The Contractor shall review and demonstrate the effectiveness of mitigation measures to CEDD for agreement.

Operation Phase (Bitumen Emission (including bitumen fume, PAH and non-PAH hazardous air pollutants, and non-PAH organic compounds) and Odour Impact)

4.10.8 Monitoring of PAH and non-PAH hazardous air pollutants, non-PAH organic compounds are recommended to be conducted at sources upon commissioning and during the first three years to ensure the concentration limits/emission rates adopted in the modelling assessment and the assessment results are valid. Agreement with the EPD shall be sought to review if further monitoring works are required after three years of monitoring.

4.10.9 Odour patrol are also recommended to be conducted in the first three years after the

commencement of the Project so as to ensure no adverse odour impact at ASRs. Agreement with the EPD shall be sought to review if further monitoring works are required after three years of monitoring.

- 4.10.10 The details of the monitoring, including but not limited to the locations of monitoring, monitoring frequencies, and duration, will be confirmed with EPD under the APCP to be prepared by the Contractor in a later stage. The monitoring shall include the exhaust(s) and/or stack(s) of the proposed asphalt production operation area.

Operation Phase (Heavy Metal)

- 4.10.11 Monitoring of heavy metal are recommended to be conducted at sources upon commissioning and during the first three years to ensure the concentration limits / emission rates adopted in the modelling assessment and the assessment results are valid. The details of the monitoring, including but not limited to the locations of monitoring, monitoring frequencies, and duration, will be confirmed with EPD under the APCP to be prepared by the Contractor in a later stage. The monitoring shall include the exhaust(s) and/or stack(s) of the proposed asphalt production operation area. Agreement with the EPD shall be sought to review if further monitoring works are required after three years of monitoring.

4.11 Conclusion

Construction Phase

- 4.11.1 Potential construction air quality impact would arise from site formation, construction of two portals, potential internal road widening and erection of equipment for ancillary activities. With the implementation of suppression measures as suggested in *Air Pollution Control (Construction Dust) Regulation*, together with the recommended air quality mitigation measures including frequent watering on active works areas, exposed areas and haul roads, and other site management measures such as good site practice and air quality monitoring and audit programme with real-time monitoring of RSP and FSP, no adverse construction air quality impact on ASRs in the vicinity of the work sites is anticipated during the construction phase.

Operation Phase (Air Quality Impact)

- 4.11.2 Cumulative air quality impact arising from proposed underground quarry and above-ground ancillary operations, adjacent industrial sources, existing and planned open roads and parking sites within 500m assessment area has been evaluated. The quantitative assessment conducted in this PER is based on the best available information on the development operation parameters, including but not limited to activity intensity, emission strength, and site layout, as detailed in **Appendix 4.2**.
- 4.11.3 The prediction results predicted exceedance in RSP, FSP and NO₂ within the Project Site. All air sensitive uses, including any office or workshop of the proposed ancillary operations, shall avoid being located within exceedance zones to avoid any adverse air quality impact. Should any office or workshop be located in the exceedance area, an air filtering system with at least 73% RSP removal efficiency, at least 51% FSP removal efficiency and at least 46% NO₂ removal efficiency will be provided at these buildings in order to achieve AQO compliance.
- 4.11.4 Exceedances in annual NO₂ and annual FSP were predicted at the Lantau Link Administration Building (ASR A02). An APS with at least 10% NO₂ removal efficiency and 1% FSP removal efficiency should be provided at this building before the commencement of the operation phase of the Project in order to achieve AQO compliance. The APS shall be kept in place until AQO compliance at A02 can be demonstrated by a quantitative air quality impact assessment. However, APS is not required for rooms with fresh air intake located outside the exceedance zone, plant rooms, storerooms, and rooms intended for transient / short-term occupancy.
- 4.11.5 With the installation of aforementioned APSs and the implementation of the proposed air quality monitoring and audit program, no adverse air quality impacts in respect of the criteria

air pollutants are anticipated during the operation phase of the Project.

Operation Phase (Bitumen Emission (including bitumen fume, PAH and non-PAH hazardous air pollutants, and non-PAH organic compounds) and Odour Impact)

- 4.11.6 Potential bitumen emission (including bitumen fume, PAH and non-PAH hazardous air pollutants, and non-PAH organic compounds) and odour impacts arising from ancillary operations have been evaluated. Exceedance of odour, bitumen fume and benzene was predicted within the Project Site. Given that no air sensitive uses within the Project Site, such as the office or workshop of the proposed operations, will be located within any exceedance zones, no adverse air quality impacts due to bitumen emissions (including bitumen fume, PAHs, non-PAH hazardous pollutants) are anticipated during the operation phase of the Project

Operation Phase (Heavy Metal)

- 4.11.7 Heavy metal impacts arising from ancillary operations have been evaluated. Exceedance in cumulative concentration for nickel and arsenic was predicted within the Project site. Given that no air sensitive uses within the Project Site, such as the office or workshop of the proposed operations, will be located within any exceedance zones, no adverse air quality impacts due to heavy metal emissions are anticipated during the operation phase of the Project.

5 NOISE

5.1 Introduction

5.1.1 This section presents the assessment findings of the potential noise impacts associated with the construction and operation of the Project.

5.2 Environmental Legislation, Standards and Assessment Criteria

5.2.1 Potential noise impacts have been assessed in accordance with the criteria and guidelines given in the HKPSG, Technical Memoranda (TMs) under the Noise Control Ordinance (NCO) (Cap. 400), and guidelines and references provided by EPD.

5.2.2 Assessment procedures, standards, and guidelines relevant to the Project are listed below:

- Chapter 9 of Hong Kong Planning Standards and Guidelines (HKPSG);
- Technical Memorandum on Noise from Percussive Piling (PP-TM);
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM);
- Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM);
- Section 3 of Recommended Pollution Control Clauses for Construction Contracts; and
- Professional Persons Environmental Consultative Committee Practice Note 1/24 (ProPECC PN 1/24) *Minimizing Noise from Construction Activities*.

Construction Phase and Operation Phase - Quarry Noise (Excluding Fixed Noise Sources)

General Construction Works

5.2.3 The NCO provides the statutory framework for noise control of construction works other than percussive piling, using powered mechanical equipment (PME) between the hours of 1900 and 0700 hours or at any time on Sundays and general holidays (that is, restricted hours). Noise control on construction activities taking place at other times is subject to the criteria for evaluating noise impact stated in ProPECC PN 1/24. The noise limit is $L_{eq} (30 \text{ minutes})$ 75dB(A) at all domestic premises, temporary housing accommodation, hostels, convalescences homes and homes for the aged; and $L_{eq} (30 \text{ minutes})$ 70dB(A) at places of public worship, courts of law, hospitals and medical clinics, and educational institutions (including kindergartens and nurseries) (with criterion of $L_{eq} (30 \text{ minutes})$ 65dB(A) during examinations). The above standards apply to uses which rely on opened windows for ventilation and are assessed at 1m from the external façade.

Construction Works During Restricted Hours

5.2.4 The NCO designates Acceptable Noise Levels (ANLs) for Noise Sensitive Receivers (NSRs) on the basis of an Area Sensitivity Rating (ASR), based on the characteristics of the area within which they are located, such as rural, village, low-density residential, or urban (**Table 5.1** refers) for the purpose of the assessments of the construction noise impact during restricted hours (i.e. between 1900 and 0700 hours or at any time on Sundays and general holidays). Within these areas, the presence of “influencing factors” (IF) (such as the presence of industrial area or major roads) can further affect the ASR and hence the ANLs.

Table 5.1 Area Sensitivity Ratings

Type of Area Containing NSR	Degree to which NSR is affected by IF		
	Not Affected	Indirectly Affected	Directly Affected
Rural area, including country parks or village type developments	A	B	B
Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C

Type of Area Containing NSR	Degree to which NSR is affected by IF		
	Not Affected	Indirectly Affected	Directly Affected
Urban area	B	C	C
Area other than those above	B	B	C

Remarks:

- (1) "Country park" means an area that is designated as a country park pursuant to section 14 of the Country Parks Ordinance;
- (2) "Directly affected" means that the NSR is at such a location that noise generated by the IF is readily noticeable at the NSR and is a dominant feature of the noise climate of the NSR;
- (3) "Indirectly affected" means that the NSR is at such a location that noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR;
- (4) "Not affected" means that the NSR is at such a location that noise generated by the IF is not noticeable at the NSR; and
- (5) "Urban area" means an area of high density, diverse development including a mixture of such elements as industrial activities, major trade or commercial activities and residential premises.

- 5.2.5 Between 1900 and 0700 hours and all day on Sundays and public holidays (i.e. restricted hours), activities involving the use of PME for the purpose of carrying out construction work are prohibited unless a construction noise permit (CNP) has been obtained. A CNP may be granted provided that the ANLs for NSRs can be complied with. ANLs are assigned depending upon the ASRs. The corresponding Basic Noise Levels (BNLs) for evening and night-time periods are given in **Table 5.2**.

Table 5.2 Construction Noise Criteria During Restricted Hours

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

- 5.2.6 Despite any description or assessment made in this PER on construction noise aspects, there is no guarantee that a CNP will be issued for the Project construction. The Noise Control Authority will consider a well-justified CNP application, once filed, for construction works within restricted hours as guided by the relevant TMs issued under the NCO. The Noise Control Authority will take into account of contemporary conditions/situations of adjoining land uses and any previous complaints against construction activities at the site before making his decision in granting a CNP. Nothing in this PER shall bind the Noise Control Authority in making his decision. If a CNP is to be issued, the Noise Control Authority shall include in it any condition he thinks fit. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution action under the NCO.
- 5.2.7 The regulatory control of all blasting operations in Hong Kong is vested in the Commissioner of Mines (CoM). The Mines/CEDD undertakes the regulatory control duties under delegated authority from CoM. The *Dangerous Goods (Control) Regulation* (Cap. 295G) also stipulates that a blasting permission granted by the CoM is required for carrying out blasting operations in a blasting site. As recommended in the *Recommended Pollution Control Clauses for Construction Contracts* by EPD, less noisy techniques (such as pulse plasma fragmentation) shall be considered when blasting is to be carried out where practical.

Operation Phase - Fixed Noise Sources

- 5.2.8 Fixed noise sources are controlled by Section 13 of the NCO and IND-TM. Noise criteria for fixed noise sources impact with a noise criterion of 5dB(A) below the appropriate ANL shown in Table 2 of the IND-TM or the prevailing background noise levels (for quiet areas with level

5dB(A) below the ANL) recommended in Table 4.1 of Chapter 9 of the HKPSG for planning purposes was applied to this Study. For the protection of noise sensitive developments against impacts from existing fixed noise sources, IND-TM has stipulated appropriate ANLs. The ANLs and criteria for different ASRs are summarised in **Table 5.3** below.

Table 5.3 ANLs at NSRs for Fixed Noise Sources

Time Period	Acceptable Noise Levels ^{(1) (2)} (ANLs) (L_{eq} (30 minutes), dB(A))		
	ASR A	ASR B	ASR C
Day (0700 to 1900 hours)	60 (55)	65 (60)	70 (65)
Evening (1900 to 2300 hours)			
Night (2300 to 0700 hours)	50 (45)	55 (50)	60 (55)

Notes:

- (1) The above standards, or equivalent, apply to uses which rely on opened windows for ventilation and are assessed at 1m from the external façade.
(2) The numbers in brackets represent the ANLs for planned fixed noise sources.

Operation Phase - Road Traffic Noise

5.2.9 For road traffic noise, the L_{10} (1 hour) criteria as stipulated in Table 4.1 of Chapter 9 of the HKPSG shall be adopted for different types of NSRs which rely on opened windows for ventilation. These criteria are summarized as follows:

Table 5.4 Noise Criteria for Road Traffic Noise

Uses	Road Traffic Noise (L_{10} (1 hour), dB(A)) ⁽¹⁾
- All domestic premises, including temporary housing accommodation - Hotels and hostels - Offices	70
- Educational institutions, including kindergartens, child care centres and all others where unaided voice communication is required - Places of public worship and courts of law	65
- Hospitals, clinics, convalescences and residential care homes for the elderly - diagnostic rooms - wards	55
Amphitheatres, and auditoria, libraries, performing arts centres and Country Parks	depend on locations and construction

Note:

- (1) The above standards apply to uses which rely on opened windows for ventilation.

5.3 Description of Baseline Condition

5.3.1 The Project is located at the northwest of Tsing Yi Island and the locality of area near the Project is predominantly as Green Belt and areas used for industrial activities (e.g. Hong Kong Cement, Hong Kong Shipyard, etc.). The dominant noise sources are the vehicular traffic from the existing Tsing Long Highway and Tsing Yi North Coastal Road, and the existing industrial activities from shipyards along Tam Kon Shan Road.

5.4 Identification of Noise Sensitive Receivers

5.4.1 In accordance with Appendix 4.1 of Chapter 9 of the HKPSG, domestic premises including temporary housing, educational institutions including kindergartens and child care centres, hospitals, medical clinics, residential care homes for the elderly, convalescent homes, places of public worship, libraries, courts of law, performing arts centres, auditoria, amphitheatres, hotels, hostels, country parks and offices are classified as NSRs.

- 5.4.2 The assessment area for noise impact assessment is defined by a distance of 300m from the Project Boundary. Based on site observation and review of the latest information including topographic maps, the OZP (i.e. Approved OZP No. S/TY/32), Layout Plans and other relevant published land use plans, including plans and drawings published by the Lands Department (LandsD), and land use and planning application approved by the Town Planning Board in the vicinity of the Project, there are no existing and planned NSRs identified within the assessment area. The nearest NSR would be Cheung Wang Estate (i.e. NSR ID N04), which is located at about 389m to the east of the Project Boundary, and would have no direct line of sight to any part of the Project Site. The nearest NSR that would have a direct line of sight to the Project Site would be Villa Cote D'azur (i.e. NSR ID N03) which is located at more than 730m to the north of the Project Boundary. The identified representative NSRs are listed in **Table 5.5**, with their locations shown in **Figure 5.01**.

Table 5.5 Representative Noise Sensitive Receivers

Representative NSR	NSR ID	Land Use	Approximate Distance from the Project Boundary, m
Sunny Villa	N01	Residential	755
Aztec Lodge	N02	Residential	894
Villa Cote D'azur	N03	Residential	737
Cheung Wang Estate	N04	Residential	389
S.K.H. Tsing Yi Chu Yan Primary School	N05	Educational	396
Mount Haven	N06	Residential	566
Queen's College Old Boys' Association Secondary School	N07	Educational	903

5.5 Identification of Potential Impacts

Construction Phase

- 5.5.1 The major construction works would include site clearance, site formation, road modification, foundation works, construction of portals and Main Access Tunnel, installation of blasting doors, installation for ancillary activities and other quarry-related equipment, and slope stabilisation works. Construction noise sources will mainly come from the use of PME such as generators, excavators and breakers, etc., for the abovementioned construction activities. The tentative plant inventory to be used for the proposed construction works are listed in **Table 5.6** below.

Table 5.6 Tentative Plant Inventory for Key Construction Activities

Key Construction Activities	Possible PME Required ⁽¹⁾
Site Clearance	- Excavator/loader - Breaker, excavator mounted - Mobile crane - Generator - Dump truck
Construction Works Associated with the Ngau Kok Wan Access Road Modification	- Rock drill, crawler mounted - Air compressor - Water pump - Grout mixer - Grout pump - Generator - Mobile crane
Site Formation and Foundation Works Associated with the Ngau Kok	- Excavator/loader - Breaker, excavator mounted - Mobile crane - Dump truck - Piling, large diameter bored, - Piling, large diameter bored, oscillatory - Piling, large diameter bored, reverse circulation drill - Generator

Key Construction Activities	Possible PME Required ⁽¹⁾	
Wan Site Formation	grab and chisel	• Mobile crane • Concrete lorry mixer • Concrete pump
Construction of Ngau Kok Wan Portal and Front Sections of Main Access Tunnels by Mechanical Excavation, Mucking Out and Installation of Blasting Doors	• Excavator/loader • Breaker, excavator mounted • Rock drill, crawler mounted ⁽²⁾ • Air compressor ⁽²⁾ • Generator ⁽²⁾ • Water pump ⁽²⁾ • Ventilation fan ⁽²⁾ • Concrete lorry mixer ⁽²⁾	• Concrete pump ⁽²⁾ • Grout mixer ⁽²⁾ • Grout pump ⁽²⁾ • Mobile crane ⁽²⁾ • Vibratory poker ⁽²⁾ • Bar bender and cutter • Dump truck • Rock bolt rig ⁽²⁾ • Shotcreting robot ⁽²⁾
Slope Stabilization Works Associated with Ngau Kok Wan Portal's Formation	• Drill rig, rotary type (diesel) • Air compressor • Grout mixer • Grout pump • Generator	• Lorry, with crane/grab
Construction of Tam Kon Shan Portal and Front Section of Main Access Tunnel by Mechanical Excavation, Mucking Out and Installation of Blasting Door	• Excavator/loader • Breaker, excavator mounted • Rock drill, crawler mounted • Air compressor • Generator • Water pump • Ventilation fan • Concrete lorry mixer	• Concrete pump • Grout mixer • Grout pump • Mobile crane • Vibratory poker • Bar bender and cutter • Dump truck, with grab
Slope Stabilization Works Associated with the Tam Kon Shan Portal's Formation	• Drill rig, rotary type (diesel) • Air compressor • Grout mixer • Grout pump • Generator	• Lorry, with crane/grab
Ancillary Activities / Other Plants Associated with Underground Quarrying	• Mobile crane • Concrete lorry mixer • Concrete pump • Vibratory poker • Drill, percussive	• Bar bender and cutter • Lorry • Dump truck, with grab

Notes:

- (1) Quiet equipment or quality powered mechanical equipment (QPME) would be adopted where applicable and practicable.
- (2) The PMEs would also be adopted for other construction activities related to the Main Access Tunnel and formation of the Underground Quarry Site (prior to primary rock crusher), including the D&B and the quarrying activities mentioned in **Section 5.5.4** to **Section 5.5.6**, during the operation phase.

5.5.2 The Contractor should develop a reasonable construction programme to avoid noisy construction works during restricted hours, particularly for aboveground works. Based on the latest information, the proposed construction works during the construction phase will not be conducted during restricted hours, i.e. the time between 1900 and 0700 hours on all days, and any time on general holidays, including Sundays. In case any construction works are to be carried out during restricted hours, a CNP shall be obtained under the NCO (**Section 5.2.5** refers).

- 5.5.3 Based on the latest information, most of the proposed construction works will occur during non-restricted hours. However, certain underground construction activities, such as hole drilling, scaling, and mucking out, may need to be performed during restricted hours to align with the blasting cycle. It is the Contractor's responsibility to ensure the compliance with the NCO and the relevant TMs. The Contractor should submit CNP application to the Noise Control Authority and abide by any conditions stated in the CNP, should one be issued.

Operation Phase - Quarry Noise (Excluding Fixed Noise Sources)

- 5.5.4 The D&B method would be adopted for excavating the Main Access Tunnel and caverns. Given the hard rock conditions at the Project Site and its proven cost-effectiveness, the D&B method is considered as the most suitable approach compared to other quieter construction methods.
- 5.5.5 Pursuant to Section 2 of Part I of NCO, any work in connection with or for the extraction from the earth of any matter whatsoever is defined as construction works. Hence, hole drilling before blasting and quarrying activities (e.g. rock mucking from blast faces, further rock breaking for easier transportation as necessary and stabilisation works for the Underground Quarry Site, including rock bolt installation and shotcreting) after blasting during the operation phase are considered construction works. Based on the latest information, construction activities during the operation phase may need to be performed during restricted hours to facilitate the blasting cycle. It is the Contractor's responsibility to ensure the compliance with the NCO and the relevant TMs. The Contractor should submit CNP application to the Noise Control Authority and abide by any conditions stated in the CNP, should one be issued.
- 5.5.6 The instant noise from the blasting operation is considered to be minimal in terms of noise annoyance, as the duration of blasting is very short and infrequent and that all the identified representative NSRs would have no direct line of sight to the blasting operation. There is no statutory procedure or criteria under the NCO for assessing the blasting noise impact. However, the regulatory control of all blasting operations in Hong Kong is vested in the CoM and delegated to the Mines/CEDD. The *Dangerous Goods (Control) Regulation* (Cap. 295G) stipulates that a blasting permission granted by the CoM is required for carrying out blasting operations in a blasting site. Mines/CEDD is also responsible for carrying out audit inspections at times with the works activities of the Contractor.

Operation Phase - Fixed Noise Sources

- 5.5.7 During the operation phase, fixed noise sources from the Project will include rock crushing, concrete production, and asphalt production at Ngau Kok Wan Portal and an enclosed conveyor belt system used for on-site transportation at Wok Tai Wan Works Area. Tentative locations of the proposed major fixed noise sources are shown in **Figure 5.02**.
- 5.5.8 As detailed in **Section 2.3.5**, the operation phase of the Project will tentatively commence in Q4 2028. Generally, fixed noise sources will not operate during night-time hours. However, the asphalt production may need to operate during restricted hours when night-time road works require asphalt.

Operation Phase - Road Traffic Noise

- 5.5.9 As confirmed by the Project Engineer, there will be no construction of new roads and local roads to be carried out under the Project. The only road work planned is minor widening near the entrance of access road within the Project Site. The tentative traffic routes to and from the Project Site would be generally via Tsing Long Highway, Lantau Link, Tsing Yi North Coastal Road, Northwest Tsing Yi Interchange and the access road. Road traffic noise impact on the nearby NSRs would be generated from the traffic of the existing road network and the Project-related traffic due to the additional road traffic associated with the operation of the Underground Quarry Site.

5.6 Evaluation of Potential Impacts

Construction Phase and Operation Phase - Quarry Noise (Excluding Fixed Noise Sources)

- 5.6.1 As mentioned in **Section 5.4.2**, there is no NSR identified within the assessment area, and the nearest NSRs are Cheung Wang Estate and S.K.H. Tsing Yi Chu Yan Primary School, which are located more than 380m away from the Project Boundary and are substantially screened by natural terrain. At the north of the Project Boundary, the nearest NSRs that have direct line of sight to the portal areas are Sunny Villa and Villa Cote D'azur, which are located more than 700m away from the Project Boundary. In view of the considerable buffer distances between the Project Boundary and the nearest NSRs, the noise impact incurred by the construction activities of the Project is thus considered insignificant. Nevertheless, good site practices and quiet construction methods as presented in **Section 5.7** should be followed.
- 5.6.2 During the drilling activities prior to blasting, potential ground-borne noise impacts arising from breaking the rock face by rock drills and hydraulic breakers may affect the NSRs in the close vicinity of the works sites. However, there are no existing and planned NSRs located within 300m from the works sites of D&B, i.e. the Main Access Tunnel and the Underground Quarry Site. Given that the large separation distance between the works sites of D&B and the NSRs, along with the limited number of PMEs to be involved (**Table 5.6** refers), ground-borne noise impact from the drilling activities would be insignificant.
- 5.6.3 As the rock excavation will be conducted underground and the duration of blasting is very short and infrequent, associated noise impacts from the underground construction activities and rock blasting are also not expected. Nevertheless, blasting should be carried out outside restricted hours as far as practicable, and the blasting schedule should be submitted to the concerned authority for approval prior to its implementation. Firing the blast should be carried out by a person who possesses a valid Mine Blasting Certificate issued by Mines/CEDD.
- 5.6.4 There will be transport of rock products to and from the Underground Quarry Site by road traffic. Based on the latest information, the total hourly traffic induced from the Project during peak hour is approximately 74 vehicles and the details are provided in **Table 5.8**. Nevertheless, there are no existing or planned NSRs within the 300m assessment area, and the induced road traffic would be insignificant compared to the traffic volume of nearby existing heavily trafficked roads (e.g. Tsing Long Highway and Tsing Yi North Coast Road). Considering only minimal additional traffic would be generated and no NSRs are located within the assessment area, additional road traffic noise impact induced by the Project is anticipated to be minimal.

Cumulative Construction Noise Impact

- 5.6.5 As presented in **Section 3.2**, the construction phase of Tsing Yi – Lantau Link and Public Housing Development near Tsing Yi Road West will overlap with the construction activities of the Project from 2027 to 2035, resulting in potential cumulative construction noise impact.
- 5.6.6 Tsing Yi – Lantau Link is located to the southwest of the Project Boundary. The nearest NSR is Aztec Lodge, which is located over 850m from both the Project Boundary and Tsing Yi – Lantau Link. Given the large separation distance between the construction activities and the NSR, the cumulative noise impact is anticipated to be insignificant.
- 5.6.7 Public Housing Development near Tsing Yi Road West is located to the southeast of the Project Boundary. The nearest NSRs to this concurrent project (e.g. Mount Haven, Leung Chik Wai Memorial School, and Ching Wah Court) are all situated over 500m from the Project Boundary and have no direct line of sight to the Project's construction activities. Therefore, cumulative noise impact is expected to be insignificant.

Operation Phase - Fixed Noise Sources

- 5.6.8 Potential fixed noise sources impact has been assessed qualitatively at the representative NSRs based on the locations of the proposed fixed noise sources as shown in **Figure 5.02**. Factors including the separation distance between the NSRs and proposed fixed noise sources, and direct line of sight have been considered. Potential fixed noise sources impact at representative noise sensitive receivers has been evaluated and is presented in **Table 5.7**

below.

Table 5.7 Potential Fixed Noise Sources Impact

NSR ID	Land Use	Approximate Horizontal Distance to the Nearest Major Fixed Noise Source	Potential Screening Effect (Y/N)	Potential Fixed Noise Sources Impact
N01	Residential	Rock Crushing – 837m	N	In view of the large separation distance of more than 830m between N01 and the nearest fixed noise source, no adverse fixed noise sources impact from the Project to N01 is anticipated.
N02	Residential	Asphalt Production – 908m	N	In view of the large separation distance of more than 900m between N02 and the nearest fixed noise source, no adverse fixed noise sources impact from the Project to N02 is anticipated.
N03	Residential	Rock Crushing – 747m	N	In view of the large separation distance of more than 740m between N03 and the nearest fixed noise source, no adverse fixed noise sources impact from the Project on N03 will be anticipated.
N04	Residential	Rock Crushing – 1,088m	Y (No direct line of sight to the fixed noise sources due to the screening provided by natural terrain)	In view of the large separation distance of more than 1km between N04 and the nearest fixed noise source along with the screening effect, no adverse fixed noise sources impact from the Project to N04 is anticipated.
N05	Educational	Rock Crushing – 1,074m	Y (No direct line of sight to the fixed noise sources due to the screening provided by natural terrain)	In view of the large separation distance of more than 1km between N05 and the nearest fixed noise source along with the screening effect, no adverse fixed noise sources impact from the Project to N05 is anticipated.
N06	Residential	Rock Crushing – 1,297m	Y (No direct line of sight to the fixed noise sources due to the screening provided by natural terrain)	In view of the large separation distance of more than 1km between N06 and the nearest fixed noise source along with the screening effect, no adverse fixed noise sources impact from the Project to N06 is anticipated.

NSR ID	Land Use	Approximate Horizontal Distance to the Nearest Major Fixed Noise Source	Potential Screening Effect (Y/N)	Potential Fixed Noise Sources Impact
N07	Educational	Rock Crushing – 1,393m	Y (No direct line of sight to the fixed noise sources due to the screening provided by natural terrain)	In view of the large separation distance of more than 1km between N07 and the nearest fixed noise source along with the screening effect, no adverse fixed noise sources impact from the Project to N07 is anticipated.

- 5.6.9 As presented in **Table 5.7**, there is no NSR identified within the assessment area, and the representative NSRs that have direct line of sight to the portals are Sunny Villa, Aztec Lodge and Villa Cote D'azur (i.e. N01 – N03), which are located at more than 740m away from the nearest fixed noise sources at Ngau Kok Wan Portal. While the conveyor belt system at Wok Tai Wan Works Area would be enclosed, the nearest NSR that has direct line of sight to it, i.e. Aztec Lodge, is of over 1km separation distance. In view of a considerable separation distance between the major fixed noise sources and the respective nearest NSRs, the noise impact arising from the operation of fixed noise sources is therefore considered insignificant. Nonetheless, additional mitigation measures such as selection of quieter plants, regular maintenance of the plants (as detailed in **Section 5.7.7**) should be implemented to further minimise any associated fixed noise source impacts.

Operation Phase - Road Traffic Noise

- 5.6.10 Based on the information provided by the Project Engineer, the major vehicle types to be induced by the Project would be heavy vehicles (e.g. trucks) which will be used for delivering rock products. Based on the anticipated maximum production capacity of concrete and asphalt during the operation of the Project, the estimated maximum traffic flows of concrete trucks entering and leaving for the proposed concrete production will be approximately 50 vehicles/hour; while the estimated maximum traffic flows of dump trucks entering and leaving for the proposed asphalt production will be approximately 16 vehicles/hour. There are also traffic flows of vehicles (i.e. other heavy vehicles, private cars/taxis, and light goods vehicles) with approximately a total of 8 vehicles/hour to support the operation. Details of the traffic breakdown are summarised in **Table 5.8** below.

Table 5.8 Estimated Number of Vehicles during the Operation of the Project

Vehicle Type	Predicted Maximum Traffic (vehicles/hour)
<i>Heavy Vehicles</i>	
Dump Truck (for asphalt production)	16
Concrete Truck (for concrete production)	50
Other Heavy Vehicle (for operational support) (e.g. Waste Disposal Truck, Bitumen Tanker etc.)	2
Sub-Total	68
<i>Light Vehicles</i>	

Vehicle Type	Predicted Maximum Traffic (vehicles/hour)
Private Car / Taxi (for operational support)	4
Light Goods Vehicle (for operational support)	2
Sub-total	6
Total	74

- 5.6.11 Considering only minimal of additional traffic would be generated and no NSRs are located within the assessment area, additional road traffic noise impact induced by the Project is anticipated to be minimal.

5.7 Mitigation Measures

Construction Phase and Operation Phase - Quarry Noise (Excluding Fixed Noise Sources)

- 5.7.1 In view of the large separation distance with approximately over 700m between the representative NSRs and the aboveground works areas (i.e. portal areas), the localised nature of the construction activities involved, no adverse noise impact would be anticipated during the construction phase and operation phase. Nonetheless, in order to minimise the potential noise nuisance to nearby NSRs due to the construction activities of the Project, following mitigation measures which were confirmed to be practicable and feasible by the Project Engineer, should be considered by the contractors:

- Good site practices to limit noise emissions at the sources;
- Use of quieter PME and quieter construction methods (if practicable); and
- Adoption of construction noise barriers / enclosures to screen noise from construction plants.

Good Site Practice

- 5.7.2 Although the noise mitigation effects are not easily quantifiable, and the benefits may vary with site conditions and operating conditions, good site practices are easy to implement and do not impact upon the works schedule. The site practices listed below should be continually followed during construction of the Project:

- Only well-maintained PME should be operated on-site and should be serviced regularly during construction works;
- Silencers or mufflers on construction equipment should be utilised (if appropriate) and should be properly maintained during the construction;
- Mobile plant, if any, should be sited as far away 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;
- Plant known to emit noise strongly in one direction should, wherever possible, be orientated to direct noise away from the nearby NSRs;
- Material stockpiles and other structures should be effectively utilised, wherever practicable, in screening noise from on-site construction activities; and
- The Contractor should devise, arrange methods of working and carry out the works to minimise noise impacts to the surrounding environment, and should provide experienced personnel with suitable training to ensure all these measures are implemented properly.

Use of Quieter PME and Quieter Construction Methods

- 5.7.3 The use of quieter PME is considered a practicable means to mitigate the construction noise impact. Quieter PME refers to those PMEs which could deliver the same output but have sound power levels lower than those specified in the GW-TM. In addition, the use of quieter PME could make reference to the EPD's website of Quality PME (e.g. air compressor, mobile

crane, excavator, generator, etc.).

- 5.7.4 A number of quieter construction methods should also be evaluated and reviewed by the Project Engineer to see if they are practicable to be adopted as an additional measure for construction activities. With due consideration of the quieter construction methods listed in EPD's website⁶, the following are examples of quieter construction methods / equipment that could be applicable to this Project:

- Quieter type wire saw or hydraulic crusher can be adopted for site clearance and site formation works;
- Press-in piling method for the piling works; and
- Use of pulse plasma rock fragmentation technology for blasting.

The Contractor should further review the practicality of these construction methods and adopt, where appropriate, in the construction and operation phases of the Project.

Adoption of Construction Noise Barriers / Enclosures

- 5.7.5 Movable noise barriers that can be placed close to the construction equipment and moved along with the PME are effective for screening noise. A typical design which has been used locally is a wooden framed barrier with a cantilevered upper portion of superficial density no less than 10kg/m² on a skid footing with internal sound absorptive lining. The length of the noise barrier should be at least five times greater than its height. This measure is particularly effective for low level zone of NSRs. A longer cantilevered top cover would be required to achieve screening benefits at upper floors of NSRs. The Contractor should be responsible for the design and actual position of the movable noise barriers with due consideration given to the position and size of the PME, and the requirement of intercepting the line-of-sight from the NSRs to the PME, as well as ensuring that the barriers should have no opening and gap. It is anticipated that properly designed noise barriers would achieve a 5dB(A) reduction for mobile PME and a 10dB(A) reduction for static PME. The use of full enclosure could also be considered to shelter the noise from relatively stationary plants (e.g. air compressors and generators). The minimum surface density of the enclosure panel should achieve 14kg/m² and be lined with noise absorptive material internally. These enclosures could provide about 10 – 15dB(A) noise reduction.

- 5.7.6 Guidelines stipulated in EPD's *Recommended Pollution Control Clauses for Construction Contracts* should also be incorporated in the future contract document to ensure proper implementation of noise mitigation measures and minimisation of the potential construction noise impact arising from the Project. In addition, appropriate requirements and recommendations on the practices for minimizing construction noise mentioned in ProPECC PN1/24 *Minimizing Noise from Construction Activities* should also be included in the contract document and followed by the Contractor.

Operation Phase - Fixed Noise Sources

- 5.7.7 In view of the large separation distance with approximately >700m between the NSRs and the nearest proposed fixed noise sources, no adverse fixed noise sources impact would be expected during the operation of fixed noise sources. Nonetheless, in order to minimise the potential noise nuisance to nearby NSRs, the following noise reduction measures, which are confirmed to be practical by the Project Engineer, are recommended to be considered during the detailed design and tender phases:

- Selection of quieter plant;
- Provision of silencer, enclosure, acoustic louvres or acoustic doors;
- Locating fixed plants / louvres away from any NSRs;
- Avoiding unloading of rubbles or aggregates in the cold feed system to minimise any noise impact generation from metal surface during the asphalt production process in

⁶ https://www.epd.gov.hk/epd/misc/construction_noise/contents/index.php/en/home2/quieter-construction-methods.html

- night-time; and
- Development and implementation of a regularly scheduled plant maintenance programme so that equipment is properly operated and serviced in order to maintain controlled level of noise. The programme should be implemented by properly trained personnel.

Operation Phase - Road Traffic Noise

- 5.7.8 As mentioned in **Section 5.6.10** to **Section 5.6.11**, the traffic flow induced by the operation of the Project would be minimal. The change in road traffic noise level from the operation of the Project would therefore be insignificant, and no mitigation measures are required. However, in order to minimise the potential road traffic noise nuisance on the NSRs which are located in the vicinity of the operation traffic routes (**Section 5.5.9** refers), it is recommended to adopt administrative measures to ensure that the traffic from the Project would be routed to the nearby highways instead of the local roads in Tsing Yi such as Tam Kon Shan Road where practicable to minimize the noise impact due to the additional traffic flow.
- 5.8 Conclusion
- 5.8.1 The potential noise impacts from the construction works of the Project would mainly be related to the use of PME. As there is no NSR identified within the 300m assessment area from the Project Boundary, noise impact from construction activities is anticipated to be insignificant. Nevertheless, good site practices and quiet construction methods as presented in **Section 5.7** should be followed.
- 5.8.2 During the operation phase, fixed plant noise would be generated from fixed noise sources of the Project, such as crushing, concrete production and asphalt production at Ngau Kok Wan Portal and the conveyor belt system. Given that there is no NSR identified within the assessment area, noise impact from fixed noise sources is anticipated to be insignificant.
- 5.8.3 Given only minimal amount of additional traffic would be generated from the operation of TYNUQ and no NSR are located within the assessment area, in addition to the adoption of proper traffic routes, road traffic noise impact arising from the operation of the Project is anticipated to be insignificant.

6 WATER QUALITY

6.1 Introduction

6.1.1 This section identifies and assesses the potential water quality impacts associated with the construction and operation of the Project. Practical water quality mitigation measures have been proposed, where necessary, to mitigate the potential water quality impacts.

6.2 Environmental Legislation, Standards and Assessment Criteria

Water Quality Objectives under the Water Pollution Control Ordinance

6.2.1 The *Water Pollution Control Ordinance* (WPCO) (Cap. 358) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the WPCO and its subsidiary legislation, Hong Kong waters are divided into ten water control zones (WCZs) and four supplementary WCZs. Corresponding statements of water quality objectives (WQOs) are stipulated for different water regimes (marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones) in the WCZs based on their beneficial uses. The Project is located within the Western Buffer WCZ and the respective WQOs are listed in **Table 6.1**.

Table 6.1 Summary of Water Quality Objectives for Western Buffer WCZ

Parameters	Criteria	Subzone
Aesthetic appearance	(a) There should be no objectionable odours or discolouration of the water.	Whole Zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	
	(d) There should be no recognisable sewage-derived debris.	
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	
	(f) The water should not contain substances which settle to form objectionable deposits.	
Bacteria	(a) The level of <i>Escherichia coli</i> should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones
	(b) The level of <i>Escherichia coli</i> should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in 1 calendar year. Samples should be taken at least 3 times in 1 calendar month at intervals of between 3 and 14 days.	Recreation Subzones
	(c) The level of <i>Escherichia coli</i> should be less than 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Water Gathering Ground Subzones
	(d) The level of <i>Escherichia coli</i> should not exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of	Other Inland Waters

Parameters	Criteria	Subzone
	between 7 and 21 days.	
Colour	(a) Human activity should not cause the colour of water to exceed 30 Hazen units.	Water Gathering Ground Subzones
	(b) Human activity should not cause the colour of water to exceed 50 Hazen units.	Other Inland Waters
Dissolved Oxygen (DO)	(a) The level of dissolved oxygen should not fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine Waters excepting Fish Culture Subzones
	(b) The level of dissolved oxygen should not be less than 5 mg per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Fish Culture Subzones
	(c) The level of dissolved oxygen should not be less than 4 mg per litre.	Water Gathering Ground Subzones and Other Inland Waters
pH	(a) The pH of the water should be within the range of 6.5–8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit.	Marine Waters
	(b) Human activity should not cause the pH of the water to exceed the range of 6.5–8.5 units.	Water Gathering Ground Subzones
	(c) Human activity should not cause the pH of the water to exceed the range of 6.0–9.0 units.	Other Inland Waters
Temperature	Human activity should not cause the natural daily temperature range to change by more than 2.0°C.	Whole Zone
Salinity	Human activity should not cause the natural ambient salinity level to change by more than 10%.	Whole Zone
Suspended Solids (SS)	(a) Human activity should neither cause the natural ambient SS level to be raised by more than 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine Waters

Parameters	Criteria	Subzone
	(b) Human activity shall not cause the annual median of SS to exceed 20 mg per litre.	Water Gathering Ground Subzones
	(c) Human activity should not cause the annual median of suspended solids to exceed 25 mg/L.	Other Inland Waters
Ammonia	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole Zone
Nutrients	(a) Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine Waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine Waters
5-Day Biochemical Oxygen Demand (BOD ₅)	(a) The 5-day biochemical oxygen demand should not exceed 3 mg per litre.	Water Gathering Ground Subzones
	(b) The 5-day biochemical oxygen demand should not exceed 5 mg per litre.	Other Inland Waters
Chemical Oxygen Demand (COD)	(a) The chemical oxygen demand should not exceed 15 mg per litre.	Water Gathering Ground Subzones
	(b) The chemical oxygen demand should not exceed 30 mg per litre.	Other inland Waters
Toxic Substances	(a) Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole Zone
	(b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole Zone
Turbidity	Waste discharges should not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Remark:

(1) The table is referenced to the Statement of Water Quality Objectives (Western Buffer Water Control Zone).

Technical Memorandum on Effluent Discharge Standard (DSS-TM)

6.2.2

Under Section 21 of the WPCO, *Technical Memorandum on Standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* was issued to regulate the physical, chemical and microbial quality of effluents. Any effluent discharge into the foul sewers, stormwater drains, inland and coastal waters during the construction and operation phase of the proposed Project should comply with the stipulated standards in the DSS-TM. The discharge standards into foul sewers leading into the Government's sewage treatment plants are shown in **Table 6.2** and **Table 6.3** below.

Table 6.2 Standards for effluents discharged into Foul Sewers leading into Government Sewage Treatment Plants

Determinand	Flow rate (m ³ /day)												
	≤10	>10 and ≤100	>100 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	43	43	43	43	43	43	43	43	43	43	43	43	43
Suspended Solids	1200	1000	900	800	800	800	800	800	800	800	800	800	800
Settleable Solids	100	100	100	100	100	100	100	100	100	100	100	100	100
BOD	1200	1000	900	800	800	800	800	800	800	800	800	800	800
COD	3000	2500	2200	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Oil & grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Barium	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	4	4	4	3	1.5	1.5	1	1	1	1	1	1	1
Nickel	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other toxic metals individually	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1
Total toxic metals	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1000	1000	1000	1000	1000	1000	1000	900	800	600	600	600	600
Total nitrogen	200	200	200	200	200	200	200	100	100	100	100	100	100
Total phosphorus	50	50	50	50	50	50	50	25	25	25	25	25	25
Surfactants (total)	200	150	50	40	30	25	25	25	25	25	25	25	25

Remark: All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated.

Table 6.3 Standards for effluents discharged into Foul Sewers leading into Government Sewage Treatment Plants with Microbial Treatment

Determinand	Flow rate (m ³ /day)												
	≤10	>10 and ≤100	>100 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
Copper	1.5	1	1	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1	0.05

Remark: All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated.
Standards in this table apply in place of those in **Table 6.2** for the corresponding determinand.

Practice Note for Professional Persons on Construction Site Drainage

- 6.2.3 EPD has issued a ProPECC PN 2/24 *Construction Site Drainage* to control site runoff and wastewater generated during the construction phase of proposed project. Guidelines for handling and disposal of construction discharges are provided. Practice outlines in ProPECC PN 2/24 should be closely followed during the construction phase to minimise potential water quality impacts associated with construction site drainage.

Practice Note for Professional Persons on Drainage Plans

- 6.2.4 ProPECC PN 1/23 on *Drainage Plans* provides guidelines and practices for handling, treatment and disposal of various effluent discharges to stormwater drains and foul sewers. The design of site drainage and disposal of various site effluents generated within the proposed project should follow the relevant guidelines and practices as given in the ProPECC PN 1/23.

Hong Kong Planning Standards and Guidelines (HKPSG)

- 6.2.5 The HKPSG, Chapter 9 (Environment), provides additional information on regulatory guidelines against water pollution for sensitive uses such as aquaculture and fisheries zones, bathing waters and other contact recreational facilities.

6.3 Description of Baseline Condition

6.3.1 The baseline water quality condition of marine water was established from the marine water quality monitoring data routinely collected by EPD in the Western Buffer WCZ. A summary of EPD monitoring data collected in 2024 for EPD monitoring station in Western Buffer WCZ (WM4) is tabulated in **Table 6.4**. Location of the monitoring station is shown in **Figure 6.01**.

6.3.2 The Western Buffer WCZ fully met the WQOs in 2024. Since the commissioning of the Harbour Area Treatment Scheme Advance Disinfection Facilities in 2010, the *E. coli* level in the WCZ has decreased substantially.

Table 6.4 Summary Statistics of 2024 Marine Water Quality in Western Buffer WCZ

Parameter		Tsing Yi (West)	WPCO WQO
		WM4	
Temperature (°C)		24.3 (19.8 - 28.6)	Change due to water discharges not to exceed 2°C
Salinity		30.3 (22.2 - 33.4)	Change due to water discharges not to exceed 10% of natural ambient level
Dissolved Oxygen (mg/L)	Depth Average	5.3 (4.1 - 7.9)	Not less than 4mg/L for 90% of samples
	Bottom	4.7 (2.0 - 7.7)	Not less than 2mg/L for 90% of samples
Dissolved Oxygen (% Saturation)	Depth Average	75 (59 - 105)	Not available
	Bottom	65 (29 - 103)	Not available
pH		7.8 (7.3 - 8.1)	To be in the range 6.5 - 8.5, change due to waste discharge not to exceed 0.2
Secchi Disc Depth (m)		2.4 (1.2 - 5.4)	Not available
Turbidity (NTU)		4.8 (0.3 - 7.4)	Not available
Suspended Solids (SS) (mg/L)		5.1 (2.6 - 8.0)	Not to raise the natural ambient level by 30%
5-day Biochemical Oxygen Demand (BOD ₅) (mg/L)		0.9 (<0.1 - 2.6)	Not available
Ammonia Nitrogen (NH ₃ -N) (mg/L)		0.098 (0.021 - 0.220)	Not available
Unionised Ammonia (mg/L)		0.003 (<0.001 - 0.007)	Annual mean not to exceed 0.021 mg/L

Parameter	Tsing Yi (West)	WPCO WQO
	WM4	
Nitrite Nitrogen (NO ₂ -N) (mg/L)	0.029 (0.005 - 0.082)	Not available
Nitrate Nitrogen (NO ₃ -N) (mg/L)	0.241 (0.035 - 0.620)	Not available
Total Inorganic Nitrogen (TIN) (mg/L)	0.37 (0.12 - 0.69)	Annual mean depth-averaged TIN not to exceed 0.4 mg/L
Total Kjeldahl Nitrogen (mg/L)	0.26 (0.16 - 0.38)	Not available
Total Nitrogen (TN) (mg/L)	0.53 (0.29 - 0.85)	Not available
Orthophosphate Phosphorus (PO ₄) (mg/L)	0.014 (0.003 - 0.024)	Not available
Total Phosphorus (TP) (mg/L)	0.09 (0.04 - 0.20)	Not available
Silica (as SiO ₂) (mg/L)	1.36 (0.18 - 3.80)	Not available
Chlorophyll-a (µg/L)	4.0 (0.5 - 16.8)	Not available
<i>E. coli</i> (count/100mL)	610 (130 - 13000)	Secondary contact recreation subzones and fish culture subzones: Not to exceed 610 count/100mL for geometric mean
Faecal Coliforms (count/100mL)	1200 (280 - 23000)	Not available

Remarks:

- (1) Unless otherwise specified, data presented are depth-averaged values calculated by taking the means of three depths: Surface, Mid-depth, Bottom.
- (2) Data presented are annual arithmetic means of depth-averaged results except for *E. coli* and faecal coliforms which are annual geometric means.
- (3) Data in brackets indicate the ranges.

6.4 Identification of Water Sensitive Receivers

6.4.1 As the Project is located in Western Buffer WCZ, any discharge from the Project during the construction and operation phases would potentially affect the marine water quality.

6.4.2 Water sensitive receivers (WSRs) within 500m from the Project Boundary that may have a bearing on the environmental acceptability of the Project are identified and listed in **Table 6.5** below, and are illustrated in **Figure 6.01**.

Table 6.5 List of Water Sensitive Receivers

ID	Description	Approximate Distance from the Project Boundary
W1	Channelised watercourse adjacent to Ngau Kok Wan	Partially within Project Boundary
W2	Natural watercourses downslope from Yau Kom Tau	Partially within Project Boundary
W3	Channelised watercourse near Tam Kon Shan Road	162m
W4	Channelised watercourse near Lantau Link Visitor's Centre	<10m
W5	Channelised watercourses downslope from Wok Tai Wan	Partially Within Project Boundary
W6	Down-the-slope drainage in Wok Tai Wan	<10m
W7	Horizontal drainage along Wok Tai Wan	Partially Within Project Boundary

ID	Description	Approximate Distance from the Project Boundary
W8	Semi-natural watercourse west of Cheung Tsing Highway	453m
W9	Natural watercourses downslope from Shek Wan	131m
W10	Natural watercourses downslope from Liu To Shan	85m
W11	Natural watercourses downslope from Wok Tai Wan	Partially Within Project Boundary
W12	Natural downslope watercourses below Cheung Wang Estate	446m
Others		
Secondary Contact Recreation Subzone		409m

6.5 Assessment Methodology

6.5.1 The assessment area for the water quality impact covers all areas within 500m from the Project Boundary in the Western Buffer WCZ. The WSRs that may be affected by the Project have been identified. Potential sources of water quality impact that may arise during the construction and operation phases of the Project have been described. This task included identifying pollutants from point discharges and non-point sources that could affect the quality of surface water bodies. All of the identified sources of potential water quality impact have then been evaluated and their impact significance is determined. The mitigation measures to reduce any identified adverse impacts on water quality to acceptable levels have been recommended accordingly.

6.6 Identification, Prediction and Evaluation of Potential Impacts

Construction Phase

6.6.1 The Project would only involve land-based construction works. Potential sources of water quality impact associated with the construction of the Project have been identified as below:

- Wastewater from general construction activities;
- Construction site runoff;
- Accidental spillage and potential contamination of surface water and groundwater;
- Construction works in close proximity to inland water;
- Removal or diversion of watercourses;
- Groundwater from contaminated areas and contaminated site runoff; and
- Sewage effluent from construction workforce.

Wastewater from General Construction Activities

6.6.2 Wastewater discharged from construction activities should be controlled to prevent direct discharge to the neighbouring inland waters and storm drains. Such effluent may include wastewater generated from wheel washing of site vehicles at site entrances, discharge of debris and rubbish such as packaging, construction materials and refuse. With the adoption of the guidelines and good site practices for handling and disposal of construction discharges as specified in **Sections 6.7.1 to 6.7.14**, the potential water quality impacts associated with construction activities would be minimal.

Construction Site Runoff

6.6.3 Potential pollution sources of site runoff may include:

- Runoff and erosion of exposed bare soil and earth, drainage channel, earth working area and stockpiles;
- Release of any bentonite slurries, concrete washings and other grouting materials with construction runoff or stormwater;
- Wash water from dust suppression sprays and wheel washing facilities; and

- Fuel, oil and lubricants from maintenance of construction vehicles and equipment.

- 6.6.4 During rainstorms, site runoff would wash away the soil particles on unpaved land and areas with topsoil exposed. The runoff is generally characterized by high concentrations of suspended solids (SS). Release of uncontrolled site runoff would increase the SS levels and turbidity in the nearby water environment. Site runoff may also wash away contaminated soil particles and, therefore, cause water pollution.
- 6.6.5 Wind-blown dust would be generated from exposed soil surfaces in the works areas. It is possible that wind-blown dust would fall directly onto the nearby water bodies when a strong wind occurs. Dispersion of dust within the works areas may increase the SS levels in surface runoff, causing a potential impact on the nearby sensitive receivers.
- 6.6.6 It is important that proper site practice and good site management are followed to prevent runoff with high level of SS from entering the surrounding waters. Best Management Practices (BMPs) in controlling construction site discharges are recommended for this Project. With the implementation of BMPs to control runoff and drainage from the construction site, disturbance of water bodies would be avoided and deterioration in water quality would be minimal.

Accidental Spillage and Potential Contamination of Surface Water and Groundwater

- 6.6.7 The use of engine oil and lubricants, and their storage as waste materials, has the potential to create impacts on the water quality of adjacent inland water bodies or storm drains if spillage occurs. Waste oil may infiltrate into the surface soil layer, or run off into local watercourses, increasing hydrocarbon levels. Groundwater pollution may also arise from the improper use of chemicals and petroleum products within the Underground Quarry Site where groundwater infiltrates into the area. Infiltration of groundwater may occur in areas where there are faults and/or fissures in the rock mass. The spillage of petroleum products and chemicals should be handled properly to avoid any potential surface water or groundwater contamination. The potential impacts could, however, be mitigated by practical mitigation measures and good site practices as given in **Sections 6.7.15 to 6.7.17**. Hence, adverse impact on water quality is not anticipated.

Construction Works in Close Proximity to Inland Water

- 6.6.8 Construction activities in proximity of the channelized watercourse adjacent to Ngau Kok Wan (W1), channelized watercourse near Lantau Link Visitor's Centre (W4), and watercourses and drainages near Wok Tai Wan (W5, W6, W7 & W11) may pollute these WSRs due to potential release of construction wastes, construction wastewater and site runoff which are generally characterised by high concentration of SS and elevated pH. Adoption of good housekeeping and mitigation measures would reduce the generation of construction wastes and potential water pollution. The implementation of measures to control runoff and drainage water is important for the construction works adjacent to the inland watercourses in order to prevent runoff and drainage water with high levels of SS from entering the water environment. With the implementation of mitigation measures as specified in ProPECC PN 2/24 *Construction Site Drainage* and ETWB TC(W) No. 5/2005 *Protection of Natural Streams/rivers from Adverse Impacts Arising from Construction Works* as given in **Sections 6.7.18 to 6.7.19**, it is anticipated that water quality impacts would be minimal.

Removal or Diversion of Watercourses

- 6.6.9 The construction of Ngau Kok Wan Portal may involve the diversion of the channelized watercourse adjacent to Ngau Kok Wan (W1) partially. A conveyor belt system would be established in the northern part of the Wok Tai Wan Works Area and stockpiling area will be provided at the remaining Wok Tai Wan Works Area. The conveyor belt system will be slightly elevated and supported by discrete foundations (e.g. piers), without being placed directly on the watercourses nearby (i.e. W5, W7 & W11). The provision of the proposed conveyor belt system will not involve any diversion, removal, and modification to the existing watercourses. Furthermore, the conveyor system will be fully enclosed to prevent any material spillage to the watercourses nearby. Thus, no adverse water quality impact is anticipated at watercourses W5, W7 & W11. Although sections of the natural watercourses downslope from

Yau Kom Tau (W2) are located within the Underground Quarry Site and the proposed Main Access Tunnel of Ngau Kok Wan Portal, no aboveground construction works would be conducted and thus, removal or diversion of the watercourse is deemed not necessary. The impact on the watercourse is anticipated to be negligible.

- 6.6.10 Removal or diversion of existing surface watercourse, if needed, should be undertaken before portal construction. Any flow diversion works should be conducted after full completion of the new flow paths, such that all of the flow modification works and the subsequent surface construction works can be conducted within a dry zone and physically separated from the downstream watercourse. Intercepting and diverting surface water (e.g. rain runoff and streams) from entering the Underground Quarry Site by building upstream dams or intercepting channels at site boundaries would be required to minimize the potential for water contamination from exposed rock and waste soil and rock.
- 6.6.11 With adoption of the recommended mitigation measures for protection of downstream water quality from diversion and removal of watercourses as described in **Sections 6.7.20 to 6.7.22**, there would be no significant sediment and contaminant release to the downstream water.

Groundwater from Contaminated Areas and Contaminated Site Runoff

- 6.6.12 It is identified that the reclaimed land portion of Ngau Kok Wan Portal may have potential land contamination issues. Proper land contamination remediation and mitigation measures are proposed in **Section 8.7**. Any contaminated material disturbed, or material which comes into contact with the contaminated material, has the potential to be washed with site runoff into the drainage system. Excavated contaminated materials should be properly stored, housed and covered to avoid the generation of contaminated runoff. Open stockpiling of contaminated materials should not be allowed. Any contaminated site runoff should be properly treated and disposed of. The water quality impact would be minimal with the mitigation measures for contaminated site runoff recommended in **Sections 6.7.23 to 6.7.25**.

Sewage Effluent from Construction Workforce

- 6.6.13 During the construction phase, the workforce on site will generate sewage effluents, which are characterized by high levels of BOD, ammonia and *E.coli* counts. Potential water quality impacts on the local drainage and fresh water systems may arise from these sewage effluents, if uncontrolled. As suggested by the *Reference Materials on Construction Site Facilities for Workers* issued by the Construction Industry Council in 2025 (Section 2.2b), the number of toilet facilities provided on site should be at a ratio of not less than 1 for every 30 workers. Adequate and sufficient chemical toilets should be provided in the works area to handle sewage from the construction workforce and a licensed collector should be employed to clean and maintain the chemical toilets on a regular basis. No discharge of sewage to the inland water should be allowed. With mitigation measures as recommended in **Sections 6.7.26 to 6.7.27** to be adopted as far as practicable, it is unlikely that sewage generated from the construction workforce would have a significant water quality impact.

Operation Phase

- 6.6.14 Potential sources of water quality impact during the operation phase of the Project include:
- Vessel discharge;
 - Wastewater from underground quarrying;
 - Surface runoff from portal areas and access road; and
 - Groundwater infiltration and change in groundwater levels.

Vessel Discharge

- 6.6.15 Vessels would be used during the operation of the Underground Quarry Site for delivering raw material and rock products to and from the Site using existing barging points near Ngau Kok Wan Portal or Wok Tai Wan Works Area. Discharges from vessels may include uncontaminated deck drainage, potentially contaminated drainage from machinery spaces and sewage.

- 6.6.16 Deck drainage is likely to be uncontaminated and is not likely to impact water quality. Other sources of possible impacts to water quality may arise from discharges of hydrocarbons (oil and grease) from machinery space drainage, BOD and microbiological constituents associated with sewage. All vessels should follow the *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78) to prevent and minimise the release of these water pollutants to the marine environment. Possible impacts associated with barge discharges are therefore considered to be negligible.
- 6.6.17 Potential water quality impact due to loading and unloading activities is expected to be insignificant with proper implementation of all recommended mitigation measures as specified in **Section 6.7.28**.
- 6.6.18 No solid wastes should be permitted to be disposed overboard and thus water quality impacts from such sources could be eliminated.

Wastewater from Underground Quarrying

- 6.6.19 The wastewater generated from the operation of the Underground Quarry Site would include the sewage from the users, the industrial wastewater from the ancillary operations (i.e. rock crushing, concrete production and asphalt production) and wastewater from the formation or operation of the Underground Quarry Site. The means of disposal of wastewater generated from the operation of the Underground Quarry Site would be determined by the future Contractor of the Underground Quarry Site.
- 6.6.20 Sewage generated from the workforce at the Underground Quarry Site in the operation phase is characterised by high levels of BOD, ammonia and *E. coli*. The industrial wastewater generated from the ancillary operations, including concrete production, rock processing and asphalt production would contain high levels SS. During the formation of the Underground Quarry Site and the Main Access Tunnel, wastewater would be generated during the process of rock bolt installation and on-site dust suppression. The wastewater generated by quarrying would also contain high SS concentrations.
- 6.6.21 Concrete production will be set at Ngau Kok Wan Portal to produce fresh concrete. All wastewater and slurry generated will be collected by an on-site wastewater / slurry treatment system which is comprised of reclaimers and filter press systems. Treated effluent will be recycled and reused for production processes and dust control measures (e.g. wheels watering) at the Project Site. No treated effluent from the concrete production activities will be discharged to nearby natural watercourses. Besides, no wastewater will be generated from the operations of asphalt production and rock processing in view of the high operating temperature and operation mode (i.e. no water would be involved), respectively.
- 6.6.22 The sewage should be properly disposed of and treated, and no wastewater from the ancillary activities should be discharged to nearby natural watercourses. The wastewater from the formation of the Underground Quarry Site can be minimised with mitigation measures and good site practices as recommended in **Sections 6.7.29 to 6.7.30**. Therefore, no adverse water quality impact is therefore anticipated.

Surface Runoff from Portal Areas and Access Road

- 6.6.23 Surface runoff to be generated by the Project is known as non-point source pollution. The at-grade portals and paved access road will increase the amount of surface runoff. The presence of oil, grease and grit on the surfaces of the portals and road could be washed into the nearby drainage system or even directly into the marine water during a rainfall event due to their close proximity to the shoreline. Surface runoff generated from these areas may contain debris, refuse and dust from the operation activities. Practices that cleaning agents used for washing streets may also affect the quality of the nearby receiving water environment. However, the potential water quality impacts could be mitigated by measures recommended in **Sections 6.7.31 to 6.7.34**. Therefore, no adverse water quality impact is therefore anticipated.

Groundwater Infiltration and Change in Groundwater Levels

6.6.24 Excavation of the Underground Quarry Site and the Main Access Tunnels may result in infiltration of groundwater. The major concern from these construction activities would be the increase in site runoff and the associated potential drawdown of groundwater in any soil and aquifer layers. Groundwater infiltration would affect the construction works and infiltrated water would carry away silt and other contaminants from site into the site drainage. Considerations given in **Sections 6.7.35 to 6.7.40** should be taken in designing the Underground Quarry Site to minimize the infiltration of groundwater and the potential impacts from the change in groundwater level. Therefore, no adverse water quality impact is anticipated.

6.7 Mitigation Measures

Construction Phase and Construction Works during Operation Phase

General Construction Activities

6.7.1 Control of potential water quality impact arising from general construction works should be achieved based on the following principles:

- Prevent or minimise the likelihood of pollutants (generated from construction activities) being in contact with rainfall or runoff; and
- Abate pollutants in the stormwater surface runoff prior to the discharge of surface runoff to the nearby water bodies.

6.7.2 These principal objectives should be achieved by implementation of the BMPs of mitigation measures in controlling water pollution. The guidelines for handling and disposal of construction site discharges as detailed in the ProPECC PN 2/24 *Construction Site Drainage* should be followed, where applicable. All effluent discharged from the construction site should comply with the standards stipulated in the DSS-TM. The following measures are recommended to protect water quality of the inland and coastal waters, and should be sufficient to adequately control site discharges so as to avoid water quality impacts when properly implemented.

Construction Site Runoff

6.7.3 Surface runoff 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 during construction works to properly direct stormwater to such silt removal facilities. Perimeter channels should be provided on site boundaries where necessary to intercept storm runoff from outside the Project Site so that it will not wash across the Project Site. Catchpits and perimeter channels should be constructed in advance of site formation works and earthworks.

6.7.4 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. Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements in order to provide adequate hydraulic capacity of all drains.

6.7.5 Construction works should be programmed to minimize soil excavation works in rainy seasons (April to September). If soil excavation 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 temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Intercepting channels should be provided (e.g. along the crest / edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements should always be in place in such a way that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.

6.7.6 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. Appropriate drainage, like intercepting channels,

should be provided where necessary.

- 6.7.7 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 foundation excavations should be discharged into storm drains via silt removal facilities.
- 6.7.8 Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms.
- 6.7.9 Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm runoff from getting into foul sewers. Discharge of surface runoff into foul sewers must always be prevented in order not to unduly overload the foul sewerage system.

Boring and Drilling Water

- 6.7.10 Water used in ground boring and drilling for site investigation (SI) or rock / soil anchoring should be re-circulated as far as practicable after sedimentation. When there is a need for final disposal, the wastewater should be treated in compliance with WPCO requirements before discharging into storm drains via silt removal facilities.

Wheel Washing Water

- 6.7.11 All vehicles and plants should be cleaned before they leave a construction site to minimise the deposition of earth, mud, and debris on roads. A wheel washing bay should be provided at every site exit of practicable and washwater 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 backfill to reduce vehicle tracking of soil and to prevent site runoff from entering public road drains.

Rubbish and Litter

- 6.7.12 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 Project Site. It is recommended to clean the construction site on a regular basis.

Effluent Discharge

- 6.7.13 There is a need to apply to EPD for a discharge licence for the discharge of effluent from the construction site under the WPCO. The discharge quality should meet the requirements specified in the discharge licence. All the runoff and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the DSS-TM. The beneficial uses of the treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., can minimise water consumption and reduce the effluent discharge volume. If monitoring of the treated effluent quality from the works areas is required during the construction phase of the Project, the monitoring should be carried out in accordance with the relevant WPCO licence.

Acid Cleaning, Etching and Pickling Wastewater

- 6.7.14 Acidic wastewater generated from acid cleaning, etching, pickling and similar activities should be neutralised to within the pH range of 6 to 10 before discharging into foul sewers.

Accidental Spillage and Potential Contamination of Surface Water and Groundwater

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

- 6.7.16 Any service shop and maintenance facilities should be located on hard standings within a bunded area with sumps and oil interceptors provided. Maintenance of vehicles and equipment involving activities with the potential of leakage and spillage should only be undertaken within the areas appropriately equipped to control these discharges.
- 6.7.17 Disposal of chemical wastes should be carried out in compliance with the WDO. The *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* published under the WDO details the requirements to deal with chemical wastes. General requirements are given as follows:
- Suitable containers should be used to hold the chemical wastes to avoid leakage or spillage during storage, handling and transport;
 - Chemical waste containers should be suitably labelled, to notify and warn the personnel who are handling the wastes, to avoid accidents; and
 - Storage area should be selected at a safe location on site and adequate space should be allocated to the storage area.

Construction Works in Close Proximity to Inland Water

- 6.7.18 The practices outlined in ETWB TC (Works) No. 5/2005 *Protection of Natural Streams/rivers from Adverse Impacts Arising from Construction Works* should also be adopted where applicable to minimise the water quality impacts on any natural streams or surface water systems. Relevant mitigation measures from the ETWB TC (Works) No. 5/2005 are listed below:
- The use of less or smaller construction plants may be specified in areas close to the watercourses to reduce the disturbance to the surface water;
 - Temporary storage of materials (e.g. equipment, chemicals and fuel) and temporary stockpile of construction materials should be located well away from any water courses when carrying out of the construction works;
 - Stockpiling of construction materials and dusty materials should be covered and located away from any watercourses;
 - Construction debris and spoil should be covered up and / or disposed of as soon as possible to avoid being washed into the nearby water receivers;
 - Proper shoring may need to be erected in order to prevent soil or mud from slipping into the watercourses; and
 - The proposed works should preferably be carried out during the dry season, when flow in the stream/river is low.
- 6.7.19 The main practices provided in the ProPECC PN 2/24 (**Sections 6.7.1 to 6.7.14** refer) should also be implemented by the Contractor during the construction phase.

Removal or Diversion of Watercourses

- 6.7.20 The construction works for the removal and diversion of watercourses should be undertaken within a dry zone. Construction works at watercourses should be undertaken only after the flow diversion or dewatering operation is fully completed to avoid water flow in the works area. Dewatering of watercourses should be performed by diverting the water flow to new or temporary water paths. The permanent or temporary water paths for carrying the diverted flow from existing watercourses to be removed should be constructed and completed before the dewatering of that existing watercourse. Construction of all the proposed permanent and temporary water paths should be undertaken in a dry zone prior to receiving any water flow.
- 6.7.21 The Contractor should provide a dry zone for all the construction works to be undertaken in watercourses as described above or using other approved methods as appropriate to suit the works condition. The flow diversion works should be conducted in a dry season, where possible, when the flow in the watercourses is low. The wastewater and ingress water from the site should be properly treated to comply with the WPCO and the DSS-TM before discharge.

- 6.7.22 The site practices outlined in the ProPECC PN 2/24 *Construction Site Drainage* (**Sections 6.7.1 to 6.7.14** refer) and ETWB TC (Works) No. 5/2005 *Protection of Natural Streams/ivers from Adverse Impacts Arising from Construction Works* (**Section 6.7.18** refers) should be adopted for the proposed demolition or diversion of watercourses where applicable.

Groundwater from Contaminated Areas and Contaminated Site Runoff

- 6.7.23 Remediation of contaminated land should be properly conducted following the recommendations proposed under **Section 8.7**. Any excavated contaminated material and exposed contaminated surface should be properly housed and covered to avoid the generation of contaminated runoff. Open stockpiling of contaminated materials should not be allowed. Any contaminated runoff generated under the construction process should be properly collected and diverted to wastewater treatment facilities (WTF) as necessary. The WTF should deploy suitable treatment processes (e.g. oil interceptor or activated carbon) to reduce the pollution level to an acceptable standard and remove any prohibited substances, such as total petroleum hydrocarbon, to an undetectable range. All treated effluent from the WTF should meet the requirements as stated in the DSS-TM and should be either discharged into the foul sewers or tankered away for proper disposal.
- 6.7.24 No direct discharge of groundwater from contaminated areas should be allowed. Prior to any excavation works within the potentially contaminated areas, the baseline groundwater quality in these areas should be reviewed based on the relevant past SI data and any additional groundwater quality measurements to be performed should make reference to *Guidance Note for Contaminated Land Assessment and Remediation*, and the review results should be submitted to EPD for examination. If the review results indicate that the groundwater generated from the excavation works would be contaminated, the contaminated groundwater should be either properly treated or properly recharged into the ground in compliance with the requirements of the DSS-TM. If wastewater treatment is to be deployed for treating the contaminated groundwater, the wastewater treatment unit should deploy a suitable treatment process (e.g. oil interceptor or activated carbon) to reduce the pollution level to an acceptable standard and remove any prohibited substances, such as total petroleum hydrocarbon, to an undetectable range. All treated effluent from the wastewater treatment plant should meet the requirements as stated in the DSS-TM and should be either discharged into the foul sewers or tankered away for proper disposal.
- 6.7.25 If deployment of wastewater treatment is not feasible for handling the contaminated groundwater, groundwater recharging wells should be installed as appropriate for recharging the contaminated groundwater back into the ground. The recharging wells should be selected at places where the groundwater quality will not be affected by the recharge operation as indicated in the DSS-TM. The baseline groundwater quality should be determined prior to the selection of the recharge wells and a working plan should be submitted to EPD for agreement. Pollution levels of groundwater to be recharged should not be higher than the pollutant levels of ambient groundwater at the recharge well. Groundwater monitoring wells should be installed near the recharge points to monitor the effectiveness of the recharge wells and to ensure that no likelihood of an increase of groundwater level and transfer of pollutants beyond the Project Site. Prior to recharge, free products should be removed as necessary by installing the petrol interceptor. The Contractor should apply for a discharge licence under the WPCO through the Regional Office of EPD for groundwater recharge operation or discharge of treated groundwater.

Sewage Effluent from Construction Workforce

- 6.7.26 The construction workforce on site will generate sewage. Sufficient chemical toilets should be provided in the works area, with a licensed collector employed to clean the chemical toilets on a regular basis.
- 6.7.27 Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the surrounding environment. Regular environmental audit of the construction site could provide effective control of any malpractices and encourage continual improvement of environmental performance on site. It is anticipated that sewage generation during the construction phase of the Project would not cause a water pollution

problem after undertaking all required measures.

Operation Phase

Vessel Discharge

- 6.7.28 Adverse impacts related to marine water quality are not expected to arise from marine vessel operation, provided that good site practices are strictly followed. Recommendations for good site practices during operation of the Project include:
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
 - All vessels must have a clean ballast system;
 - All vessels should be well maintained and inspected before use to limit any potential discharges to the marine environment;
 - No direct discharge of sewage/grey wastewater should be allowed;
 - No soil waste should be allowed to be disposed overboard;
 - Loading and/or unloading of barges and hoppers should be controlled to prevent splashing of material into the surrounding water. Barges or hoppers should not be filled to a level that will cause overflow of materials or polluted water during loading or transportation;
 - Proper storage, handling and disposal of chemicals and oils to prevent the release into the marine environment; and
 - All vessels should follow the MARPOL 73/78 to prevent and minimise the release of water pollutants to the marine environment.

Wastewater from Underground Quarrying

- 6.7.29 The means of wastewater disposal would be determined by the future Contractor of the Underground Quarry Site. There is no existing sewerage system available within and in the vicinity of the Project. The nearest sewerage system is located over 600m away to the east of the Tam Kon Shan Portal. The sewage generated by the user should be treated by the on-site sewage treatment facility or tanked away by registered waste collectors. For the tankering option, the domestic sewage would be collected by proposed chemical toilets and holding tanks, and transferred off-site by a registered waste collector. Then, sewage will be transported to sewage treatment works for further treatment. The destination will be decided by the Water Pollution Control Ordinance (WPCO) license holder, ideally, Tsing Yi Preliminary Treatment Works. The industrial wastewater and polluted runoff generated from the concrete production, the machinery workshop/depot, stockpiling area, etc. should be collected by on-site WTF and reused as far as practicable. A discharge license under the WPCO should be obtained from EPD before commencing discharge, and the discharge quality should meet the standard as stipulated in the DSS-TM. Besides, no wastewater will be generated from the operations of asphalt production and rock processing in view of the high operating temperature and the operation modes (i.e. no water would be involved).
- 6.7.30 Water used in rock drilling for D&B excavation should be re-circulated as far as practicable after sedimentation. When there is a need for final disposal, the wastewater should be treated in compliance with WPCO requirements before discharging into storm drains via silt removal facilities.

Surface Runoff from Portal Areas and Access Road

- 6.7.31 All ancillary activities associated with the future underground quarrying and aboveground activities will mainly be within the portal areas. BMPs for stormwater discharges recommended for the underground quarrying are given below:

Design measures to Control Erosion and Runoff Quantity

- 6.7.32 Exposed surface should be avoided within the Project Site to minimise soil erosion. The Project Site should either be hard paved or covered by landscaping area where appropriate to reduce soil erosion.

- 6.7.33 The drainage system should be designed to avoid any case of flooding based on the 1-in-50-year return period.

Management Measures

- 6.7.34 Good management measures such as regular cleaning and sweeping of road surface/open areas are suggested. The road surface/open area cleaning should also be carried out prior to the occurrence of a rainstorm.

Groundwater Infiltration and Change in Groundwater Levels

- 6.7.35 Appropriate measures during the development of the Underground Quarry Site should be implemented to minimise groundwater infiltration. The water control strategies include:

- Probing Ahead: As normal practice, the Contractor would undertake rigorous probing of the ground ahead of excavation works to identify zones of significant water inflow. The probe drilling results should be evaluated to determine specific grouting requirements in line with the underground space. In such zones of significant water inflow that could occur as a result of discrete, permeable features, the intent would be to reduce overall inflow by means of cut-off grouting executed ahead of the underground space.
- Pre-grouting: Where water inflow quantities are excessive, pre-grouting would be required to reduce the water inflow into the underground space. The pre-grouting could be achieved via a systematic and carefully specified protocol of grouting.

- 6.7.36 In principle, the grout pre-treatment would be designed on the basis of probe hole drilling ahead of the underground space.

- 6.7.37 In the event of excessive infiltration being observed as a result of the excavation works, even after incorporation of the water control strategies, post-grouting should be applied as far as practicable as described below:

- Groundwater drawdown would be most likely due to inflows of water into the underground space that have not been sufficiently controlled by the pre-grouting measures. Where this occurs, post-grouting will be undertaken. While unlikely to be required in significant measure, such a contingency should be allowed for reduction in permeability of the underground space surround (by grouting) to limit inflow to acceptable levels.

- 6.7.38 The practical groundwater control measures stated above are proven technologies and have been extensively applied in other past projects. These measures or other similar methods, as approved by the Supervising Officer to suit the works condition, should be applied to minimise the groundwater outflow.

- 6.7.39 In case seepage of groundwater occurs, groundwater should be pumped out from works areas and discharged to the storm drains via silt traps. Uncontaminated groundwater from dewatering processes should also be discharged to the storm drains via silt removal facilities. The discharges during quarrying should comply with WPCO requirements.

- 6.7.40 As recommended in Geoguide 4 *Guide to Cavern Engineering, Second Edition (2018)* published by CEDD, ground investigation (GI) should cover an assessment of the hydrogeology of the site, including the hydraulic connectivity of the discontinuities that may intercept the proposed cavern. It is also necessary to assess the need for ground treatment and groundwater control works. Assessment of the impact of groundwater drawdown caused by an inflow should be made in establishing the inflow limit. It is necessary to define the seasonal variations in the groundwater levels, in particular knowledge of the lowest levels. Where large groundwater drawdowns are expected in the soil, it is necessary to carry out detailed assessments of the potential impacts and whether excessive ground settlements are likely to occur as a result of groundwater drawdown. In the geotechnical / hydrogeological assessment, the potential drawdown of the groundwater level and alteration of hydrogeological regime is evaluated for both the short-term scenario (such as during

construction) as well as the long-term scenario (for the operation phase). Grouting should be considered in the excavation design to control the groundwater inflow within the established inflow limit.

6.8 Conclusion

- 6.8.1 Potential water quality impacts from the construction and operation of the Project have been identified. Minor water quality impacts are associated with land-based construction and the operation of the underground quarrying. In the construction phase, water quality impacts may result from wastewater from general construction activities, construction site runoff, accidental spillage and potential contamination of surface water and groundwater, construction works in proximity of inland water, removal or diversion of watercourses, groundwater from contaminated areas and contaminated site runoff, and sewage effluent from on-site construction workforce. During the operation phase, the potential water quality impacts would include vessel discharge, wastewater from underground quarrying, surface runoff from portal areas and access road, and groundwater infiltration and change in groundwater levels. Proper mitigation measures have been recommended such that the water quality impacts could be controlled to comply with the WPCO standards. Therefore, no adverse water quality impact is anticipated in both the construction and the operation phases of the Project.

7 WASTE MANAGEMENT

7.1 Introduction

7.1.1 This section discusses the waste management implications during the construction and operation phases of the Project and evaluates the potential environmental impacts that may result from handling, storage, collection, transportation and disposal of the wastes.

7.2 Environmental Legislation and Guidelines

7.2.1 The following legislation relates to the handling, storage, collection, transportation and disposal of wastes in Hong Kong:

- Waste Disposal Ordinance (WDO) (Cap. 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C);
- Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap. 354N);
- Land (Miscellaneous Provisions) Ordinance (Cap. 28);
- Building Ordinance (Cap. 123); and
- Public Health and Municipal Services Ordinance (Cap. 132BK) – Public Cleansing and Prevention of Nuisances Regulation.

7.2.2 The WDO prohibits unauthorised disposal of wastes. Under the WDO, waste can be disposed of only at designated waste disposal facilities licensed by the EPD.

7.2.3 Issued under the WDO, the *Chemical Waste (General) Regulation* administers the possession, storage, collection, transport and disposal of chemical wastes. EPD has also issued three statutory guidelines, namely *A Guide to the Chemical Waste Control Scheme* (2016), *A Guide to the Registration of Chemical Waste Producers* (2024) and *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (1992), which detail how the Contractor should comply with the regulations on chemical wastes.

7.2.4 *Public Cleansing and Prevention of Nuisances Regulation* provides control on illegal tipping of wastes on unauthorised (unlicensed) sites. The illegal dumping of wastes can lead to a fine and/or imprisonment.

7.3 Assessment Methodology

7.3.1 The waste management implications have been assessed in accordance with the following approaches:

- Identification of construction and operation activities that could give rise to waste arising;
- Estimation of types and quantities of the waste to be generated;
- Review of the opportunities for waste reduction and reuse;
- Identification of disposal options for each type of waste; and
- Assessment of potential impacts from the management of the waste with respect to potential hazards, air and odour emissions, noise, and wastewater discharge.

7.3.2 Prior to considering the disposal options for various types of wastes, opportunities for reducing waste generation, on-site or off-site reuse and recycling have been evaluated. Measures which can be taken in the planning and design phases (e.g. by modifying the design approach) and in the construction phase for maximising waste reduction have been separately considered.

7.3.3 After considering all the opportunities for reducing waste generation and maximising reuse, the types and quantities of the waste required to be disposed of have been estimated and the disposal options for each type of waste have been described. The disposal method recommended for each type of waste has taken into account the result of the assessment. The impacts caused by handling (including stockpiling, labelling, packaging and storage), collection, transportation and reuse / disposal of waste have been addressed and appropriate

mitigation measures have been proposed.

7.4 Identification and Evaluation of Waste Management Implications

- 7.4.1 Wastes generated from the construction and operation of the Project would include construction and demolition (C&D) materials, general refuse from the on-site workforce, and chemical wastes from the maintenance of construction plants, equipment and vehicles. These wastes may have the potential to give rise to environmental impacts if not properly handled and disposed of.

Construction and Demolition (C&D) Materials

- 7.4.2 It is envisaged that C&D materials, including inert and non-inert, would be generated during site formation, slope stabilization works, excavation works at tunnel portals, including slope cutting works, tunnelling works for the Main Access Tunnel, and installation for ancillary activities. Inert C&D materials will comprise mainly soil and rock, while non-inert C&D materials will include vegetation, plastic and equipment wrappings, etc.
- 7.4.3 Based on the current design scheme, the estimated quantities of C&D materials to be generated during construction phase are summarised in **Table 7.1** below.

Table 7.1 Estimated Quantities of C&D Materials During Construction Phase

Description	Approx. Quantities of C&D Materials (m ³)		
	Inert C&D Materials		Non-inert C&D Materials
	Soil	Rock ⁽¹⁾	
C&D Materials Generated	49,000	38,000	605
On-site Reuse	2,000	38,000	-(3)
Disposal Outlet	Public Fill Reception Facilities ⁽²⁾	-	Designated Landfill Site (For example: NENT Landfill)

Notes:

- (1) The rock generated will be processed within the Site for reuse in ancillary operations.
(2) Delivery of inert C&D materials to Public Fill Reception Facilities (PFRFs) should be agreed with CEDD.
(3) Non-inert C&D materials will be recycled as far as possible before being disposed of at a designated landfill.

- 7.4.4 The inert C&D materials, including soil and rock, could be sorted and reused on-site as far as practicable before delivery to PFRFs (e.g. Tuen Mun Area 38 Fill Bank) for reuse by other projects, subject to designation by the Public Fill Committee of CEDD. Non-inert C&D materials will also be reused or recycled on-site wherever possible before being disposed of at a designated landfill site (for example: NENT Landfill). Details of proposed mitigation measures are provided in **Section 7.5** below.
- 7.4.5 During the operation phase, the ancillary operations, including concrete production and asphalt production, would produce solid waste such as dried cements and dust paste. During concrete production, waste concrete and slurry with an estimated total quantity of approximate 40 tonnes per day would be generated due to improper concrete pouring and handling. To minimise the waste generation, these wastes will be diverted to the concrete recycling machine to separate aggregates and slurry after washing for recycle and reuse on-site. The slurry will be directed into the settlement pits and the aggregates will be reused for the production of subbase material. The final solid waste, including an estimated quantity of approximately 15 tonnes per day of dried cement collected by filter press, could not be further reused on-site and will be delivered to PFRFs by trucks. Besides, all rejected asphalt concrete during asphalt production will be crushed and recycled for production use. The excess filler generated will be conditioned as dust paste with an estimated volume of approximately 8 tonnes per day. The generated dust paste could not be further reused on-site and will be delivered to PFRFs for beneficial reuse in other projects. With proper handling, recycling and reuse of solid waste, no adverse waste management impact is expected during the operation of the Project.

- 7.4.6 By the end of the operation phase, the Project will involve dismantling of temporary structures and removal of ancillary equipment. Given the limited scale of works involved, the quantity of C&D materials generated is anticipated to be insignificant (approximately 1,000 cubic meters, of which approximately 80% is non-inert C&D materials and the rest is inert C&D materials). Any inert C&D materials generated (e.g. concrete) will be sorted for on-site reuse or delivered to designated PFRFs, as appropriate. Non-inert C&D materials (e.g. scrap metals and plastic), if any, will also be sorted and handled following the same principles to be adopted in the construction phase, with priority given to on-site reuse or recycling before disposal at designated landfills. With proper implementation of waste management measures, no adverse environmental impact is expected during the decommissioning phase.

General Refuse

- 7.4.7 General refuse, such as food waste, waste paper, empty containers, etc., would be generated from the construction workforce and Contractor of the TYNQU during construction and operation phases. Such refuse should be properly managed so that intentional or accidental release to the surrounding environment does not occur. Effective collection of site wastes would be required to prevent waste materials being blown around by wind, flushed or leached into nearby waters, or creating an odour nuisance, visual impacts, or pest and vermin problems. Waste storage areas should be well maintained and cleaned regularly.
- 7.4.8 Based on a generation rate of 0.65kg per worker per day and around 100 workers/staff to be deployed, around 65kg of general refuse would be generated daily during the construction and operation phases of the Project.
- 7.4.9 With the implementation of good waste management practices as mentioned in **Section 7.5**, adverse environmental impacts are not expected to arise from the handling, storage, transportation and disposal of general refuse generated by the workers.

Chemical Wastes

- 7.4.10 The maintenance and servicing of construction plants, equipment and vehicles would involve the use of a variety of chemicals and generate chemical wastes. The possible chemical waste that would be generated during the construction and operation phases includes:
- Spent lubrication oils and cleansing fluids from plant maintenance;
 - Spent hydraulic fluids and waste fuel from plant operation;
 - Scrap batteries from vehicle maintenance; and
 - Spent paint, cleaners and solvents from equipment maintenance.
- 7.4.11 Chemical wastes arising during the construction and operation phases 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*. The potential hazards include:
- Toxic effects on the workforce;
 - Adverse impacts on water quality and aquatic biota from spills; and
 - Fire hazards.
- 7.4.12 It is difficult to quantify the amount of chemical wastes that would arise from the construction and quarrying activities since it would depend on the Contractor's on-site maintenance requirements and the amount of plant utilised. However, it is anticipated that the quantity of chemical waste produced would be small and in the order of a few cubic meters per month during construction and operation phases. The amount of chemical waste to be generated would be quantified in Waste Management Plan to be prepared by the Contractor.
- 7.4.13 These chemical wastes will be readily accepted for appropriate treatment and disposal of at the Chemical Waste Treatment Centre (CWTC) at Tsing Yi. Provided that the handling, storage, transportation and disposal of chemical wastes are in accordance with the requirements and the *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes* published by EPD, adverse environmental impacts are not expected.

Floating Refuse

- 7.4.14 Floating refuse (e.g. waste paper and empty containers) might be generated from construction workforce/operation staff while working near water bodies if there is no proper site management in place. With the mitigation and control requirements as detailed in **Section 7.5**, including avoiding placing waste collection bins close to any water bodies, ensuring construction materials are well covered to prevent occurrence of wind-blown light materials, and proper waste management and training to workers, the quantity is expected to be insignificant. Adverse waste management implications, including potential hazards, air and odour emissions, noise, wastewater discharge, ecology, and public transport, associated with handling of floating refuse during the construction and operation phases of the Project are not expected.

7.5 Mitigation Measures

General

- 7.5.1 Good housekeeping practices, such as waste segregation prior to disposal should be adopted. Stockpiling and segregating areas should be provided on-site. Effective collection of site wastes would be required to prevent waste materials being blown around by wind, flushed or leached into nearby waters, or creating an odour nuisance, visual impact, or pest and vermin problem. Waste storage areas should also be well maintained and cleaned regularly.

Waste Management Hierarchy

- 7.5.2 The waste management hierarchy has been applied in the assessment and development of mitigation measures for waste, which aims at evaluating the desirability of waste management methods and includes the following in descending preference:

- Avoidance and minimisation of waste generation;
- Reuse of materials where practicable;
- Recovery and recycling of residual materials where possible; and
- Treatment and disposal of waste according to relevant laws, guidelines and good practices.

- 7.5.3 Recommendations of good site practices and waste reduction measures should be stated in order to achieve the avoidance and minimisation of waste generation in the waste management hierarchy. A trip-ticket system is recommended for monitoring management of waste. Specific measures targeting the mitigation of impacts in works sites and the transportation of waste off-site should be provided to minimise the potential impacts to the surrounding environment.

Good Site Practices

- 7.5.4 Appropriate waste handling, storage, collection, transportation, and disposal methods for all waste arising generated during the construction phase of the Project should be implemented to ensure that construction wastes will not enter the nearby water bodies.

- 7.5.5 Recommendations for good site practices during the construction activities include:

- Nomination of approved personnel, such as a site manager, to be responsible for good site practices, and making arrangements for the collection of all wastes generated at the site and effective disposal to an appropriate facility;
- Training of site personnel in proper waste management and chemical waste handling procedures;
- Provision of sufficient waste reception/disposal points, of a suitable vermin-proof design that minimises windblown litter;
- Arrangement for regular collection of waste for transport off-site and final disposal;
- Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting waste in enclosed containers;
- Regular cleaning and maintenance programme for drainage systems, sumps and oil

- interceptors; and
- A recording system for the amount of wastes generated, recycled and disposed of (including the disposal sites) should be proposed.

Waste Reduction Measures

7.5.6 Good management and control of construction site activities/ processes can minimise the generation of waste. Waste reduction is best achieved in the planning and design phases, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:

- Segregate and store different types of construction related waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;
- Provide separate labelled bins to segregate recyclable waste such as aluminium cans from other general refuse generated by the workforce, and to encourage collection by individual collectors;
- Recycle any unused chemicals or those with remaining functional capacity;
- Maximise the use of reusable steel formwork to reduce the amount of C&D materials;
- Prior to disposal of C&D waste, it is recommended that wood, steel and other metals should be separated for reuse and / or recycle to minimise the quantity of waste to be disposed of at landfill;
- Adopt proper storage and site practices to minimise the potential for damage to, or contamination of, construction materials;
- Plan the delivery and stock of construction materials carefully to minimise the amount of waste generated; and
- Minimise over-ordering of concrete, mortars and cement grout by doing careful check before ordering.

7.5.7 In addition to the above measures, other specific mitigation measures are recommended below to minimise environmental impacts during handling, transportation and disposal of wastes.

Storage, Collection and Transportation of Waste

7.5.8 Storage of materials on-site may induce adverse environmental impacts if not properly managed. The following recommendations should be implemented to minimise the impacts:

- Waste, such as soil, should be handled and stored well to ensure secure containment, thus minimising the potential of pollution;
- Maintain and clean storage areas routinely;
- Stockpiling area should be provided with covers and water spraying system to prevent materials from being wind-blown or washed away; and
- Different locations should be designated to stockpile each material to enhance reuse.

7.5.9 Waste hauler with appropriate permits should be employed by the Contractor for the collection and transportation of waste from works sites to respective disposal outlets. The following recommendations should be implemented to minimise the impacts:

- Remove waste in a timely manner;
- Employ the trucks with cover or enclosed containers for waste transportation;
- Obtain relevant waste disposal permits from the appropriate authorities; and
- Dispose of waste at licensed waste disposal facilities.

Construction and Demolition (C&D) Materials

7.5.10 Careful design, planning together with good site management can reduce over-ordering and the generation of C&D materials such as concrete, mortar and cement grouts. Formwork and temporary works should be designed to minimise the use of standard wooden panels, so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic

facing should be considered to increase the potential for reuse.

- 7.5.11 Inert C&D materials with suitable characteristics / size should be reused on-site as fill or recycled as aggregate for other projects where practicable. The C&D material to be delivered to a PFRF for beneficial reuse should only consist of soil, rock, concrete, brick, cement plaster / mortar, inert building debris, aggregates, and asphalt. The material should be free from household refuse, plastic, metals, industrial and chemical waste, animal and vegetable matter, and other material considered to be unsuitable by the Filling Supervisor. Prior to disposal of non-inert C&D materials, wood, steel and other metals should also be separated for reuse and / or recycling where practicable so as to minimise the quantity of waste to be disposed of at landfill.
- 7.5.12 Suitable areas should be designated within the site boundaries for on-site sorting and providing temporary stockpiling of C&D materials. Within stockpiling areas, the following measures should be taken to control potential environmental impacts or nuisance:
- Surface of stockpiled soil should be regularly wetted with water especially during dry season (i.e. November to March);
 - Disturbance of stockpiled soil should be minimised;
 - Stockpiled soil should be properly covered with tarpaulin especially during heavy storms are predicted; and
 - Stockpiling areas should be enclosed where space is available.
- 7.5.13 In order to monitor the delivery of C&D materials at the designated PFRFs and landfill and to control fly-tipping, a trip-ticket system should be implemented in accordance with the DEVB TC(W) No. 6/2010 *Trip Ticket System for Disposal of Construction & Demolition Materials*. The Contractor should ensure that every truck carrying C&D materials leaving the Project Site must bear a completed CHIT which should be presented to the designated waste facility operator during waste delivery. Truck operator should return the Transaction Record Slip and stamped CHIT received from the facility operator to the Supervising Officer to verify the compliance with waste handling policy. A recording system for the amount of waste generated, recycled and disposed of, including the disposal sites, should also be set up. Warning signs should be put up to remind the designated disposal sites. CCTV should also be installed at the vehicular entrance and exit of the site to monitor handling of C&D materials disposal. To prohibit illegal dumping and landfilling of C&D materials, the dump trucks engaged on-site should be equipped with a Global Positioning System or equivalent automatic system for real time tracking and monitoring of their travel routings, parking locations and disposal activities.
- 7.5.14 For non-inert biomass waste arising from the construction activities, such as yard waste, they are required to be handled in accordance with the principles of reduce, reuse, and recycle. Specifically, to minimise the generation of yard waste, the following measures should be adopted:
- Avoid unnecessary removal or excessive pruning of trees. Preserve trees in their original locations and implement tree transplanting when on-site preservation is not feasible;
 - Segregate various types of yard waste and shred wood into smaller pieces if necessary to facilitate reuse and recycling;
 - Reuse yard waste on-site for a variety of purposes (e.g. decomposition and composting, recreational and decorative uses, and mulching in planting areas, etc.); and
 - Identify recycling options (e.g. delivery to Y-Park) for yard waste that cannot be directly reused on-site.
- 7.5.15 Where yard waste generation is unavoidable, sorting of yard waste for recycling and reuse on-site should always be the priority. Yard waste should be separated from C&D materials to facilitate recycling, such as delivering them to Y-Park so as to minimise the quantity of waste to be disposed of at the landfill site. Where appropriate, the Contractor should be responsible to cut and shred the yard waste on-site in order to meet the collection

requirements of the recycling outlet for processing / disposal. Disposal of yard waste directly at landfills should only be regarded as the last resort, when no alternatives are available.

- 7.5.16 In addition, the Contractor should prioritise materials with higher recycled content or those that are more easily recyclable, such as engineered wood products over solid lumber. Procuring materials in standardised sizes can also help reduce the need for on-site cutting and trimming, which often generates significant wood waste. Establishing take-back agreements with suppliers for unused or damaged goods is another effective way to prevent these materials from ending up in landfills. Dedicated bins or storage areas for different waste streams, including non-inert biomass, in construction sites enable efficient sorting and facilitate recycling and reuse. Ultimately, reducing non-inert biomass waste in construction requires a holistic approach that spans material selection, procurement, on-site management, and end-of-life processing.

General Refuse

- 7.5.17 General refuse should be stored in enclosed bins or compaction units separated from other wastes including C&D materials and chemical wastes. A reputable waste collector should be employed to remove general refuse separately from C&D materials and chemical wastes for disposal at a designated landfill. Preferably an enclosed and covered area should be provided to reduce the occurrence of “wind-blown” light materials. Clearly labelled recycling bins should be provided on-site in order to encourage segregation and recycling of aluminum and plastic wastes, and wastepaper in order to reduce general refuse production.
- 7.5.18 The Contractor should carry out an education programme for workers in avoiding, reducing, reusing, and recycling of materials generation. Posters and leaflets advising on the use of the bins should also be provided on-site as reminders. The recyclable waste materials should then be collected by reliable waste recycling agents on a daily basis.

Chemical Wastes

- 7.5.19 The Contractor should register with EPD as a chemical waste producer and follow the guidelines stated in the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste*. Chemical wastes should be stored in appropriate containers with proper labels and collected and delivered to designated outlet by a licensed collector. Chemical wastes (e.g. spent lubricant oil) should be recycled at an appropriate facility as far as possible, while the chemical waste that cannot be recycled should be disposed of at either the CWTC, or another licensed facility, in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation*.

Floating Refuse

- 7.5.20 Proper waste management, such as using collection bins with lids, avoiding placing waste collection bins close to any river channels or water bodies, and ensuring construction materials are well covered, should be considered to avoid having waste transported to water bodies under extreme weather conditions. The Contractor should be responsible for the collection of floating refuse, if any, within the work sites. The Contractor should collect and remove floating refuse, if any, at regular intervals on a daily basis to keep water bodies within the Project Site and the neighbouring water free from rubbish. The floating materials should be removed and eventually stored and disposed of together with the general refuse by the Contractor, after separating the recyclables for recycling.
- 7.5.21 Provided that good site practices and the above mitigation measures are strictly followed, there would be no adverse impacts related to waste management during construction and operation phases.
- 7.6 Conclusion
- 7.6.1 A variety of wastes, including inert and non-inert C&D materials, general refuse, chemical waste, and floating refuse would be generated during construction and operation phases. Provided that the wastes generated would be managed with appropriate measures, no adverse environmental impacts arising from the handling, storage, collection, transportation

and disposal of the wastes generated during construction and operation phases are envisaged.

8 LAND CONTAMINATION

8.1 Introduction

8.1.1 This section presents a review of potential land contamination issues associated with the Project.

8.2 Environmental Legislation, Standards and Guidelines

8.2.1 The relevant environmental legislation, standards, and guidelines for land contamination assessment include the following:

- Guidance Note for Contaminated Land Assessment and Remediation (Guidance Note) (EPD, April 2023) - This Guidance Note sets out the requirements for proper assessment and management of potentially contaminated sites such as oil installations (e.g. oil depots, petrol filling stations), gas works, power plants, shipyards/boatyards, chemical manufacturing/processing plants, steel mills/metal workshops, car repairing/dismantling workshops and scrap yards. In addition, this Guidance Note provides guidelines on how site assessments should be conducted and analysed and suggests practical remedial measures that can be adopted for the clean-up of contaminated sites.
- Practice Guide for Investigation and Remediation of Contaminated Land (Practice Guide) (EPD, April 2023) - This Practice Guide outlines typical investigation methods and remediation strategies for the range of potential contaminants typically encountered in Hong Kong.
- Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management (Guidance Manual) (EPD, April 2023) - This Guidance Manual introduces the risk-based approach in land contamination assessment and present instructions for comparison of soil and groundwater data to the Risk-Based Remediation Goals (RBRGs) for 54 chemicals of concern commonly found in Hong Kong. The RBRGs were derived to suit Hong Kong conditions by following the international practice of adopting a risk-based methodology for contaminated land assessment and remediation and were designed to protect the health of people who could potentially be exposed to land impacted by chemicals under four broad post restoration land use categories. The RBRGs also serve as the remediation targets if remediation is necessary.

8.3 Assessment Methodology

8.3.1 Land contamination assessment has been carried out with reference to the abovementioned Guidance Note, Practice Guide and Guidance Manual.

8.3.2 A site appraisal (including desktop review and site walkover) was conducted to identify any current / historical potentially contaminating land uses that may pose an adverse impact on the Project. The following information was reviewed for the site appraisal:

- Environmental Impact Assessment (EIA) Report for Tsing Yi – Lantau Link (HyD) (2025) (EIAO Application No.: EIA-314/2025);
- Civil Engineering and Development Department (CEDD) (2024) Agreement No. CE 57/2018 (GE) Pilot Planning and Engineering Study on Development of Selected Strategic Cavern Areas – Preliminary Environmental Review of Preferred Land Use Option at SCVA No. 10 (TR1B);
- Aerial photographs and topographic maps held by the LandsD;
- Available records of dangerous goods (DG), Chemical Waste Producers (CWPs), chemical spillage/leakage and fire incidents at the Project Site from EPD and Fire Services Department (FSD);
- Hong Kong Geological Survey Map (Series HGM 20) – Sheet 6 (1:20,000); and
- Relevant ground investigation reports from the CEDD civil engineering library.

8.3.3 If land contamination issues are identified at the Project Site, the potential land contamination impacts to the Project will be evaluated and appropriate mitigation measures / further works will also be recommended.

8.4 Description of Environment

8.4.1 The Project Site is located in Tsing Yi Island, occupying the areas of Wok Tai Wan, Yau Kom Tau and Cheung Shue Tau. It is bounded by Rambler Channel and Tam Kon Shan Road in the north, and vegetated land in the east, south and west. The Project Site of about 39 hectares is mainly occupied by vegetated/vacant land, access road and the Tsing Yi North Coastal Road. The location of the Project is shown in **Figure 2.01**.

8.4.2 As discussed in **Section 2.2.4**, the Wok Tai Wan Works Area has been planned to function as an ancillary operation zone and a conveyor belt system will be installed at sloping area. Based on the latest engineering design, the surface land of Wok Tai Wan Works Area will be used for stockpiling only and no soil excavation is required under the Project.

8.5 Identification of Potential Land Contamination Concern

Review of Previous Study

Environmental Impact Assessment Report for Tsing Yi – Lantau Link

8.5.1 Land contamination assessment was conducted under the EIA Report for Tsing Yi – Lantau Link (EIAO Application No.: EIA-314/2025) (hereinafter referred to as the “TYLL EIA Report”). The assessment area of TYLL covered the southwestern portion of Project Site, including Wok Tai Wan Works Area and part of the adjacent slope and access road. The assessment area of TYLL also covered a small portion of the slope and the Northwest Tsing Yi Interchange near the western part of the Underground Quarry Site. The location of the assessment area is shown in **Figure 8.01**. The land contamination assessment included desktop review and site walkovers and was conducted in accordance with the EIAO-TM and EPD’s prevailing guidelines. The site walkovers were conducted in 2023 and 2025. The TYLL EIA Report was approved on 27 November 2025.

8.5.2 Based on the findings of the approved TYLL EIA Report, the Wok Tai Wan Works Area was vacated after the construction of the existing Tsing Ma Bridge since 2003 and used as storage site for excavated rocks from Sha Tin Cavern under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction* since 2022. No vehicle / equipment maintenance / refueling activities and no signs of chemicals or chemical stains / spillage or stressed vegetation were identified within the works area at the time of the site walkover. No land contamination issues were identified within the Wok Tai Wan Works Area. For the remaining areas within the assessment area of the TYLL that fall inside the Project Boundary, no land contamination issues were also identified. According to the recommendations in the approved TYLL EIA Report, further site appraisal would be carried out at a later stage of the TYLL project to confirm / update the land uses / activities and to identify the presence of any potential contamination sources.

8.5.3 Based on the above recent findings of the approved TYLL EIA Report and that no soil excavation works are required within the Wok Tai Wan Works Area under this Project (**Section 8.4.2** refers), no land contamination issues to the Project are anticipated within the Wok Tai Wan Works Area and the remaining areas within the assessment area of TYLL that fall inside the Project Boundary. Nevertheless, a further site walkover was conducted under this PER to update the site conditions and to identify any new potential contamination sources within those areas. (**Sections 8.5.13** and **8.5.18** to **8.5.19** refer).

Previous Preliminary Environmental Report under Agreement No. CE 57/2018 (GE) Pilot Planning and Engineering Study on Development of Selected Strategic Caverns Area – Feasibility Study

8.5.4 The previous PER, including land contamination assessment, was completed in 2024 under the Pilot Study. The land contamination assessment had been carried out in the form of desktop review and site walkover, covering the Project Site including the northeastern portion of the Ngau Kok Wan Portal, the northern portion of the potential site formation area adjacent to the Ngau Kok Wan Portal, most of the access road, most of Tam Kon Shan Portal and adjacent potential site formation area and the Underground Quarry Site. The location of the assessment area is shown in **Figure 8.01**.

- 8.5.5 Based on the findings of the previous PER, Ngau Kok Wan Portal was largely reclaimed after 1991 and used as a barging point and open storage of materials between 1996 and 2002. The reclaimed land was partly occupied by the Marine Department as Ngau Kok Wan Vessel Traffic Service System Maintenance Site and had been used as material storage since 2016. It had been vacated at the time of the site walkover in 2021. No large-scale polluting installations / facilities were identified within the area. However, as the reclaimed land portion of Ngau Kok Wan Portal was unpaved and it was possible that handling and storage of chemicals for vehicle / equipment maintenance was undertaken, it was concluded at the time that the risk of potential land contamination could not be ruled out. Except the surface land at Ngau Kok Wan Portal, no land contamination issues were identified in the previous PER. The previous PER recommended a detailed land contamination assessment at the next design phase of the underground quarrying project (i.e. this Project) to confirm the presence and, if any, extent of contamination, evaluate the potential land contamination impact and recommend appropriate remedial actions and mitigation measures as necessary.

Review of Historical Land Uses

Assessment Area under the Previous PER

- 8.5.6 A review of aerial photographs in the period since the time of the previous PER has been undertaken to evaluate the likelihood of potential contamination associated with past land uses within the assessment area under the previous PER. The reviewed aerial photographs are enclosed in **Appendix 8.1** and the findings are summarised in **Table 8.1**.

Table 8.1 Review of Historical Land Uses within the Assessment Area under the Previous PER

Year	Reference of Aerial Photos ⁽¹⁾ in Appendix 8.1 (Photo Reference Number)	Review of Land-Uses and Site Operation/Activities Since the Time of the Previous PER
2021	AP5 (#E129562C, #E129564C, #E129566C, #E139349C)	Ngau Kok Wan Portal remained occupied by vacant land and natural hillside whilst the Tam Kon Shan Portal remained occupied by vegetated land and natural hillside. The cavern remained occupied by natural hillside. The remaining assessment area of the previous PER remained occupied by the access road and Tsing Yi North Coastal Road.
2023	AP6 (#E194717C, #E194719C, #E194721C, #E195093C)	The vacant land at Ngau Kok Wan Portal was converted into a works area. No other significant land use changes were observed within the assessment area under the previous PER.

Note: (1) Source of aerial photographs: Survey and Mapping Office, LandsD

- 8.5.7 Based on the review above, except the works area observed at Ngau Kok Wan Portal in 2023, no significant land use changes were observed within the assessment area under the previous PER since the time of the previous PER. For the works area observed in 2023 at Ngau Kok Wan Portal, based on information from the EPD and FSD and findings of the site walkover (refer to **Sections 8.5.12 to 8.5.15** and **8.5.20 to 8.5.24** for details), no potential land contamination issue associated with the works area of the Project is anticipated.
- 8.5.8 From the above, apart from the open storage of materials and the Marine Department Ngau Kok Wan Vessel Traffic Service System Maintenance Site identified in the previous PER (**Section 8.5.5** refers), no additional past potentially contaminating land uses were identified.

Project Site outside the Assessment Area under the Previous PER

- 8.5.9 Referring to **Section 8.5.1** and **Section 8.5.4**, the approved TYLL EIA Report and the previous PER only covered the Wok Tai Wan Works Area and part of the adjacent slope and access road, small portion of slope and North West Tsing Yi Interchange near the western part of the Underground Quarry Site, the northeastern portion of the Ngau Kok Wan Portal, the northern portion of the potential site formation area adjacent to the Ngau Kok Wan Portal,

most of access road, most of Tam Kon Shan Portal and adjacent potential site formation area and the Underground Quarry Site. For the remaining portion of the Project Site not covered in the approved TYLL EIA Report and the previous PER (See **Figure 8.01**), a review of available aerial photographs has been undertaken to evaluate the likelihood of potential contamination associated with past land uses within these areas.

- 8.5.10 Based on the 1991 aerial photograph (AP1 in **Appendix 8.1** refers), the remaining portion of the Project Site was mainly occupied by natural hillside and the western part of the remaining portion of the Project Site was observed under reclamation. By 2002, reclamation at the western part of the remaining portion of the Project Site was completed and vegetated land was observed. The existing Tsing Yi North Coastal Road, Northwest Tsing Yi Interchange and Tam Kon Shan Road were also observed within the remaining portion of the Project Site (AP2 in **Appendix 8.1** refers). No significant land use changes have been observed in this area since then (AP3 to AP6 in **Appendix 8.1** refers).

- 8.5.11 Based on the above review, no potential land contamination associated with past land uses were identified within the remaining portion of the Project Site.

Site Walkover

- 8.5.12 Drone surveys were conducted on 18 September 2023, 17 and 19 March 2025 to facilitate the identification of the current land uses within the Project Site. Site walkover was also conducted on 8 April 2025 to update the findings of the previous PER and to investigate any land contamination issues associated with the current land uses within the Project Site. In addition, referring to **Section 8.5.3**, further site walkover was conducted on 20 October 2025 within the Wok Tai Wan Works Area to update the site conditions and to identify any new potential contamination sources. Photographic records, along with the site layout plan, are shown in **Figures 8.02 to 8.06**. Questionnaires were conducted with available site representatives and the site walkover checklists are attached in **Appendix 8.2**.

- 8.5.13 Based on the findings of drone surveys and site walkovers, the majority of the Project Site is currently occupied by non-contaminating land uses, including natural hillsides, slopes, vegetated land, access road, Tam Kon Shan Road, Northwest Tsing Yi Interchange and Tsing Yi North Coastal Road. No signs of oil stain, chemical spillage / leakage, stressed vegetation or potentially contaminating activities were observed in these areas of the Project Site during the site walkover.

- 8.5.14 A works area of DSD under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction* was observed at Ngau Kok Wan Portal. According to information provided by the site representative, the works area serves as a temporary stockpiling area, rock crushing and screening facilities for rocks excavated from the caverns at Nui Po Shan of A Kung Kok. The works area has been in operation since late 2022, and the associated works are anticipated to be completed in June 2026.

- 8.5.15 As observed during the site walkover, the DSD works area at Ngau Kok Wan Portal was mainly comprised of two sets of crushing and screening facilities, stockpiling areas, two material stores, a site office, a recorder house, a weighbridge, a barging point, an unloading platform and hopper, material storage areas and an access road. The site was largely unpaved except the site office, the recorder house and the material store in the south of the site. The material store in the west of the site was inaccessible for detailed site inspection (Photo 3284 in **Figure 8.03** refers). As reported by the site representative, the material store was used for storage of valuable parts only. Based on site observations, chemicals identified on-site include gear oil, hydraulic oil, grease, lubricating oil and engine oil. These chemicals were reportedly used for the daily operation of the crushing and screening facilities, which were observed to be stored directly on concrete paved floor in the chemical storage area within the material store at the southern works area. The chemical storage area was noted to be in good condition with no signs of oil stain / chemical leakage / stressed vegetation observed in the vicinity (Photo 5998 in **Figure 8.03** refers). In addition, diesel oil was reportedly used for the operation of the crushing and screening facilities and was refueled directly to the facilities from diesel trucks as needed. Based on observation during the site walkover and as reported by the site representative, no chemical waste is generated at the

site. Weekly inspection by the Environmental Team (ET) and Independent Environmental Checker (IEC) is conducted under the EM&A programme under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction* to monitor the chemicals handled and to check and rectify any spillage on-site.

- 8.5.16 A works area of CEDD under *Contract No. GE/2022/08 Ground Investigation – New Territories East* was observed at the Tam Kon Shan Portal. According to information provided by the site representative, the works area was used from February 2025 to April 2025 for GI works within the works area and adjacent natural hillside.
- 8.5.17 As observed during the site walkover, the CEDD works area was generally unpaved and mainly comprised of material storage areas, a changing room, drill rigs, a water pump, an elevated working platform and natural hillside. Two chemical storage cabinets containing diesel oil drums were observed in the material storage area. A chemical waste collection bin and a compressed nitrogen cylinder were observed in the changing room and lubricating oil was observed on the elevated working platform. Based on site observations, the diesel oil drums were stored in chemical storage cabinets with drip trays in good condition with no signs of oil stain / chemical leakage / stressed vegetation observed in the vicinity (Photo 3063 in **Figure 8.04** and Photo 5664 in **Figure 8.05** refer). The diesel oil was reportedly used as fuel for the drill rigs and water pump as needed. The chemical waste collection bin and compressed nitrogen cylinder were observed on timber floorboard with no signs of oil stain / chemical leakage / stressed vegetation noted in the vicinity (Photo 5679 in **Figure 8.04** refers). The compressed nitrogen was observed to be in gaseous form which would not lead to land contamination. The lubricating oil was placed on wooden plank of the elevated working platform without direct contact with the ground (Photo 5649 in **Figure 8.05** refers). Wooden sideboards were installed around the elevated working platform which would prevent any chemical spillage to the ground underneath (Photo 5655 in **Figure 8.05** refers). The wooden plank of the elevated working platform was observed in good condition with no signs of oil stain / chemical leakage / stressed vegetation observed in the vicinity. The lubricating oil was reportedly used as lubricants for the drill rods as needed. According to the site representative, no chemical spillage or leakage incidents were reported at the site.
- 8.5.18 Similar to the findings of the approved TYLL EIA Report, the Wok Tai Wan Works Area is currently the DSD works areas under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction* and is used as a storage area for excavated rocks from Sha Tin Cavern.
- 8.5.19 As observed during the site walkover, the DSD works area was generally unpaved and mainly comprised of a barging point, stockpiles of rocks and rest rooms. As reported by the site representative, diesel oil was used for the operation of excavators and refueled directly from the oil tanker as needed. A diesel oil drum with a drip tray was observed in the north of the site and was reportedly used as fuel for excavators for emergency use only. The drip tray was observed in good condition with no signs of oil stain / spillage observed in the vicinity of the diesel oil drum (Photo 0361 in **Figure 8.06** refers). Based on the observations during the site walkover and as reported by the site representative, no chemical waste is generated at the site. Based on the information provided by the site representative, weekly site inspection by ET and IEC under the EM&A programme under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction* and daily inspection by the residential site staff are reportedly conducted to monitor the chemicals handled and to check and rectify any spillage on-site. No records of land contamination / chemical spillage / leakage for the site have been reported.

Acquisition of Information from Government Departments

- 8.5.20 The EPD and FSD have been contacted for (i) records of any spillage / leakages of chemicals and chemical waste, (ii) records of DG, (iii) records of CWP(s) and (iv) records of reported fire incidents within the Project Boundary. EPD's and FSD's replies to the request are attached in **Appendix 8.3**. In addition, records acquired in the approved TYLL EIA Report were also reviewed. The information is summarised below.

Environmental Protection Department

- 8.5.21 Based on the EPD's reply on 4 September 2024, 22 April 2025, 22 October 2025 and findings of the approved TYLL EIA Report, there is no record of chemical spillage / leakage records within the Project Boundary. Further to the EPD's reply, visit to EPD's Southern Centre Office was undertaken on 26 November 2024 to review the available CWP records. According to the records reviewed, there is 1 registered CWP identified within the Project Boundary with details summarised in **Table 8.2** and location shown in **Figure 8.07**.

Table 8.2 Registered Chemical Waste Producer within the Project Boundary

CWP Licensee Name	Address	Status	Nature of Business
China State - Alchmex Joint Venture operated by China State Construction Engineering (Hong Kong) Limited and Alchmex International Construction Limited	Ngau Kok Wan and Wok Tai Wan at Tsing Yi	Valid	Construction

- 8.5.22 The CWP is likely to be associated with the works areas under DSD *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns – Main Caverns Construction* at Ngau Kok Wan Portal or Wok Tai Wan Works Area. Based on the site walkover, no chemical waste storages / oil stain / chemical leakage / stressed vegetation were observed within these works areas. For DSD works area at Ngau Kok Wan Portal and Wok Tai Wan Works Area, there have been regular site walks conducted by the ET and IEC to monitor the handling of chemicals and to check and rectify any spillage on-site. The storage of chemical wastes, if any, associated with this CWP record is unlikely to have caused any land contamination issues to the Project.

Fire Services Department

- 8.5.23 Based on the reply from FSD on 26 September 2024, 6 May 2025, 22 October 2025 and findings of the approved TYLL EIA Report, no records of DG license or incidents of spillage / leakage of DG were found within the Project Boundary. However, 6 incident records were provided in the FSD's replies. The details of the incident records are summarised in **Table 8.3** and the locations are shown in **Figure 8.07**.

Table 8.3 Summary of Incident Records

No.	Address	Date	Type of Incident	Within Project Boundary?
1	Near Lamppost AC1725, Near Tam Kon Shan Road	9/7/2025	Electrical Fire	Yes
2	Kiosk 5, UTM Grid Reference KK001751, Tsing Yi Nature Trail	14/9/2024	Mountain Rescue	No
3	Hillside, UTM Grid Reference KK000755, Tsing Yi Nature Trail	10/6/2024	Mountain Rescue	Yes
4	No. 80-82, Tam Kon Shan Road	19/4/2024	No. 2 Alarm Fire	No
5	Man Shun Shipyard, Tam Kon Shan Road	5/8/2023	No. 1 Alarm Fire	No
6	Hillside, UTM Grid Reference JK997754, Near Tsing Yi Nature Trail	6/3/2023	Mountain Rescue	Yes

- 8.5.24 Of the 6 incident records, 3 records (Incident Nos. 2, 4 and 5) occurred outside the Project Boundary. For Incident No. 1, based on further information provided by FSD, no DG / chemicals were involved in the fire incident concerned. Thus, potential land contamination issues associated with the incident record are not anticipated. For Incident Nos. 3 and 6, given the nature of the two incidents (i.e. mountain rescue), potential land contamination issues associated with these incident records are not anticipated.

Site Geology

- 8.5.25 According to the 1:20,000 Geological Map Sheet 6 (Yuen Long), the bedrock underlying the Project Site in Northwest Tsing Yi comprises mainly coarse ash Tuffs. Some minor intrusions of Felsparphyric and Quartzphyric Rhyolite also occur.
- 8.5.26 Based on the relevant GI reports, the Project Site was underlain by Completely Decomposed Tuff / Colluvium comprising loose yellowish brown with dark grey speckles and slightly clayey fine to coarse sand with some angular gravels of rock fragments of 2.5m thickness, followed by highly decomposed Tuff comprising weak to moderately, yellowish brown with dark grey and green to brown speckles and spots, gravels of rock fragments and slightly silty fine to coarse sand matrix of 4m thickness and highly to moderately decomposed Tuff comprising light grey and yellowish brown rock fragment of 1m thickness. The underlying rock was moderately and slightly decomposed Tuff of at least 52.83m, with the corresponding termination elevation of -36.68mPD. The strength of the rock was moderately strong to very strong.
- 8.6 Prediction and Evaluation of Potential Impacts
- 8.6.1 According to the findings of the site appraisal, the Project Site has been mainly occupied by non-contaminating land uses (e.g. natural hillside, vegetated land, slopes and roads). No land contamination impact associated with these land uses to the Project is anticipated.
- 8.6.2 For the CEDD works area under Contract No. *GE/2022/08 Ground Investigation – New Territories East* at the Tam Kon Shan Portal, handling of chemicals and chemical waste were identified. However, the operation of the works area, and the associated chemical and chemical waste storage are temporary (i.e. 2 months only). The chemical and chemical waste storages were observed to be in good condition with no signs of oil stain / chemical leakage / stressed vegetation noted in the vicinity. In addition, no records of spillage / leakage incidents involving chemicals / chemical wastes were reported by the site representative, EPD and FSD. Given the above and the nature of works (i.e. GI works), potential land contamination impact associated with operation of this works area is not anticipated.
- 8.6.3 For the Wok Tai Wan Works Area, the site is currently the DSD works areas under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction*. Based on the land contamination assessment under the approved TYLL EIA Report, no land contamination issues were identified within the site. Although a diesel oil drum was observed in the north of the site during the site walkover in this review, the drum was placed with drip tray in good condition and with no signs of oil stain / spillage observed in the vicinity. There have also been regular inspections conducted by the resident site staff, ET, and IEC to monitor the chemicals handled and to check and rectify any spillage on-site and no records of land contamination / chemical spillage / leakage were reported. Given the above and that no soil excavation works are required on the surface land at Wok Tai Wan Works Area (**Section 8.4.2** refers), no land contamination issues to the Project are anticipated within the Wok Tai Wan Works Area.
- 8.6.4 For the reclaimed land portion of Ngau Kok Wan Portal, the area had been used as a barging point and open storage of materials between 1996 and 2002, and Marine Department Ngau Kok Wan Vessel Traffic Service System Maintenance Site from 2016. The area had been vacated in 2021. From the site walkover conducted under this assessment, the area is currently occupied by the DSD works area under *Contract No. DC/2020/05 Relocation of Sha Tin Sewage Treatment Works to Caverns - Main Caverns Construction*, which is a Designated Project under the EIAO with respective Environmental Permit in place, and handling of chemicals were identified in the works area. There have been regular site walks conducted by the ET and IEC, and any sign of land contamination detected would be rectified in accordance with the EIAO during the course of the operational and decommissioning phases of the works area. In addition, no records of spillage / leakage incidents involving chemicals / chemical wastes were reported by the site representative, EPD and FSD. As such, potential land contamination impact associated with the operation of this works area is not anticipated. Nevertheless, according to the previous PER, it is possible that vehicle / equipment maintenance activities, which were associated with the handling and storage of chemicals, were carried out within the reclaimed land portion of Ngau Kok Wan Portal. However, it should be noted that based on the latest engineering design, no soil excavation

works will be carried out within 10m from the seawall in the land portion of Ngau Kok Wan Portal in order to avoid any adverse impacts on the structural stability of the existing seawall. As such, no land contamination issues to the Project are anticipated within this 10m 'buffer area' due to no soil excavation works at this area. The potentially contaminated area (i.e. the area of the former open storage and the Marine Department Ngau Kok Wan Vessel Traffic Service System Maintenance Site but excluding the 10m buffer area near the seawall) are indicated in **Figure 8.02** to **Figure 8.03**. A detailed land contamination assessment (including further site appraisal and if necessary intrusive SI) should be carried out within the potentially contaminated area prior to commencement of construction works of the Project to confirm the presence and, if any, extent of contamination. The detailed land contamination assessment should be carried out according to the EPD's Guidance Note, Guidance Manual and Practice Guide. Details of the further works are discussed in **Section 8.7** below.

- 8.6.5 Given any soil/groundwater contamination would be identified and properly treated prior to the commencement of construction works of the Project if the further works outlined in **Section 8.7** are implemented, land contamination impacts are considered not insurmountable to future occupants.

8.7 Recommended Further Works

- 8.7.1 Further site appraisal should be carried out at the potentially contaminated area within the reclaimed land portion of Ngau Kok Wan Portal after site handover but prior to commencement of construction works of the Project to confirm the presence of any potential land contamination sources. Any necessary intrusive SI works and remediation action are recommended to be carried out prior to the commencement of construction works under the Project.
- 8.7.2 The further site appraisal and submission of Contamination Assessment Plan (CAP) should be carried out prior to the commencement of the SI works, presenting findings of the further site appraisal, the latest site conditions and proposed sampling strategy and testing protocol, and submitted to EPD for endorsement. The SI works should be carried out according to EPD's agreed CAP. Following the completion of SI works and receipt of laboratory test results, Contamination Assessment Report (CAR) should be prepared to present the findings of the SI works and to discuss the presence, nature and extent of contamination. If contamination is identified, Remediation Action Plan (RAP) which provides details of the remedial actions for the identified contaminated soil and / or groundwater should be endorsed by EPD.
- 8.7.3 Remediation action, if necessary, should be carried out according to EPD endorsed RAP and Remediation Report (RR) should be submitted after completion of the remediation action. The RR should be endorsed by EPD prior to the commencement of construction works at the respective identified contaminated areas (if any).

8.8 Conclusion

- 8.8.1 A site appraisal, in the form of a desktop review and site walkover, was conducted between September 2023 and October 2025 to identify any current / historical potentially contaminating land uses within the Project Boundary. Based on the findings of the site appraisal, the Project Site was mainly occupied by non-contaminating land uses. Three existing works areas were identified within the Project Boundary but no potential land contamination issues associated with operations of the works areas are anticipated. For the reclaimed land portion of Ngau Kok Wan Portal, the area was used as a barging point, open storage of materials and Marine Department Ngau Kok Wan Vessel Traffic Service System Maintenance Site. According to the previous PER, it is possible that vehicle / equipment maintenance activities, which were associated with handling and storage of chemicals, were carried out within the reclaimed land portion of Ngau Kok Wan Portal.
- 8.8.2 A detailed land contamination assessment (including further site appraisal and if necessary intrusive SI) should be carried out for the potentially contaminated area within the reclaimed land portion of Ngau Kok Wan Portal prior to commencement of construction works involving soil excavation under the Project to confirm the presence and, if any, extent of contamination.

The detailed land contamination assessment should be carried out according to EPD's Guidance Note, Guidance Manual and Practice Guide.

- 8.8.3 With the implementation of the recommended follow up works for the Project, any soil/groundwater contamination would be identified and properly treated prior to the construction works. No insurmountable land contamination impacts on the Project are therefore anticipated.

9 TERRESTRIAL ECOLOGY

9.1 Introduction

9.1.1 This section presents the baseline terrestrial ecological resources within the assessment area which is 500m from the Project Boundary (**Figure 9.01** refers), and the preliminary review results of the potential terrestrial ecological impacts arising from the construction works (e.g. site formation, slope stabilization, and the installation for ancillary activities) within Surface Works Area (i.e. portal areas, associated access road and Wok Tai Wan Works Area), excavation of the Main Access Tunnel by mechanical breaking methods, as well as operation (i.e. underground quarrying by D&B method) of the Project.

9.1.2 Baseline conditions for ecological components of the terrestrial environment have been evaluated based on information from available literature and field surveys. Measures required to mitigate any identified adverse impacts have been recommended, where appropriate.

9.2 Environmental Legislation, Standards and Assessment Criteria

9.2.1 Ordinances/regulations, guidelines, standards and documents listed below were referred to during the course of the preliminary ecological review:

- Country Parks Ordinance (Cap. 208);
- Forests and Countryside Ordinance (Cap. 96);
- Wild Animals Protection Ordinance (Cap. 170);
- Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586);
- Town Planning Ordinance (Cap. 131);
- Chapter 10 of the Hong Kong Planning Standard and Guidelines (HKPSG);
- The International Union for the Conservation of Nature (IUCN)'s Red List of Threatened Species;
- The List of Key Protected Wildlife and Plant Species under the People's Republic of China's (PRC) Wild Animal Protection Law; and
- The Convention on Biological Diversity (CBD).

9.3 Assessment Methodology

9.3.1 A desktop review of relevant available studies/surveys regarding the ecological conditions within the assessment area was conducted. Literature reviewed includes:

- Agreement No. CE 21/2016 (GE) – Technical Study on Underground Quarrying in Hong Kong – Investigation, Final Technical Report on Preliminary Assessment of the Selected Underground Quarry Site – Preliminary Environmental Review (TR1B) (CEDD, 2018);
- Agreement No. CE 84/2017 (CE) – Technical Study on Potential Sites for Relocation of Wholesale Markets and for Other Industrial Uses in North West Tsing Yi – Feasibility Study – Preliminary Report on Preliminary Environmental Study (CEDD, 2023);
- Agreement No. CE 57/2018 (GE) – Pilot Planning and Engineering Study on Development of Selected Strategic Cavern Areas – Feasibility Study – Preliminary Environmental Review of Preferred Land Use Option at SCVA No. 10 (TR1B) (CEDD, 2024);
- AFCD Biodiversity Information Hub (AFCD, 2025);
- Approved Tsing Yi OZP No. S/TY/32; and
- Cavern Master Plan under Long-term Strategy for Cavern Development – Feasibility Study (CEDD, 2019).

9.3.2 The current Project Boundary overlaps with the study area of the PER for the *Technical Study on Underground Quarrying in Hong Kong* (CEDD, 2018) and the study area of the previous PER. With the available recent information, the ecological characters of the current Project Boundary were verified and consolidated with the latest aerial photographs, countryside maps published by the Survey and Mapping Office of LandsD and the reconnaissance site

visits conducted in September 2024, January 2025, and June 2025 according to the methodology agreed with AFCD. The walk transects and freshwater communities sampling points during the reconnaissance site visits are provided in **Figure 9.01**.

9.4 Description of Baseline Condition

Habitat and Vegetation

- 9.4.1 No recognized site of conservation importance was identified within the assessment area. A total of six habitats (i.e. mixed woodland, shrubland, plantation, modified watercourse, natural watercourse and developed area) were identified within the Project Boundary and the 500m assessment area after collating and consolidating the findings from literature review and the reconnaissance site visits (**Figure 9.02** refers). A total of three flora species of conservation importance were recorded within the assessment area during the reconnaissance site visits, all of which were also recorded in previous studies (**Table 9.1**, **Figure 9.02** and **Appendix 9.1** refer).

Table 9.1 Flora Species of Conservation Importance Recorded within the Assessment Area

Species	Distribution in Hong Kong ⁽¹⁾	Conservation Status	Previous Studies ⁽⁹⁾	Recent Reconnaissance Site Visits
Incense Tree (<i>Aquilaria sinensis</i>)	Common in Hong Kong	Cap. 586 ⁽²⁾ , Cat 2&3 (NT) ⁽³⁾ , Cat II ⁽⁴⁾ , VU ⁽⁵⁾ , NT ⁽⁶⁾ , VU ⁽⁷⁾ , VU ⁽⁸⁾	Mixed Woodland*; Shrubland	Mixed Woodland*; Shrubland; Plantation*
<i>Aralia chinensis</i>	Common in Hong Kong	VU ⁽⁸⁾	Mixed Woodland*; Plantation*	Mixed Woodland*; Plantation*
Small Persimmon (<i>Diospyros vaccinioides</i>)	Common in Hong Kong	EN ⁽⁷⁾ , CR ⁽⁸⁾	Mixed Woodland; Plantation*	Mixed Woodland*; Plantation*

Notes:

- (1) AFCD (2025): Hong Kong Biodiversity Information Hub.
Distribution in Hong Kong follows Hong Kong Herbarium (2007; 2008; 2009; 2011), Wu, S.H. & Lee, T.C.W. (2000), Xing, F.W., Ng, S.C. & Chau, L.K.C. (2000), and Siu, L.P.G. (2000).
(2) Protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).
(3) Hu et al. (2003): Rare and Precious Plants of Hong Kong. NT= Near Threatened.
(4) List of Wild Plants under State Protection (promulgated by the Ministry of Forestry in 2021).
(5) Fu (1992): China Plant Red Data Book. Vol. 1 - Rare and Endangered Plants. VU= Vulnerable.
(6) Feng et al. (2002): Study on Rare and Endangered Plants and National Key Protected Plants in Guangdong. NT= Near Threatened.
(7) Qin et al. (2017): Threatened Species List of China's Higher Plants. VU = Vulnerable, EN = Endangered.
(8) The International Union for the Conservation of Nature (IUCN) (2025). The IUCN Red List of Threatened Species (2024.2). VU = Vulnerable, CR = Critically Endangered.
(9) CEDD (2018); CEDD (2023); CEDD (2024).
* Recorded within Project Boundary.

Overview of the Project Site

- 9.4.2 The Project comprises different components, with the majority of the Project Site made up of underground caverns and associated underground access tunnels (hereinafter collectively referred to as the "Underground Quarry Site") which are located underneath mixed woodland, plantation, modified watercourse, natural watercourse and developed area. Aboveground components of the Project include two portal areas, namely Ngau Kok Wan Portal and Tam Kon Shan Portal, associated access road west of Ngau Kok Wan and Wok Tai Wan Works Area, and are hereinafter collectively referred to as "Surface Works Area", which are mainly made up of developed area, with small areas of mixed woodland, plantation and shrubland, short sections of modified watercourses (i.e. W1 and W3) as well as a short section of natural watercourse (i.e. W6) (**Table 9.2** and **Figure 9.02** refer).

Table 9.2 Area of Habitats of Surface Works Area, Underground Site, Potential Cavern Expansion, Other Area within Project Boundary (excluding Surface Works Area, Underground Site, and Potential Cavern Expansion) and 500m Assessment Area

Habitat	Surface Works Area (ha) [a]	Underground Site (ha) [b]	Potential Cavern Expansion (ha) [c]	Other Area within Project Boundary (excluding [a], [b] and [c]) (ha) ⁽¹⁾	500m Assessment Area (ha)
Mixed Woodland	0.85	15.31	2.27	5.28	66.48
Shrubland	0.11	-	-	<0.01	5.52
Plantation	0.92	2.98	-	1.47	36.58
Modified Watercourse	0.05 (~ 0.15km)	0.01 (~ 0.02km)	-	0.06 (~0.20km)	0.43 (~ 0.86km)
Natural Watercourse	<0.01 (~0.03km)	0.12 (~ 1.21km)	-	0.01 (~0.11km)	0.24 (~ 2.39km)
Developed Area	7.49	2.28	-	2.47	67.15
Total	9.43	20.71	-	9.30	176.39

Note:

(1) No construction works are proposed within this area in the current project design presented in this PER.

Mixed Woodland

- 9.4.3 Mixed woodlands were identified within the Project Boundary. The mixed woodland at both portal areas and Ngau Kok Wan formed a narrow continuous patch of mixed woodland. Another continuous patch of mixed woodland was identified along the coastal area of Wok Tai Wan. The patches of mixed woodland were around 5-8m tall with similar floristic composition. Flora species recorded include native species typically found in disturbed environment, such as Sweet Gum (*Liquidambar formosana*), Pop-gun Seed (*Bridelia tomentosa*), Yellow Cow Wood (*Cratogeomys cochinchinense*), Elephant's Ear (*Macaranga tanarius* var. *tomentosa*) and Ivy Tree (*Schefflera heptaphylla*), interspersed with exotic plantation species such as *Eucalyptus* spp. and Taiwan Acacia (*Acacia confusa*).
- 9.4.4 Outside the portal areas, the majority of the mixed woodland was situated at Liu To Shan in the southeastern part of the assessment area. The canopy was about 8-12m tall, where a mix of native species (e.g. Castanopsis (*Castanopsis fissa*) and Lance-leaved Sterculia (*Sterculia lanceolata*)) and exotic species (e.g. Taiwan Acacia and *Eucalyptus* spp.) were present. Shrub and herb species (e.g. Rough-leaved Holly (*Ilex asprella*), Wild Coffee (*Psychotria asiatica*) and Semi-pinnated Brake (*Pteris semipinnata*)) were recorded in the understorey.
- 9.4.5 A total of three flora species of conservation importance, including Incense Tree (*Aquilaria sinensis*), *Aralia chinensis* and Small Persimmon (*Diospyros vaccinioides*), were recorded in the mixed woodland within both the assessment area and Project Boundary. Individuals of Incense Tree were found in Tam Kon Shan Portal and above the footprint of the Underground Quarry Site, individuals of *Aralia chinensis* were found in both Tam Kon Shan Portal and Ngau Kok Wan Portal, and individuals of Small Persimmon were found in Ngau Kok Wan Portal. Outside the Project Boundary, individuals of Incense Tree were also recorded at Liu To Shan, while clusters of Small Persimmon were recorded at the mixed woodland west of Ngau Kok Wan.
- 9.4.6 The mixed woodland at Liu To Shan was considered to be of moderate naturalness, less fragmented, larger in size and structurally connected to adjacent plantation and shrubland habitats and subject to some disturbance from human activities (e.g. traffic from Tsing Yi North Coastal Road, regular human disturbances on hiking trails and paved hiking trails with pavilion structures). The mixed woodlands in Ngau Kok Wan and Wok Tai Wan were small in size with high fragmentation, low to moderate naturalness and subject to regular disturbance (e.g. heavy vehicular traffic from adjacent developed area at Tsing Yi North Coastal Road, Tam Kon Shan Road, shipyard and cement works, and construction works at Ngau Kok Wan). The mixed woodland at Liu To Shan is considered to be of **moderate** ecological value, while those at Ngau Kok Wan and Wok Tai Wan are considered to be of

low ecological value.

Shrubland

- 9.4.7 A narrow continuous patch of shrubland was found within the Project Boundary along the coast of Wok Tai Wan Works Area. Outside the Project Boundary, patches of shrubland were identified on the knoll between the portals and Liu To Shan. Native shrubs such as Rose Myrtle (*Rhodomyrtus tomentosa*) and Oblong-leaved Litsea (*Litsea rotundifolia* var. *oblongifolia*) were typically recorded in this habitat. The understorey comprised herbaceous species such as Oriental Blechnum (*Blechnum orientale*) and Dichotomy Forked Fern (*Dicranopteris pedata*). An Individual of Incense Tree was recorded at Liu To Shan. Considering the small size, young age, low wildlife diversity and abundance as well as high fragmentation, shrubland is considered to be of **low** ecological value.

Plantation

- 9.4.8 Plantations were largely found along the access road west of Ngau Kok Wan, Yau Kom Tau, and man-made slopes (e.g. along Tsing Yi North Coastal Road and Northwest Tsing Yi Interchange) across the assessment area and within the Project Boundary (including Ngau Kok Wan Portal, Tam Kon Shan Portal, Wok Tai Wan Works Area and above the footprint of the Underground Quarry Site). Exotic plantation species such as Taiwan Acacia, Big-leaved Acacia (*Acacia mangium*) and Horsetail Tree (*Casuarina equisetifolia*) were predominant in this habitat, where a mix of native and exotic vegetation, such as Wood Fern (*Cyclosorus parasiticus*), Microcos (*Microcos nervosa*) and *Wedelia trilobata* were occasionally recorded in the understorey.
- 9.4.9 A total of three flora species of conservation importance, including Incense Tree, *Aralia chinensis* and Small Persimmon, were recorded in plantation within the assessment area and the Project Boundary. Within the Project Boundary, an individual of Incense Tree was identified at the slope between the Main Access Tunnel of the Ngau Kok Wan Portal, individuals of *Aralia chinensis* were found in and near Ngau Kok Wan Portal, while individuals of Small Persimmon were found near Tam Kon Shan Portal, south and west to the Ngau Kok Wan Portal and above the footprint of the Underground Quarry Site. Outside the Project Boundary, an individual of Incense Tree was found on the engineered slope adjacent to Tsing Yi North Coastal Road, individuals of *Aralia chinensis* were found along the access road west of Ngau Kok Wan, and an individual of Small Persimmon was found adjacent to the access road near Wok Tai Wan.
- 9.4.10 Considering the low naturalness, diversity and abundance of wildlife, high fragmentation and recreatability, and regular disturbance (e.g. heavy vehicular traffic from Tam Kon Shan Road, Tsing Yi North Coastal Road and Northwest Tsing Yi Interchange and the construction works at Ngau Kok Wan), plantation is considered to be of **low** ecological value.

Modified Watercourse

- 9.4.11 Three modified watercourses (i.e. W1 – W3) were identified in the northern and western seafront of the assessment area. Short sections of W1 are located within the footprint of Ngau Kok Wan Portal. It was subject to sedimentation from runoff from the adjacent human and vehicular activities on excavated land, had stagnant water flow and appeared to lack natural substratum. Ruderal weedy species such as Shell Ginger (*Alpinia zerumbet*), *Bidens alba*, Opposite-leaved Fig (*Ficus hispida*) and Mile-a-minute Weed (*Mikania micrantha*) formed the bankside vegetation. W2 was a stormwater drainage channel that crosses the access road west of Ngau Kok Wan Portal. It was observed to be dry during the reconnaissance site visits. A section of W3 is located within the Wok Tai Wan Works Area. It was a stormwater drainage channel with slow water flow and poor water quality. No flora species of conservation importance were identified along the modified watercourses which supported low diversity and abundance of vegetation. Considering the low naturalness, heavy disturbance, low diversity and abundance of wildlife, the modified watercourses are considered to be of **low** ecological value.

Natural Watercourse

- 9.4.12 Four natural watercourses (i.e. W1a, W4 – W6) were identified within the assessment area. W1a and W4 are seasonal natural watercourses recorded at the northern slope of Liu To Shan, which partly falls within the footprint of the Main Access Tunnel of the Ngau Kok Wan Portal and the Underground Quarry Site. Cobbles and boulders are found at the bottom of both watercourses. During the reconnaissance site visits in wet season (i.e. September 2024 and June 2025), W1a was observed to be dry, while good water quality was recorded at W4. W5 is a perennial watercourse found at the eastern slope of Liu To Shan with stagnant water flow. The bottom of the watercourse is formed by bedrocks. A short section of W6 is located within Wok Tai Wan Works Area. It is a seasonal natural watercourse which was observed to be dry during the reconnaissance site visits in wet season, with cobbles and mud at the bottom. Limited vegetation, such as Common Centotheca (*Centotheca lappacea*), Lily Turf (*Liriope spicata*) and Wild Coffee (*Psychotria asiatica*), were recorded at the riparian zone of the natural watercourses. No flora species of conservation importance were recorded along the natural watercourses. No fauna species were recorded at W1a and W6. The fauna species recorded at W4 and W5 are presented in **Appendix 9.2**. Considering the moderate naturalness, and their structural connection to adjacent mixed woodland, shrubland and plantation habitats, and subject to some disturbance from human activities (e.g. regular human disturbances on the hiking trail), the natural watercourses are considered to be of **low to moderate** ecological value.

Developed Area

- 9.4.13 Developed areas were identified at several locations within the Project Boundary. There is a developed area in the coastal area of Ngau Kok Wan Portal. This area was fenced, and showed some signs of dumping and storage activities. Another developed area was identified at Wok Tai Wan Works Area and along the access road west of Ngau Kok Wan Portal, where low abundance and diversity of flora species were found. A small portion of the developed area (i.e. the man-made slope along Northwest Tsing Yi Interchange) was also identified within the western footprint of the Underground Quarry Site.
- 9.4.14 Beyond the Project Boundary, a developed area was recorded east of Ngau Kok Wan Portal, with frequent human and heavy vehicular activities on the excavated land. The developed area northeast to the Tam Kon Shan Portal and southeast to the Wok Tai Wan Works Area also experienced frequent heavy vehicular activities from cement works and the shipyard along Tam Kon Shan Road. Other developed areas, such as roads, highways, built-up areas and construction sites were also identified within the assessment area.
- 9.4.15 The developed area was observed with low diversity and abundance of vegetation, overgrown with ruderal species such as the tree species White Popinac (*Leucaena leucocephala*), Elephant's Ear, and herbs *Bidens alba* and Mile-a-minute Weed. No flora species of conservation importance was recorded within this habitat. Considering the low naturalness, heavy disturbance, low diversity and abundance of wildlife, developed area is considered to be of **low** ecological value.

Fauna

- 9.4.16 In general, the fauna abundance and diversity recorded in terms of avifauna, mammal, butterfly, odonate, herpetofauna and freshwater communities were low, while no firefly species was recorded within the assessment area. No breeding or roosting behaviour were recorded within the assessment area.
- 9.4.17 A total of ten fauna species of conservation importance, including five avifauna, four butterfly, and one odonate species, were recorded from previous studies, while two avifauna species were recorded within the Project Boundary, namely Chinese Hwamei and Little Egret. Chinese Hwamei was found above the footprint of the Underground Quarry Site, and Little Egret was found at the coastal area of Ngau Kok Wan Portal.
- 9.4.18 A total of 13 fauna species of conservation importance, including five avifauna, six mammal, one herpetofauna and one freshwater communities species, were recorded in recent reconnaissance site visits, while four species of conservation importance, namely Crested Goshawk, Lesser Yellow Bat, Short-nosed Fruit Bat, and Unknown Vespertilionidae Species

2, were recorded within the Project Boundary. Crested Goshawk was found above the footprint of the Underground Quarry Site, Lesser Yellow Bat was found along the access road west of Ngau Kok Wan Portal, Short-nosed Fruit Bat was found at Tam Kon Shan Portal area where potential site formation works would be carried out, and Unknown Vespertilionidae Species 2 was found south to the Tam Kon Shan Portal but within the Project Boundary (**Table 9.3**, **Figure 9.02** and **Appendix 9.2** refer).

Table 9.3 Fauna Species of Conservation Importance Recorded within the Assessment Area

Species	Distribution in Hong Kong ⁽¹⁾	Conservation Status	Previous Studies ⁽¹⁰⁾	Recent Reconnaissance Site Visits
Black Kite (<i>Milvus migrans</i>)	Common resident and winter visitor. Widely distributed in Hong Kong.	Cap. 170 ⁽²⁾ ; Cap. 586 ⁽³⁾ ; (RC) ⁽⁴⁾ ; Class II ⁽⁵⁾	In Flight	In Flight
Black-throated Laughingthrush (<i>Pterorhinus chinensis</i>)	Common resident. Widely distributed in woodland and shrubland throughout Hong Kong.	Cap. 170 ⁽²⁾ ; Class II ⁽⁵⁾	-	Mixed Woodland
Chinese Hwamei (<i>Garrulax canorus</i>)	Common resident. Widely distributed in hillside shrubland throughout Hong Kong.	Cap. 170 ⁽²⁾ ; Cap. 586 ⁽³⁾ ; Class II ⁽⁵⁾	Mixed Woodland*; Shrubland; Plantation	-
Chinese Pond Heron (<i>Ardeola bacchus</i>)	Common resident. Widely distributed in Hong Kong.	Cap. 170 ⁽²⁾ ; PRC (RC) ⁽⁴⁾	Modified Watercourse	-
Collared Scops Owl (<i>Otus lettia</i>)	Common resident. Widely distributed in shrubland throughout Hong Kong.	Cap. 170 ⁽²⁾ ; Cap. 586 ⁽³⁾ ; Class II ⁽⁵⁾	-	Mixed Woodland
Crested Goshawk (<i>Accipiter trivirgatus</i>)	Common resident. Widely distributed in woodlands and shrublands throughout Hong Kong.	Cap. 170 ⁽²⁾ ; Cap. 586 ⁽³⁾ ; Class II ⁽⁵⁾ ; Rare ⁽⁶⁾	-	In Flight*
Greater Coucal (<i>Centropus sinensis</i>)	Common resident. Widely distributed in Hong Kong.	Cap. 170 ⁽²⁾ ; Class II ⁽⁵⁾ ; Vulnerable ⁽⁶⁾	Plantation	-
Little Egret (<i>Egretta garzetta</i>)	Common resident, migrant and winter visitor. Widely distributed in coastal area throughout Hong Kong.	Cap. 170 ⁽²⁾ ; PRC (RC) ⁽⁴⁾	In Flight*	In Flight
Greater Bent-winged Bat (<i>Miniopterus magnater</i>)	Data deficient.	Cap. 170 ⁽²⁾ ; PRC (RC) ⁽⁴⁾	-	Plantation

Species	Distribution in Hong Kong ⁽¹⁾	Conservation Status	Previous Studies ⁽¹⁰⁾	Recent Reconnaissance Site Visits
Japanese Pipistrelle (<i>Pipistrellus abramus</i>)	Widely distributed throughout Hong Kong.	Cap. 170 ⁽²⁾	-	Mixed Woodland; Shrubland; Plantation
Lesser Yellow Bat (<i>Scotophilus kuhlii</i>)	Fairly widely distributed in countryside areas throughout Hong Kong.	Cap. 170 ⁽²⁾ ; (LC) ⁽⁴⁾	-	Developed Area*
Short-nosed Fruit Bat (<i>Cynopterus sphinx</i>)	Very widely distributed in urban and countryside areas throughout Hong Kong.	Cap. 170 ⁽²⁾	-	Mixed Woodland; Plantation*
Unknown Vespertilionidae species 1	-	Cap. 170 ⁽²⁾	-	Mixed Woodland; Shrubland; Developed Area
Unknown Vespertilionidae species 2	-	Cap. 170 ⁽²⁾	-	Mixed Woodland; Shrubland; Plantation*; Developed Area
Courtesan (<i>Euripus nyctelius</i>)	Tai Po, Kai Shan.	Very Rare ⁽⁷⁾	Mixed Woodland	-
Grass Demon (<i>Udaspes folus</i>)	Widely distributed throughout Hong Kong.	Rare ⁽⁷⁾	Mixed Woodland	-
Lesser Band Dart (<i>Potanthus trachala</i>)	Widely distributed throughout Hong Kong.	Rare ⁽⁷⁾	Plantation	-
Small Cabbage White (<i>Pieris rapae</i>)	Shep Mun Kap, Fan Lau, Ngong Ping, Kam Tin, Ho Chung, Luk Keng, Tuen Mun Ash Lagoon.	Rare ⁽⁷⁾	Plantation	-
Dusk-hawker (<i>Gynacantha</i> sp.)	-	LC ⁽⁴⁾	Modified Watercourse	-
Four-clawed Gecko (<i>Gehyra mutilata</i>)	Widely distributed throughout Hong Kong.	VU ⁽⁸⁾ , VU ⁽⁹⁾	-	Plantation
Hong Kong Freshwater Crab (<i>Nanhaipotamon hongkongense</i>)	Presumably endemic to Hong Kong, but been recently discovered in Shenzhen; Common.	PGC ⁽⁴⁾	-	Plantation; Natural Watercourse

Notes:

(1) AFCD (2025): Hong Kong Biodiversity Information Hub.

- (2) Protected under the Wild Animal Protection Ordinance (Cap. 170).
 - (3) Protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586).
 - (4) Fellowes et al. (2002): Wild Animals to Watch: Terrestrial and Freshwater Fauna of Conservation Concern in Hong Kong. LC=Local Concern; RC=Regional Concern; PRC=Potential Regional Concern. Letter in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
 - (5) List of Wild Animals under State Protection (promulgated by National Forestry and Grassland Administration in 2021).
 - (6) Zheng & Wang (1998): China Red Data Book of Endangered Animals. Aves.
 - (7) Chan et al. (2011): A Review of the Local Restrictedness of Hong Kong Butterflies.
 - (8) Jiang et al. (2016): Red List of China's Vertebrates. VU=Vulnerable.
 - (9) Redlist of China's Biodiversity - Vertebrates (promulgated by the Ministry of Ecology and Environment and Chinese Academy of Sciences in 2020). VU=Vulnerable.
 - (10) CEDD (2018); CEDD (2023); CEDD (2024).
- * Recorded within Project Boundary.

9.5 Prediction and Evaluation of Ecological Impacts

9.5.1 The construction phase of the Project includes site establishment for the quarry (including site formation, slope stabilization, slope cutting works and installation for ancillary activities at portals and the conveyor belt system at Wok Tai Wan Works Area), excavation of tunnel portals by slope cutting, and excavation of the initial sections of the Main Access Tunnel by mechanical breaking methods. The operation phase of the Project includes rock excavation within the Underground Quarry Site by the D&B method and ancillary operations.

Construction Phase – Direct Impact

Habitat Loss

9.5.2 Loss of mixed woodland, plantation, modified watercourses and developed area is anticipated due to the aboveground construction works, including the construction of portals and associated works areas (**Table 9.4** refers). The affected mixed woodland consisted of common native and exotic floral species, which are typical vegetation assemblage in a disturbed environment, while the small area of affected strips of plantation comprised common and typical exotic plantation species. The poor water quality of the modified watercourses, and heavy disturbance and predominance of ruderal floral species in the developed area imply low ecological values of these two habitats. In general, the recorded biodiversity was low in these potentially affected small areas, and they are under constant disturbance such as human activities and traffic of heavy vehicles. Therefore, direct impact of habitat loss is considered **minor**.

Table 9.4 Area of Habitat Loss due to Surface Works

Habitat	Approx. Area of Habitat Loss (ha) ⁽¹⁾
Mixed Woodland	0.85
Shrubland	0.11
Plantation	0.92
Modified Watercourse	0.03 (~ 0.10km) ⁽²⁾
Natural Watercourse	Nil ⁽²⁾
Developed Area	7.49
Total	9.40

Notes:

- (1) Area of habitat loss included the habitats within the Surface Works Area under the current design.
- (2) The modified watercourse (i.e. W3) and natural watercourse (i.e. W6) located partially within the Wok Tai Wan Works Area will be preserved as far as practicable. Therefore, direct loss of these two watercourses is not anticipated.

Injury and Mortality of Wildlife

9.5.3 The construction activities may result in injury and mortality of wildlife. Animals may be killed or injured by construction activities, including collision with rapidly moving vehicles and aboveground structures. Traffic flow brought by construction vehicles may lead to roadkill. However, as only low diversity and abundance of fauna was recorded within and in the vicinity of the Project Boundary, potential injury and mortality of wildlife would be unlikely with the adoption of appropriate mitigation measures to prevent terrestrial fauna from entering the

Project Site.

Impact on Species of Conservation Importance

- 9.5.4 A total of three flora species of conservation importance (i.e. three individuals of Incense Tree, one individual of *Aralia chinensis* and one individual of Small Persimmon) were recorded within Tam Kon Shan Portal while one flora species (i.e. three individuals of *Aralia chinensis*) was recorded within Ngau Kok Wan Portal (**Sections 9.4.5 and 9.4.9** refer). Direct impact on these species is unavoidable and therefore would require mitigation measures such as transplantation. Details of mitigation measures are provided in **Section 9.6**. Impacts to these species of conservation importance would be **minor** with appropriate mitigation measures implemented.
- 9.5.5 The four fauna species of conservation importance (i.e. Crested Goshawk, Lesser Yellow Bat, Short-nosed Fruit Bat and Unknown Vespertilionidae Species 2) recorded within Project Boundary were in flight and neither breeding nor roosting behaviour were recorded within the Project Boundary. Thus, direct impacts to these species of conservation importance would be unlikely.

Construction Phase – Indirect Impact

Disturbance to Natural Habitats and Concomitant Wildlife

- 9.5.6 Aboveground construction activities described in **Section 9.5.1** would produce various forms of disturbance (e.g. noise, air quality, glare, increased traffic and human activities) and impact the adjacent natural habitats and the concomitant wildlife. Given that the Project Boundary is already under considerable disturbance and low biodiversity was recorded in the affected habitats, the indirect impact from the increased disturbance is anticipated to be **minor**.
- 9.5.7 The mechanical excavation for the construction of Main Access Tunnel would produce noise and vibration disturbance impacts on the aboveground habitats and lead to potential displacement of fauna. Considering that the aboveground habitats are already subject to the disturbance and vibrations from the heavy traffic flow on Tsing Yi North Coastal Road and Tam Kon Shan Road, disturbance impacts due to the construction of Main Access Tunnel would be **minor**.

Impacts on Water Quality

- 9.5.8 Short sections of W1 fall within Ngau Kok Wan Portal, while W2 is in the vicinity of the portal. Also, short sections of W3 and W6 fall within the Wok Tai Wan Works Area. The water quality of these watercourses could be indirectly impacted by uncontrolled site runoff and chemical spillage from construction activities. However, the poor water quality and stagnant water flow of W1 and W3, and the absence of water flow of W6 make the watercourses unlikely habitats for aquatic communities. With good site practices and standard measures to prevent site runoff and other contaminants from entering these modified watercourses, the indirect ecological impact from change in water quality would be **insignificant**.

Operation Phase

- 9.5.9 No direct ecological impacts would be expected from the operation phase of the Project. Despite the underground nature of the quarrying, disturbance (e.g. ground vibration, noise and air quality) to the surrounding, aboveground habitats and concomitant wildlife may be created from the rock excavation by D&B method, ancillary operations, and increased road traffic associated with the operation of the Underground Quarry Site. The operation of the conveyor belt system at Wok Tai Wan Works Area may also generate disturbances, including the increase in human activities and the associated noise and dust and gaseous disturbances.
- 9.5.10 Underground construction activities (e.g. rock excavation within the Underground Quarry Site and construction of Main Access Tunnel) could potentially affect water quality in soil and aquifer layers due to groundwater infiltration. Nonetheless, comparing to excavation in soft

ground, the construction activities would result in relatively minor infiltration/drawdown of groundwater, as the rock itself is a natural barrier with low permeability, preventing potential groundwater drawn in layers above. Furthermore, only short sections of seasonal natural watercourses (i.e. W1a and W4) with limited water flow were identified above the footprint of the Underground Quarry Site. With the implementation of appropriate mitigation measures (e.g. probing ahead and pre-grouting) to reduce the overall inflow of water and the effect of groundwater infiltration and drawdown, no adverse impacts due to groundwater table drawdown would be anticipated.

- 9.5.11 Since the Underground Quarry Site is at a significant depth from ground surface, the quarrying-induced vibration would be unlikely to result in significant disturbance impacts. On the other hand, the noise level and dust and gaseous emission from the operation of the Underground Quarry Site and the ancillary activities are not anticipated to increase significantly from the current level (i.e. from existing heavy vehicular activities on excavated land and access road). As such, the impacts would also be **insignificant**.

9.6 Mitigation Measures

Avoidance of Flora Species of Conservation Importance

- 9.6.1 Direct impact to species of conservation importance outside the Project Boundary (e.g. *Aralia chinensis* along the access road west of Ngau Kok Wan Portal) should be avoided with careful construction design and Plant Protection Zone should be setup during the construction phase (e.g. preservation in-situ) to avoid encroachment and injury, where appropriate (DEVB, 2020).

Minimisation of Direct Impact of Terrestrial Natural Habitats

- 9.6.2 To minimise the extent of terrestrial habitat loss and its ecological impact, the proportion and extent of land-based works (e.g. portals and surface works areas) have been carefully designed and strategically positioned along existing developed area as far as practicable. The surface works area in Wok Tai Wan Works Area has been confined to minimise direct loss to the mixed woodland (**Figure 9.02** refers).

Transplantation of Flora Species of Conservation Importance

- 9.6.3 Direct impacts on the three species of conservation importance (i.e. Incense Tree, *Aralia chinensis* and Small Persimmon) at the portal areas are unavoidable and should be minimised by transplantation of the affected individuals to a nearby suitable recipient site before commencement of construction activities at the respective site (e.g. portal site formation). A detailed pre-construction vegetation survey should be conducted within the Project Site by a qualified ecologist/botanist with at least five years of relevant experience to assess the locations and conditions of the flora species of conservation importance. A Pre-construction Vegetation Survey Report and Transplantation Proposal should also be prepared to include findings of the vegetation survey and recommend applicable mitigation measures (e.g. transplantation and mitigation planting at a recipient site, and subsequent monitoring visit for the affected individuals) where necessary.

Adoption of Good Site Practice

- 9.6.4 The procedures promulgated under ProPECC PN 2/24 *Construction Site Drainage* should be adopted, where applicable, to contain the site runoff and minimise water quality impacts.
- 9.6.5 Indirect impacts (e.g. construction runoff, air quality, noise and glare) to the nearby habitats could be minimised by adopting good site practices, including but not limited to the following:
- Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural habitats, and ensure litter and fuels would not enter nearby drainages and waterbodies;
 - Noise mitigation measures by means of movable noise barriers/enclosures, the use of Quiet PME and other good site practices to limit noise emissions at source;
 - Glare reduction measures such as restriction of construction hours and provision of

hoarding to the adjoining habitats to minimise the impact to nearby nocturnal fauna; and

- Air quality control measures such as regular water spraying of unpaved roads, proper covering of dusty material storage piles to avoid and minimise emission and dispersal dust, which would cover vegetation and subsequently suppress their health and growth.

Buffer Planting

- 9.6.6 Though the habitats and associated wildlife already experience disturbance from existing road traffic and construction activities, subject to the detailed design, buffer planting could be implemented at both portal entrances and along the access road west of Ngau Kok Wan to minimise disturbance. Buffer planting of native tree species could be considered as an ecological enhancement while helping to contain disturbances within the portal and works areas.

9.7 Conclusion

- 9.7.1 Six habitats (i.e. mixed woodland, shrubland, plantation, modified watercourse, natural watercourse and developed area) were identified within the assessment area, with generally low diversity and abundance of flora and fauna recorded. Mixed woodland within the assessment area is considered to range from '**low**' to '**moderate**' ecological values. Natural watercourses within the assessment area are considered to be of '**low to moderate**' ecological value. Shrubland, plantation, modified watercourses and developed area within the assessment area are considered to be of '**low**' ecological value. Three flora species of conservation importance (i.e. Incense Tree, *Aralia chinensis*, and Small Persimmon) were recorded at various habitats within the assessment area, including mixed woodland, shrubland and plantation.

- 9.7.2 Direct ecological impacts during construction phase would include minor loss of mixed woodland and plantation at Tam Kon Shan Portal, minor loss of mixed woodland, plantation, modified watercourse and developed area at Ngau Kok Wan Portal, minor loss of developed area along the access road west of Ngau Kok Wan Portal, and minor loss of mixed woodland, shrubland, plantation and developed area at Wok Tai Wan Works Area. Potential injury and mortality of wildlife, and direct impact on the three flora species of conservation importance (i.e. Incense Tree, *Aralia chinensis* and Small Persimmon) are also anticipated. Avoidance of these species located outside the Project Boundary should be considered and adopted where applicable. As the direct impacts on flora species of conservation importance within both portal areas are unavoidable, transplantation of individuals would be required (which includes a detailed pre-construction vegetation survey at the impacted areas and preparation of a Pre-construction Vegetation Survey Report and Transplantation Proposal).

- 9.7.3 Indirect ecological impacts during construction would also affect adjacent habitats and concomitant wildlife through disturbance (e.g. noise, air quality, glare, increased traffic and human activities), groundwater table drawdown and water quality impacts. The operation phase of the Project would also result in a potential indirect disturbance impact. These ecological impacts are considered **minor** in general.

- 9.7.4 Nonetheless, with the proper implementation of the mitigation measures (e.g. careful construction design, setup of plant protection zone, transplantation of flora species of conservation importance, clear demarcation of site boundary, adoption of good site practices and buffer planting), no unacceptable ecological impacts are anticipated to arise from the Project.

9.8 Reference

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10 LANDSCAPE AND VISUAL

10.1 Introduction

10.1.1 This section identifies and assesses the potential landscape and visual impacts arising from the Project. Based on the impact identified, preliminary landscape and visual mitigation measures are proposed to alleviate any potential adverse impact.

10.1.2 The site location and the details of the Project are described in **Section 2**.

10.2 Environmental Legislation, Standards and Guidelines

10.2.1 Legislation and standards that are relevant to the consideration of preliminary landscape and visual impacts under this assessment include the following:

- Chapters 4, 10 and 11 of Hong Kong Planning Standards and Guidelines;
- DEVB TC(W) No. 4/2020 – Tree Preservation;
- DEVB TC(W) No. 5/2020 – Registration and Preservation of Old and Valuable Trees;
- ETWB TC(W) No. 5/2005 – Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works;
- GEO Publication No. 1/2011 – Technical Guidelines on Landscape Treatment for Slopes;
- TPB PG-No. 41A – Town Planning Board Guidelines on Submission of Visual Impact Assessment for Planning Applications to the Town Planning Board;
- Tree Management Practice Note No. 1 – Tree Preservation during Construction; and
- Study on Landscape Value Mapping of Hong Kong.

10.3 Assessment Methodology and Area

10.3.1 Identification of the baseline landscape resources (LRs), landscape character areas (LCAs) and public viewers (PVs) within the assessment area was achieved by a desktop study of topographical maps, information databases, and aerial photographs, as well as undertaking site visits.

10.3.2 The assessment area for the preliminary landscape impact assessment is proposed as 500m from the Project Boundary. The assessment area of visual impact assessment is defined by Tuen Mun Road in the north, Ma Wan in the west, natural hillside in the south and shipyard factories along the Tam Kon Shan Road in the east. The assessment area and the Visual Envelope are shown in **Figure 10.01** and **Figure 10.02**, respectively.

10.3.3 The methodology for the preliminary landscape impact assessment during the construction and operation phases includes:

- Broad identification of the baseline LRs and LCAs that would be potentially affected by the Project;
- Broad assessment of the degree of sensitivity of the LRs and LCAs identified;
- Broad identification of selected sources of landscape impacts;
- Broad identification of the magnitude of landscape impacts;
- Broad recommendation of selected landscape mitigation measures; and
- Broad prediction of the significance of residue landscape impacts with mitigation measures.

10.3.4 The sensitivity of each LR and LCA is classified as follows:

- High: Important landscape or landscape resource of particularly distinctive character or high importance, sensitive to relatively small changes;
- Medium: Landscape or landscape resource of moderately valued landscape characteristics reasonably tolerant to change; and
- Low: Landscape or landscape resource, the nature of which is largely tolerant to change.

10.3.5 The magnitude of change on LR and LCA is classified as follows:

- Substantial: The landscape or landscape resource would have a major change;
- Moderate: the landscape or landscape resources would have a moderate change.
- Slight: The landscape or landscape resources would have slight or barely perceptible changes; and
- Negligible: The landscape or landscape resource would have no discernible change.

10.3.6 The significant thresholds of landscape impacts are categorized as follows:

- Substantial: Adverse/ beneficial impact where the proposal would cause significant deterioration or improvement in existing landscape quality;
- Moderate: Adverse/ beneficial impact where the proposal would cause a noticeable deterioration or improvement in existing landscape quality;
- Slight: Adverse/ beneficial impact where the proposal would cause a barely perceptible deterioration or improvement in existing landscape quality; and
- Negligible: No discernible change in the existing landscape quality.

10.3.7 The following **Table 10.1** shows the rationale in assessing the potential significance of landscape impacts.

Table 10.1 Relationship between Landscape Sensitivity and Impact Magnitude in Defining Impact Significance

		Sensitivity of LR / LCAs		
		Low	Medium	High
Magnitude of Change	Substantial	Moderate	Moderate / Substantial	Substantial
	Moderate	Slight / Moderate	Moderate	Moderate / Substantial
	Slight	Slight	Slight / Moderate	Moderate
	Negligible	Negligible	Negligible	Negligible

10.3.8 The methodology for the preliminary visual impact assessment during the operation phase includes:

- Broad identification of the Visual Envelope and associated PVs, including key visual resources and visual detractors, that would be potentially affected by the Project;
- Broad assessment of the degree of sensitivity of the PVs identified;
- Broad identification of sources of visual change, including visual composition and obstruction;
- Broad assessment of visual change experienced by the identified PVs and visual resources/ elements; and
- Recommendation of visual mitigation measures.

Table 10.2 Relationship between Visual Sensitivity and Magnitude of Change in Defining Impact Significance

		Visual Sensitivity		
		Low	Medium	High
Magnitude of Change	Substantial	Moderate	Moderate / Substantial	Substantial
	Moderate	Slight / Moderate	Moderate	Moderate / Substantial
	Slight	Negligible / Slight	Slight / Moderate	Moderate
	Negligible	Negligible	Negligible	Negligible

10.3.9 The resultant overall visual impact may be concluded and classified within a range of threshold:

- Beneficial: If the Proposed Development in the overall term will improve the visual quality and complement the visual character of its setting from most of the identified key public viewing points.
- Negligible: If the Proposed Development will, with or without mitigation measures, in the overall term have insignificant visual effects to most of the identified key public viewing points, or the visual effects would be screened or filtered by other distracting visual elements in the assessment area.
- Slight: If the Proposed Development will, with or without mitigation measures, result in overall term slight adverse visual effects to most of the identified key public viewing points.
- Moderate: If the Proposed Development will, with or without mitigation measures, result in overall term some adverse visual effects to most of the key identified key public viewing points, but these can be eliminated, reduced or moderated to a certain extent by design/mitigation measures.
- Substantial: If the Proposed Development will in overall term cause serious and detrimental visual effects to most of the identified key public viewing points even with mitigation measures.

10.4 Review of Planning Control Framework

- 10.4.1 A review of the existing and planned development framework for the proposed works and for the surroundings was considered. It aims to gain an insight into the outlook of the area affected, identify potential resources and sensitive receivers, and evaluate the compatibility between the Project and the existing and planned land use setting.
- 10.4.2 The Project Site is covered by the Approved Tsing Yi OZP No. S/TY/32 (**Figure 10.03** refers). The land use zones to be potentially affected by the Project and the future outlook of the area are discussed in **Table 10.3**.
- 10.4.3 The proposed portal structures and potential site formation area will be fall within “Green Belt”, “Other Specified Uses” (“OU”) annotated “Recreation and Tourism Related Uses” (“OU(RTRU)”) and “OU” annotated “Boatyard and Marine-oriented Industrial Uses” (“OU(BMIU)”) on the approved Tsing Yi Outline Zoning Plan.

Table 10.3 Summary of the Review of Planning and Development Control Framework

OZP Plan Title and No.	Land Use Zoning	Approx. Area within 500m Assessment Area (ha)	Approx. Area Affected (ha) (Approximate % of Zoning Affected)
Approved Tsing Yi OZP No. S/TY/32	Green Belt (“GB”)	104.7	30.7 (29%)
	Area shown as “Road”	26.6	1.4 (5%)
	Other Specified Uses (“OU”) annotated “Recreation and Tourism Related Uses” (“OU(RTRU)”)	10.9	6.9 (63%)
	Other Specified Uses (“OU”) annotated “Boatyard and Marine-oriented Industrial Uses” (“OU(BMIU)”)	10.2	0.2 (2%)
	Industrial (“I”)	7.5	0 (0%)
	Residential (Group A)	3.3	0 (0%)
	Other Specified Uses (“OU”) annotated Viewing Platform	1.9	0 (0%)
	Government, Institution or Community (“G/IC”)	1.5	0 (0%)
	Other Specified Uses (“OU”) annotated Cement Plant	0.9	0 (0%)

10.4.4 In general, the majority of the affected area falls within the “OU(RTRU)” and “OU(BMIU)” zones on the approved Tsing Yi OZP No. S/TY/32 for the construction/site formation works of work areas, portals, and conveyor belt system. A small portion of the area within the OU Zone will be taken up for the construction of the portals, while a small portion of the area within the GB Zone will potentially be changed due to the site formation works for the portal and conveyor belt system construction.

10.5 Baseline Findings

10.5.1 Under this PER, only key LRs, LCAs, and PVs which would be potentially affected are included and discussed.

Existing Trees

10.5.2 Approx. 16,700 m² of existing hillside vegetation, including green belt, will be inevitably affected by the portal construction and associated development. There are approximately 1,230 nos. of existing trees surveyed and approximately 765 nos. of trees proposed to be removed within the proposed works area. None of these are Registered Old and Valuable Trees on the records of Greening, Landscape and Tree Management Section of DevB. No mature tree was found in the site, i.e. trees with individual trunk(s) over 750mm diameter at

breast height. Tree species to be removed included *Acacia confusa*, *Acacia mangium*, *Adina pilulifera*, *Celtis sinensis*, *Cinnamomum burmannii*, *Corymbia citriodora*, *Cratoxylum cochinchinense*, *Eucalyptus exserta*, *Ilex rotunda*, *Liquidambar formosana*, and *Schefflera heptaphylla*, etc.

10.5.3 Transplanting should be considered as far as possible unless the trees affected are of low conservation and amenity value, or have a low chance of surviving or recovering to its normal form after transplanting. Among the trees to be affected by the proposed works, trees are selected as far as possible for transplanting to reduce the impact on existing trees. However, since most of the affected individual trees are located either on natural terrain or engineered slopes and in mature size, their survival rate after transplanting is low and not feasible for transplanting. Therefore, tree felling is proposed with compensatory planting. The tree treatment proposal should be submitted under a separate submission – Tree Preservation and Removal Proposal.

10.5.4 The compensatory planting strategy of the proposal is as follows:

- Compensatory planting for trees to be removed due to non-slope works will be of a ratio not less than 1:1 in terms of number, as far as practicable. The size of the proposed compensatory tree is appropriate to the location and function;
- For slope works, the ratio of 1:1 by number requirement may not apply due to site constraints; and the planting of shrubs, climber mix and woodland shrub mix would be more appropriate;
- Apart from the above compensatory planting requirements, quality greenery will be considered, such as themed planting, enhancing the landscape amenity value and maximizing greening opportunity etc.

Landscape Resources (LRs)

10.5.5 The preliminary findings of baseline LR, which will be potentially affected by the Project, together with their sensitivity, are discussed in **Table 10.4**. The locations of these baseline LR are mapped in **Figure 10.01**.

Table 10.4 Baseline LR and their Sensitivity

LRs	Description	Sensitivity
LR1	<u>Hillside vegetation along Tsing Yi North Coastal Road</u> Hillside vegetation along the Tsing Yi North Coastal Road is the key LR and is a common LR. The quality of this LR is high and the ability to accommodate change is low. Therefore, the sensitivity of this LR is considered as high.	High
LR2	<u>Rambler Channel Sea Waterbody</u> The sea waterbody comprises Rambler Channel and Ma Wan Channel, which is a valuable LR contributing to the unique waterfront setting of the Ting Kau area. In view of the physical characteristics of the channels, the sensitivity of this LR is high.	High
LR3	<u>Coastal Landscape along Wok Tai Wan and Cheung Shue Tau</u> Natural rocky shore, trees and scattered shrubland along the coastal area of Wok Tai Wan and Cheung Shue Tau are the dominant LR and is a common LR. The quality of this LR is medium. The ability to accommodate changes and the sensitivity of this LR are considered as medium.	Medium

Landscape Character Areas (LCAs)

10.5.6 The preliminary findings of baseline LCAs, which will be potentially affected by the Project,

together with their sensitivity, are discussed in **Table 10.5**. The locations of these baseline LCAs are mapped in **Figure 10.01**.

Table 10.5 Baseline LCAs and their Sensitivity

LCA	Description	Sensitivity
LCA1	<u>Strait Landscape</u> This LCA is an inshore coastal water enclosed by significant landforms of north Tsing Yi and Ting Kau, creating a distinct sense of enclosure on the two sides. It is characterized by the surrounding landforms and the muted hues and horizontality of their coastal waters comprised of passing vessels, shipping traffic, and waterborne recreational activity. The quality of this LCA is high, with low ability to accommodate change and the sensitivity of this LCA is considered as medium.	Medium
LCA2	<u>Transportation Corridor Landscape</u> This LCA comprises the major highway corridor in the North West Tsing Yi Interchange, the Ting Kau Bridge and the Lantau Link Visitors Centre. Major features include bridges, flyovers, signage gantries, interchange, and associated roadside buffer planting areas. This type of LCA is common in Hong Kong. It has high ability to accommodate change. The sensitivity is therefore considered as low.	Low
LCA3	<u>Industrial Urban Landscape</u> This is found on the low-lying areas of the reclaimed land along the coast of north Tsing Yi. It mainly comprises the cement plants and shipyards within the assessment area and the adjoining vacant lands on the peripheries. The quality of this LCA is low, with high ability to accommodate change, and the sensitivity of this LCA is considered as low.	Low
LCA4	<u>Upland and Hillside Landscape</u> Woodland is a significant landscape element of this LCA and is of good quality with low ability to accommodate change. The sensitivity of this LCA is high.	High

Visual Envelope

- 10.5.7 Visual Envelope is identified by site visit and desktop study of topographic maps and photographs to determine visibility of the Project from various locations. The Project Site is located within the coastal area of the Northern part of Tsing Yi, adjacent to the shipyard along the Tam Kon Shan Road. It is a waterfront site sandwiched between the Northwest Tsing Yi Interchange, Tsing Long Highway and Tsing Yi North Coastal Road, vegetated hillsides to the east, and Rambler Channel and Ma Wan Channel to the north and west respectively. An industrial cluster including boatyards and marine-oriented industrial uses with building heights (BHs) generally not exceeding +35mPD is situated at the northeast of the Site along the coastline. Another low-rise industrial cluster, including dockyards and oil storage with BH generally not exceeding +30mPD is located to its further south. Lantau Link Viewing Platform at about +68.5mPD is located to the immediate north of Wok Tai Wan Works Area, for public enjoyment of the scenic view of Tsing Ma Bridge and the surrounding landscape and seascape.
- 10.5.8 The visual envelope of the Project includes from the Tuen Mun Road in the north, Ma Wan in the west, natural hillside in the south and shipyard factories along the Tam Kon Shan Road in the east. The key visual resources within or in the vicinity of the visual envelope including the ridgeline formed by Shek Lung Kung at Tai Lam, the unique scene of Rambler Channel and Ma Wan Channel, and the spectacular view of the Ting Kau Bridge. The open sky view is one of the key visual resources. The visual detractor of the Project Site is the industrial area in north Tsing Yi with industrial buildings, vacant lands and limited landscape areas.

Public Viewers (PVs)

10.5.9 Within the visual envelope, a number of key PVs were identified during the operation phase. They are listed, together with their baseline assessment and sensitivity, in **Table 10.6** and mapped in **Figure 10.02**.

10.5.10 The sensitivity of PVs were assessed with key factors, including type of PVs, number of PVs, quality of existing view, degree of visibility and duration of view of the PVs are evaluated.

Representative Public Viewing Points

10.5.11 Photomontages at representative locations show a comparison between existing conditions and proposals on the Proposed Scenario with mitigation measures as presented from **Figure 10.07** to **Figure 10.13**. An enlarged version of these figures are presented in **Appendix 10.1**.

10.5.12 The criteria for the selection of representative public viewing points for photomontages includes:

- the public viewing points which cover the aboveground structure viewed from different angles of major public viewing points representing key PVs or PV groups who would be potentially affected by the proposed structures in the operation phase; and
- the public viewing points should be able to represent the worst-case scenarios and demonstrate the compatibility of the aboveground structures to the adjacent visual context and illustrate the visual effect during the Proposed Scenario with mitigation measures.

10.5.13 Based on the locations of the proposed aboveground structures, the proposed public viewing points from key representative PVs are mapped in **Figure 10.03** with their description provided as below:

- VP1 – View from Ting Kau Beach viewing at the proposed Ngau Kok Wan Portal and Tam Kon Shan Portal. This viewing point is selected to represent the view of PV RE1.
- VP2 – View from Approach Beach viewing at the proposed Ngau Kok Wan Portal and Tam Kon Shan Portal. This viewing point is selected to represent the view of PV RE1.
- VP3 – View from the Minibus Stop on Tam Kon Shan Road near Cheung Shue Tau, viewing at the proposed Tam Kon Shan Portal. This viewing point is selected to represent the view of PV T1.
- VP4 – View from Hoi Mei Wan Beach viewing at the proposed Ngau Kok Wan Portal and Wok Tai Wan Works Area (the conveyor belt system). This viewing point is selected to represent the view of PV RE2.
- VP5 – View from Ma Wan Tung Wan Beach viewing at the Wok Tai Wan Works Area. This viewing point is selected to represent the view of PV RE3.
- VP6 – View from Tsing Yi Nature Trail viewing at the proposed Ngau Kok Wan Portal and Tam Kon Shan Portal. This viewing point is selected to represent the view of PV RE4.
- VP7 – View from Lantau Link Viewing Platform, viewing at the Wok Tai Wan Works Area (the conveyor belt system). This viewing point is selected to represent the view of PV RE5.

Table 10.6 PVs and their Visual Sensitivity

VP No.	PV ID	Visual Sensitivity of the Public Viewers (VPs)	PVs	Approx. Viewing Distance	Type of PVs	Number of PVs (Many/ Medium/ Few)	Quality of Existing View (Good/ Fair/ Poor)	Degree of Visibility (Full/ Partial/ Glimpse)	Duration of View (Long/ Medium/ Short)	Frequency of View (Frequent / Occasional / Rare)	Sensitivity (Low/ Medium/ High)
VP1	RE1	Ting Kau Beach	Recreational User of the beaches along Castle Peak Road – New Ting Kau	1km	Recreational	Medium	Good	Full	Medium	Occasional	High
VP2	RE1	Approach Beach	Recreational User of the beaches along Castle Peak Road – New Ting Kau	0.9km	Recreational	Medium	Good	Full	Medium	Occasional	High
VP3	T1	Minibus Stop on Tam Kon Shan Road near Cheung Shue Tau	Travellers at Cheung Shue Tau	30m	Travelling	Medium	Fair	Partial	Short	Rare	Low
VP4	RE2	Hoi Mei Wan Beach	Recreational User of the beaches along Castle Peak Road – Ting Kau	1.4km	Recreational	Medium	Good	Full	Medium	Occasional	High
VP5	RE3	Ma Wan Tung Wan Beach	Recreational User from Ma Wan	2km	Recreational	Medium	Good	Full	Medium	Occasional	Medium
VP6	RE4	Tsing Yi Nature Trail	Recreational User from Tsing Yi Nature Trail	0.6km	Recreational	Medium	Fair	Glimpse	Short	Occasional	Low
VP7	RE5	Lantau Link Viewing Platform	Recreational User from Lantau Link Viewing Platform	0.2km	Recreational	Few	Good	Glimpse	Medium	Occasional	High

Remark: RE = Recreational; T = Traveller

10.6 Preliminary Landscape and Visual Impact Assessment

Sources of Landscape Impact

10.6.1 The sources of landscape impact due to the Project would create various levels of landscape impact during the construction and operation phases of the Project. Potential impacts would result from the temporary and permanent works during the construction phase and non-permanent aboveground structure elements during the operation phase.

10.6.2 The sources of landscape impact in the construction phase for Ngau Kok Wan Portal, Tam Kon Shan Portal and Wok Tai Wan Works Area would include:

- Site formation works;
- Slope cutting and stabilisation works;
- Installation and establishment for ancillary operations and conveyor belt system;
- Road modification works; and
- Loss of existing trees and other vegetation due to construction works.

10.6.3 The sources of landscape impact in the operation phase for Ngau Kok Wan Portal, Tam Kon Shan Portal and Wok Tai Wan Works Area would include:

- Operation of the quarry and the ancillary activities; and
- Demolishment of ancillary and conveyor belt system.

Landscape Resources (LRs)

10.6.4 The magnitude of unmitigated impacts on LRAs associated with the construction phase and operation phases of the Project was assessed and described in **Table 10.7**:

Table 10.7 Magnitude of Changes on Landscape Resources during Construction and Operation

LR	Landscape Resources	Potential Source and Description of Change	Magnitude of Change (Substantial/ Moderate/ Slight/ Negligible)	
			Construction	Operation
LR1	Hillside vegetation along Tsing Yi North Coastal Road	Approx. 2,200 sqm. of existing hillside vegetation, including green belt with around 165 nos. of existing non-mature trees, will be inevitably affected by the portal construction and associated development.	Slight	Slight
LR2	Rambler Channel Sea Waterbody	No construction or development will be carried out in this LR.	Negligible	Negligible
LR3	Coastal Landscape along Wok Tai Wan and Cheung Shue Tau	Approx. 14,500 sqm. of existing natural rocky landscape including green belt with around 600 nos. of non-mature existing trees will be affected by the portal construction and associated structures.	Moderate	Moderate

Landscape Character Areas (LCAs)

- 10.6.5 The magnitude of unmitigated impacts on LCAs associated with the construction phase and operation phases of the Project was assessed and described in **Table 10.8**:

Table 10.8 Magnitude of Changes on Landscape Character Areas during Construction and Operation

LCA	Landscape Character Area	Potential Source and Description of Changes	Magnitude of Change (Substantial/ Moderate/ Slight/ Negligible)	
			Construction	Operation
LCA1	Strait Landscape	No construction or development will be carried out in this LCA	Negligible	Negligible
LCA2	Transportation Corridor Landscape	Approx. 14,500 sqm. of existing natural rocky landscape with around 600 nos. of existing trees and approx. 2,200 sqm. of hillside vegetation with around 165 nos. of existing trees will be affected by the portal development and associated structures. However, the changes on this LCA due to the Project is relatively small in scale and localized. Therefore, the magnitude of change during both construction and operation phases is considered as slight.	Slight	Slight
LCA3	Industrial Urban Landscape	No construction or development is carried out in this LCA	Negligible	Negligible
LCA4	Upland and Hillside Landscape	No aboveground construction or development will be carried out in this LCA.	Negligible	Negligible

Public Viewers (PVs)

- 10.6.6 The source of visual impact due to the Project would create varying levels of visual impact during the operation phase. Potential impacts would result from the aboveground structure during the operation phase. The preliminary layout plans at Ngau Kok Wan Portal, Wok Tai Wan and Tam Kon Shan Portal are shown in **Figure 10.04 to Figure 10.06**.
- 10.6.7 The sources of visual impact in the operation phase for Ngau Kok Wan Portal, Tam Kon Shan Portal and Wok Tai Wan Works Area would include:
- Operation of the aboveground ancillary activities.

Proposed Works for Ngau Kok Wan Portal

- 10.6.8 The construction of works proposed for the Ngau Kok Wan Portal is mainly the site formation, slope cutting, and installation and establishment of the portal entrance and associated ancillary operations. Some of the existing vegetation will be removed due to site formation works. During the operation phase, all the aboveground structures are the major source of impact to the PVs. By the end of the operation phase, the installations will eventually be

demolished.

Proposed Works for Tam Kon Shan Portal

- 10.6.9 The proposed works for the Tam Kon Shan Portal are mainly the site formation, slope cutting, and installation and establishment of the portal entrance and utility works. To construct the portal of the Main Access Tunnel, a small portion of existing vegetated slope will be cut back. Existing trees will also be removed for site formation works. After the completion of slope works, the portal entrance will be the only aboveground structure while the natural vegetated slope will be replaced by a man-made slope with slope greening.

Proposed Works for Wok Tai Wan Works Area

- 10.6.10 The proposed works for the Wok Tai Wan Works Area are mainly the installation of conveyor belt system. To construct the system, a small portion of the existing vegetated slope will be cut. After completion of the works, the natural vegetated slope will be replaced by a man-made slope with slope greening. By the end of the operation phase, the conveyor belt system will eventually be demolished.

10.7 Preliminary Landscape and Visual Mitigation Measures

10.7.1 Based on the potential landscape and visual impacts identified, a series of mitigation measures during construction and operation phases is recommended to mitigate any adverse impacts and is listed in the table below and illustrated in **Figure 10.14**.

Table 10.9 Preliminary Landscape Mitigation Measures for Construction Phase and Operation Phase

ID No.	Preliminary Landscape Mitigation Measures	Implementation Agency
CM1	<u>Tree Preservation</u> All existing trees to be retained should be carefully protected during the works. Tree protection works should be in accordance with DEVB TC(W) No. 4/2020 – <i>Tree Preservation and Tree Management Practice Note No. 1 – Tree Preservation during Construction</i> .	CEDD (Quarry Operator)
CM2	<u>Erection of Decorative Screen Hoarding</u> Screen hoarding should be erected around the construction site during the construction / operation to reduce the visual impact caused by the works. Greening measures, such as colour variations or graphic patterns of the hoarding, should be adopted to improve the visual appearance.	CEDD (Quarry Operator)
CM3	<u>Management of Construction Activities and Facilities</u> Construction activities and temporary site facilities shall be properly managed to minimize landscape and visual impacts. All works areas, plant, machinery, storage areas and temporary structures shall be confined within designated site boundaries and arranged in an orderly manner. Temporary facilities shall adopt subdued, non-reflective colours to reduce visual intrusion. Good site housekeeping practices shall be implemented, including regular removal of waste materials, proper covering of stockpiles, and avoidance of unnecessary disturbance to retained vegetation.	CEDD (Quarry Operator)
CM4	<u>Reinstatement of the affected landscaped area</u> Upon completion of the construction works, all temporarily affected landscape areas shall be reinstated to conditions comparable to or better than the original state. Affected vegetations shall be replanted with similar or suitable native species where practicable. An establishment period shall be provided to ensure proper plant establishment and replacement of any failed planting.	CEDD (Quarry Operator)

Table 10.10 Preliminary Landscape and Visual Mitigation Measures for Operation Phase

ID No.	Preliminary Landscape and Visual Mitigation Measures	Implementation Agency
OM1	<u>Sensitive and Aesthetically Pleasing Design</u> Sensitive and aesthetically pleasing design should be incorporated in the proposed development to help blend the structures with the adjacent landscape and visual context.	CEDD (Quarry Operator)
OM2	<u>Compensatory Planting</u> Preservation for compensation of vegetation. Whip trees, woodland shrubs and/or climber mix at a spacing from around 500mm to 2,500mm will be compensated. The compensatory planting will follow the guidelines of DEVB TC(W) No. 4/2020 on tree preservation. The proposed planting species should be with reference to the <i>Guiding Principles on Use of Native Plant Species in Public Works Projects</i> issued by DEVB, where possible.	CEDD (Quarry Operator)
OM3	<u>Buffer Screen Planting</u> Buffer screen planting shall be provided along the boundaries and in areas facing sensitive receivers to reduce visual impacts arising from the proposed development. The buffer planting shall be of sufficient density and height at maturity to provide long-term screening and visual integration with the adjacent environment.	CEDD (Quarry Operator)
OM4	<u>Landscape Treatments on Slope or Retaining Structure</u> Landscape treatment shall be applied to exposed slopes and retaining structures to minimise visual impact and integrate them with the surrounding landscape. Measures may include hydroseeding, shrub planting, and climber planting.	CEDD (Quarry Operator)
CM1	<u>Tree Preservation</u> All existing trees to be retained should be carefully protected during construction. Tree protection works should be in accordance with DEVB TC(W) No. 4/2020 – <i>Tree Preservation</i> and <i>Tree Management Practice Note No. 1 – Tree Preservation during Construction</i>.	CEDD (Quarry Operator)
CM2	<u>Erection of Decorative Screen Hoarding</u> Screen hoarding should be erected around the construction site during the construction / operation to reduce the visual impact caused by the works. Greening measures, such as colour variations or graphic patterns of the hoarding, should be adopted to improve the visual appearance.	CEDD (Quarry Operator)

10.7.2 The mitigation measures for the construction phase listed above should be implemented as early as possible in order to minimize the landscape and visual impacts in the construction phase. The mitigation measures for the operation phase listed above should be adopted during the detailed design and be built as part of the construction works at the last phase of the construction period so that they are in place at the date of commissioning of the quarry operation.

10.8 Preliminary Evaluation of Residual Impacts

Landscape Impact

10.8.1 The potential significance of the impacts on LR1 and LR3 during the construction and operation phases, before and after mitigation, is provided in **Table 10.11**. The assessment followed the proposed methodology and assumed that the appropriate mitigation measures identified in **Table 10.9** and **Table 10.10** would be implemented, and the full effect of the soft landscape mitigation measures would be realized after ten years.

10.8.2 Under the proposed construction for ancillary operations and associated site formation work, the Project will have a predicted impact on the hillside vegetation (LR1) and scattered shrubland along the coastal area of LR3. Approximately 2,200 sqm. of hillside vegetation with around 165 nos. of existing trees along Tsing Yi North Coastal Road (LR1) and approximately 14,500 sqm. of coastal landscape with around 600 nos. of existing trees along Wok Tai Wan and Cheung Shue Tau (LR3) will be affected by the proposed works. The change is considered localized and the magnitude of change for LR1 and LR3 are considered as slight and moderate, respectively. The sensitivity of LR1 is high and the resultant unmitigated landscape impact is moderate while the sensitivity of LR3 is medium and the resultant unmitigated landscape impact is moderate. With the implementation of proposed mitigation measures, including tree compensation by woodland planting mix, the residual impact for both LR1 and LR3 will be reduced from moderate to slight for the Proposed Scenario and will further be reduced to negligible when the compensatory planting on the soil cut slopes and berm planter becomes mature in year 10 of operation.

10.8.3 There would be localized impact on the transportation corridor landscape (LCA2). There are approximately 14,500 sqm. of existing natural rocky landscape with around 600 nos. of existing trees and approximately 2,200 sqm. of hillside vegetation with around 165 nos. of existing trees will be affected by the portal development and associated site formation works in LCA2. The magnitude of change is considered as slight. The sensitivity of LCA2 is low. The resultant unmitigated landscape impact is considered as slight. With the implementation of proposed mitigation measures, it is anticipated there would be slight residual impact for the Proposed Scenario and will be further reduced to negligible when the proposed planting becomes mature in year 10 of operation.

10.8.4 Considering there would be no construction works and associated developments / aboveground works in the waterbody of Rambler Channel Sea Waterbody (LR2), Strait Landscape (LCA1), Industrial Urban Landscape (LCA3) and Upland and Hillside Landscape (LCA4), it is predicted that there would be no impact to these LR and LCAs. The sensitivity of these LR and LCAs is low to high. The resultant magnitude of change is considered as negligible.

10.9 Appraisal of Visual Changes

10.9.1 **VP1: Ting Kau Beach (Figure 10.07)**

- **Visual Composition:** VP1 comprises the open sky view, Ting Kau Bridge, vegetated hillside, Ting Kau Beach, Rambler Channel, low-rise industrial cluster and high-rise residential buildings in Tsing Yi area in the background.
- **Visual Obstruction:** Given the far viewing distance, the existing view to the hillside greenery will be slightly blocked by the Proposed Ngau Kok Wan Portal.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view, vegetated hillside and Rambler Channel. Although the Proposed Ngau Kok Wan Portal slightly blocked the vegetated hillside, the view to the open sky and vegetated hillside remain largely unchanged. Thus, the effect of visual changes on public

viewers from this VP is graded as *slight*.

- The proposed development will be incorporated with a sensitive and aesthetically pleasing design. Taking into account the sensitive design measures, the visual impact is anticipated from the Proposed Development is *slight*.

10.9.2 VP2: Approach Beach (Figure 10.08)

- **Visual Composition:** VP2 comprises the open sky view, Ting Kau Bridge, Tsing Ma Bridge, vegetated hillside, Approach Beach, Rambler Channel and low-rise industrial cluster.
- **Visual Obstruction:** Given the far viewing distance, the existing view to the hillside greenery will be slightly blocked by the Proposed Ngau Kok Wan Portal.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view, vegetated hillside and Rambler Channel. Although the Proposed Ngau Kok Wan Portal slightly blocked the vegetated hillside, the view to the open sky and vegetated hillside remain largely unchanged. Thus, the effect of visual changes on public viewers from this VP is qualitatively graded as *slight*.
- The proposed development will be incorporated with sensitive and aesthetically pleasing design. Taking into account the sensitive design measures, the visual impact is anticipated from the Proposed Development is *slight*.

10.9.3 VP3: Minibus stop on Tam Kon Shan Road near Cheung Shue Tau (Figure 10.09)

- **Visual Composition:** VP3 comprises the open sky view, vegetated slopes and trees.
- **Visual Obstruction:** Tam Kon Shan Portal will partially replace the existing vegetated slope and trees.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view and vegetated slope. A portion of natural vegetation slope and trees will be removed. Since a portion of the natural vegetation slope will be removed which the existing view to the hillside greenery will be permanently affected. Thus, the effect of visual changes on public viewers from this VP is qualitatively graded as *slight*. However, the open sky view and a large portion of the vegetated hillside still remain unchanged. Taking into account the sensitive design measures, the visual impact is anticipated from the Proposed Development is *slight*.

10.9.4 VP4: Hoi Mei Wan Beach (Figure 10.10)

- **Visual Composition:** VP4 comprises the open sky view, Ting Kau Bridge, Tsing Ma Bridge, vegetated hillside, Hoi Mei Wan Beach, Rambler Channel and residential buildings in Tsing Yi area.
- **Visual Obstruction:** The Proposed Ngau Kok Wan Portal and conveyor belt system at Wok Tai Wan slightly blocked the vegetated hillside.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view, vegetated hillside and Rambler Channel. Although the Proposed Ngau Kok Wan Portal and conveyor belt at Wok Tai Wan slightly blocked the vegetated hillside, the view to the open sky and vegetated hillside remain largely unchanged. Thus, the effect of visual changes on public viewers from this VP is qualitatively graded as *slight*. The proposed development will be incorporated with a sensitive and aesthetically pleasing design. Taking into account the sensitive design measures, the visual impact is anticipated from the Proposed Development is *slight*.

10.9.5 VP5: Ma Wan Tung Wan Beach (Figure 10.11)

- **Visual Composition:** VP5 comprises the open sky view, Ting Kau Bridge, Tsing Ma Bridge, vegetated hillside, Ma Wan Beach, Ma Wan Channel, Park Island Pier and residential buildings in Tsing Yi area.
- **Visual Obstruction:** Given the far viewing distance, the existing view to the hillside greenery will be slightly blocked by the proposed conveyor belt system at Wok Tai Wan.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view, vegetated hillside and Ma Wan Channel. Although the proposed

conveyor belt system at Wok Tai Wan slightly blocked the vegetated hillside, the view to the open sky and vegetated hillside remain largely unchanged. Thus, the effect of visual changes on public viewers from this VP is qualitatively graded as *negligible*. The proposed development will be incorporated with a sensitive and aesthetically pleasing design. Taking into account the sensitive design measures, the visual impact is anticipated from the Proposed Development is *negligible*.

10.9.6 VP6: Tsing Yi Nature Trail (Figure 10.12)

- **Visual Composition:** VP6 comprises the open sky view, dense vegetation and mountains in the background.
- **Visual Obstruction:** The proposed works will not be visible to the viewers due to the blockage of existing vegetation.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view and existing vegetation. Given the proposed works will not be visible to the viewers due to the blockage of existing vegetation. Hence, it is considered that the effect of visual changes on public viewers from this VP is *negligible*. The key visual resources are the vegetation at Tsing Yi Nature Trail and will not be affected. With its limited impact on the existing visual resources at this VP, the visual impact is anticipated from the Proposed Development is *negligible*.

10.9.7 VP7: Lantau Link Viewing Platform (Figure 10.13)

- **Visual Composition:** VP7 comprises the open sky view, Tsing Ma Bridge, Ma Wan Channel, vegetated hillsides and Park Island in the background
- **Visual Obstruction:** The proposed works are not visible to the viewers due to the blockage of existing vegetation.
- **Visual Change:** The value of this view is primarily attached to the visual amenity of the open sky view, vegetated hillside and Ma Wan Channel. As the view to the open sky and vegetated hillside can still be kept, the effect of visual changes on public viewers from this VP is qualitatively graded as *negligible*. As the view to the open sky and vegetated hillside can still be kept, the effect of visual changes from this VP is qualitatively graded as *negligible*.

10.10 Evaluation of Overall Visual Impact

- 10.10.1 The design and layout of the Proposed Development have carefully considered the surrounding contexts and key public viewers located within the visual envelope. The proposed developments have been carefully considered not to create significant visual blockage and to reduce adverse visual impact on the surrounding. Sensitive design measures (including sensitive and aesthetically pleasing design, buffer screen planting, landscape treatments on slope or retaining structure, and compensatory planting) have been introduced to minimize adverse visual impacts arising from the Proposed Development.
- 10.10.2 The introduction of the Proposed Development, having considered the sensitivity of public viewers, the visual composition, the visual resources, the effects on public viewers and the effects visual resources, will not generate significant adverse visual impact. The visual change caused by the Proposed Development is not significant when viewed from the identified VPs, ranges from negligible to slight.
- 10.10.3 The proposed design has catered for the sensitivity of visual experience to the neighbourhood and will continually improve the overall aesthetics and visual interests of the Proposed Development in upcoming architectural design development stages.

Table 10.11 Significance of Landscape Impacts during Construction and Operation Phases

ID No.	Landscape Resource / Character Areas	Sensitivity (Low/ Medium/ High)		Magnitude of Change (Negligible/ Slight/ Moderate/ Substantial)		Impact Significance BEFORE Mitigation (Negligible/ Slight/ Moderate/ Substantial)		Recommended Mitigation Measures	Significance of Residual Impact AFTER Mitigation (Negligible/ Slight/ Moderate/ Substantial)	
		Construction	Operation	Construction	Operation	Construction	Operation		Construction	Operation
Landscape Resources										
LR1	Natural Hillside vegetation	High	High	Slight	Slight	Moderate	Moderate	CM1 & CM3 & CM4 & OM2 & OM3 & OM4	Moderate	Negligible
LR2	Rambler Channel Sea Waterbody	High	High	Negligible	Negligible	Negligible	Negligible	-	Negligible	Negligible
LR3	Coastal Landscape along Wok Tai Wan and Cheung Shue Tau	Medium	Medium	Moderate	Moderate	Moderate	Moderate	CM1 & CM2 & CM3 & CM4 & OM1 & OM2 & OM3 & OM4	Moderate	Negligible
Landscape Character Areas										
LCA1	Strait Landscape	Medium	Medium	Negligible	Negligible	Negligible	Negligible	-	Negligible	Negligible
LCA2	Transportation Corridor Landscape	Low	Low	Slight	Slight	Slight	Slight	CM1 & CM2 & CM3 & CM4 & OM1 & OM2 & OM3 & OM4	Slight	Negligible
LCA3	Industrial Urban Landscape	Low	Low	Negligible	Negligible	Negligible	Negligible	-	Negligible	Negligible
LCA4	Upland and Hillside Landscape	High	High	Negligible	Negligible	Negligible	Negligible	-	Negligible	Negligible

Table 10.12 Significance of Visual Impacts during Operation Phase

VP No.	PV ID	Location of VPs	Key PVs	Visual Sensitivity	Magnitude of Change	Recommended Mitigation Measures	Visual Impact AFTER Mitigation
VP1	RE1	Ting Kau Beach	Recreational User of the beaches along Castle Peak Road – New Ting Kau	High	Slight	CM1 & CM2 & OM1 & OM2 & OM3 & OM4	Slight
VP2	RE1	Approach Beach	Recreational User of the beaches along Castle Peak Road – New Ting Kau	High	Slight	CM1 & CM2 & OM1 & OM2 & OM3 & OM4	Slight
VP3	T1	Minibus Stop on Tam Kon Shan Road near Cheung Shue Tau	Travellers at Cheung Shue Tau	Low	Slight	CM1 & CM2 & OM1 & OM2 & OM3 & OM4	Slight
VP4	RE2	Hoi Mei Wan Beach	Recreational User of the beaches along Castle Peak Road – Ting Kau	High	Slight	CM1 & CM2 & OM1 & OM2 & OM3 & OM4	Slight
VP5	RE3	Ma Wan Tung Wan Beach	Recreational User from Ma Wan	Medium	Negligible	CM1 & OM1	Negligible
VP6	RE4	Tsing Yi Nature Trail	Recreational User from Tsing Yi Nature Trail	Low	Negligible	-	Negligible
VP7	RE5	Lantau Link Viewing Platform	Recreational User from Lantau Link Viewing Platform	High	Negligible	-	Negligible

Remark: RE = Recreational; T = Traveller

10.11 Conclusion

- 10.11.1 With the implementation of the proposed preliminary mitigation measures, it is considered that the proposed developments would be unlikely to induce significant adverse landscape and visual impact.

11 CULTURAL HERITAGE

11.1 Introduction

11.1.1 This section presents any cultural heritage resources identified within the Project Boundary and assesses the potential impact on the identified resources due to the construction and operation of the Project.

11.2 Environmental Legislation and Standards

11.2.1 Legislation and standards that are alluded to under this Study for cultural heritage impact assessment include the following:

- Antiquities and Monuments Ordinance (A&MO) (Cap. 53); and
- Chapter 10 of the HKPSG.

11.3 Assessment Methodology

11.3.1 A desktop review including but not limited to the following sources of information, was conducted to identify any cultural heritage resources:

- List of 1,444 Historic Buildings with Assessment Results ⁷;
- List of New Items for Grading Assessment with Assessment Results ⁸;
- Declared and Proposed Monuments in Hong Kong ⁹;
- List of Sites of Archaeological Interest in Hong Kong ¹⁰;
- Government Historic Sites Identified by Antiquities and Monuments Office ¹¹;
- The previous PER under the Pilot Study;
- Historical maps related to the Project Boundary; and
- Aerial photographs of the Project Boundary.

11.4 Description of Baseline Condition

11.4.1 According to the findings of desktop studies, there is no declared or proposed monument, historic building, site of archaeological interest (SAI), or Government historic sites located within 500m of the Project Boundary. The nearest cultural heritage resource is the Ting Kau Kiln SAI, located about 1km away from the Project Boundary.

11.5 Identification and Evaluation of Potential Impacts

11.5.1 As no cultural heritage resource is identified at or in the vicinity of the Project Boundary, no impact on terrestrial archaeology and built heritage is anticipated during both construction and operation phases of the Project.

11.6 Mitigation Measures

11.6.1 As there is no impact on cultural heritage resources, no mitigation measures are required.

11.7 Conclusion

11.7.1 Based on the best available information, no cultural heritage resource is identified at or in the vicinity of the Project Boundary. The nearest cultural heritage resource is the Ting Kau Kiln SAI, located about 1km away from the Project Boundary. No impact on terrestrial

⁷ Antiquities Advisory Board. *List of the 1,444 Historic Buildings with Assessment Results (as at 10 October 2025)* https://www.aab.gov.hk/filemanager/aab/en/content_29/AAB-SM-chi.pdf

⁸ Antiquities Advisory Board. *List of New Items for Grading Assessment with Assessment Results (as at 11 September 2025)* https://www.aab.gov.hk/filemanager/aab/en/content_29/list_new_items_assessed.pdf

⁹ Antiquities and Monuments Office. *Declared and Proposed Monuments in Hong Kong (as at 10 October 2024)* <https://www.amo.gov.hk/filemanager/amo/common/form/List%20of%20Declared%20Monuments%20and%20Proposed%20Monuments.pdf>

¹⁰ Antiquities and Monuments Office. *List of Sites of Archaeological Interest in Hong Kong (as at Nov 2012)* https://www.amo.gov.hk/filemanager/amo/common/form/list_archaeolog_site_eng.pdf

¹¹ Antiquities and Monuments Office. *Government Historic Sites Identified by AMO (as at May 2022)* https://www.amo.gov.hk/filemanager/amo/common/form/build_hia_government_historic_sites.pdf

archaeology and built heritage is anticipated during both the construction and operation phases of the Project.

12 HAZARD TO LIFE

12.1 Introduction

12.1.1 This section presents a review of potential risks related to the explosives under the Project and the Potentially Hazardous Installation (PHI) in the vicinity of the Project.

12.1.2 Apart from explosives, no other dangerous goods (DGs) will be involved (i.e. storage, transport, and use) during both construction and operation phases of the Project. A Hazard Assessment Register is presented in **Appendix 12.1**.

12.1.3 There is no on-site storage of explosives under the TYNQU Project. The TYNQU Project only involves the transport and use of explosives during the operation phase. Mines Division/CEDD, which is the statutory authority for explosives (Category 1 Dangerous Goods), quarrying, and blasting in Hong Kong, enforces compliance with the Dangerous Goods Ordinance (Cap. 295) and the relevant statutory requirements for blasting permissions, conveyance, and site supervision in the Project. These measures ensure safe handling of explosives, proper blast design, execution, and monitoring to minimise risks to public safety, structures, slopes, and off-site populations. Given that the statutory authority will directly administer the operation phase of the Project, all the transport and use of explosives will be properly handled by competent personnel in accordance with the guidelines and requirements governed by CEDD. In addition, as the Project does not constitute a DP under EIAO and does not fall within the consultation zone of any PHI, a quantitative risk assessment (QRA) is considered not necessary.

12.2 Review of Potential Risk Related to Use of Explosives

12.2.1 In view of the project programme and size of the Underground Quarry Site, D&B method is considered to be more feasible and economical as a shorter time is required for the rock excavation and underground quarrying compared to other construction methods. Therefore, the use of explosives is required for quarrying.

12.2.2 Explosives present a hazard to both properties and people. This hazard manifests itself in the following ways:

- Blast and pressure wave;
- Flying fragments or missiles;
- Thermal radiation; and
- Ground shock.

12.2.3 In the case of explosions, the biggest damage is usually caused by the blast effects. The blast and pressure waves can cause injury to sensitive human organs such as ears and lungs. However, considerable overpressures are required for fatalities to occur, and consequently, people need to be fairly close to the scene of the direct explosion effects to be significant.

12.2.4 Other effects due to the blast or overpressure are associated with damage to buildings and other structures/ objects or the impact of debris and fragments from damaged building structures, and the vehicle or container in which the explosives are held. Moreover, injury may occur when people are displaced or swept away, or due to the violent movement of internal organs within the body.

12.2.5 An explosion may result in the formation of a short duration fireball since the fuel content of the emulsion is oxidised. However, it is generally the case that the thermal hazards from an explosive detonation event are of less concern than the blast and fragment hazards.

12.2.6 The transportation, handling, storage and use of explosives could increase the risks to the population in the surroundings during the operation phase (i.e. quarry activities) of the Project.

12.2.7 The explosives to be used in this Project, including detonator and cartridge explosives, will be delivered by Mines/CEDD and this Project will also be administered by Mines/CEDD. The explosives would be delivered to the Site each day and the delivery of explosives from

Government Explosives Depots to the blasting site is controlled by the Explosives Delivery Unit of the Mines/CEDD. Provision of a Project magazine and/or storage of explosives on-site overnight are not anticipated. Therefore, risk assessment for overnight storage and off-site transport of explosives is not necessary. The tentative delivery point, explosive transportation route and blasting sites are shown in **Figure 12.02**.

12.2.8 A blast design will be prepared to determine the quantity and type of explosives to be used, taking into account the sensitive receivers at the blasting location. The blast design will be prepared by the Blasting Engineer, in collaboration with the Registered Shotfirer, checked and approved by the Blasting Competent Supervisor, and then submitted to Mines/CEDD for auditing prior to implementation. All vulnerable sensitivity receivers in the area, such as underground gas mains, man-made slopes and retaining walls, will be identified in the blast design to minimise the damage caused by vibration. In addition, the tunnel portals are likely to be constructed by mechanical excavation methods based on the geological conditions. Blast door(s) will be installed at the tunnel portal prior to commencement of any blasting activity and they will be kept closed during blasting to ensure safety. As such, minimal hazard to life impacts in relation to the use of explosives is expected.

12.2.9 The following relevant best practices and procedures should be followed for the use and on-site transport of explosives by the contractor:

- Implement speed limit within the construction sites;
- Prohibit mixing the explosives with other flammable substances;
- Transport detonators from explosives separately;
- Carry out checking of the registered contractor's blasting method statement;
- Check (including both document and site checks) and satisfy, for each blast, that the registered contractor's blast design and precautionary measures comply with the plans approved by the Building Authority and the blasting permit requirements;
- Verify on site that the ground conditions and geology are as stated or assumed in the blasting assessment, and that the provisions in the method statement and the preventive, protective, and precautionary measures are adequate for the conditions as encountered on site;
- Ensure that the preventive measures, if required, have been properly carried out prior to commencement of the blasting works;
- Prepare regular reports with records of the condition of the site, sensitive receivers, adjacent grounds, structures, and services, etc. after each phase of blasting operation and completion of related works;
- Inspect the construction of preventive works, if required, for the sensitive receivers.
- Inspect the provision and installation of all necessary protective and precautionary measures prior to each blast, in accordance with the blast design;
- Monitor the site operations and working methods to ensure that they meet the safety requirements set out in the blasting permission;
- Inspect and monitor the conditions of all sensitive receivers regularly and carry out reviews of the quality of monitoring for the sensitive receivers before and after each blast;
- A Resident Explosives Supervisor (RES) shall remain on-site to check that all the explosives delivered to the site are either used, destroyed, or returned to a Government explosives depot;
- Unused explosives, such as some small quantities of explosives left over from a blast, should be destroyed on-site by a registered shot-firer, in accordance with procedures set out in the method statement, and witnessed by the Blasting Engineer and RES; and
- Safety procedures recommended by the manufacturer must be followed in the destruction of the explosives.

12.2.10 The following relevant best practices or regulations should be followed for the on-site transport of explosives:

- The vehicle should be powered by a diesel engine;
- The vehicle should be kept clean, in sound mechanical condition, and roadworthy;

- The vehicle should display a red flag, flashing light, and be equipped with a dry powder fire extinguisher when explosives are carried;
- The Registered Shotfirer and Resident Explosive Supervisor should ride with the vehicle;
- All the detailed arrangement of on-site transportation of explosives should be documented in the Blasting Method Statement by the Contractor and submitted to the Mines Division for approval.

12.3 Review of Potential Risk Related to PHI

- 12.3.1 The Project Site does not fall within any consultation zones of PHIs. The nearest PHI, i.e. Shell Hong Kong Limited – Tsing Yi LPG/Oil Terminal, is located at about 1.4km south of the Project Boundary (**Figure 12.01** refers). With no existing or potential hazardous sources located in the vicinity, no potential risk impact is therefore anticipated during both construction and operation phases of the Project.

12.4 Conclusion

- 12.4.1 Before the delivery of explosives, the Contractor is required to apply for blasting permission from the Mines Division under the Dangerous Goods (Control) Regulation (Cap. 295G) and submit a Blasting Assessment Report (BAR) and a Blasting Method Statement (BMS) to the Mines Division for approval. Any adverse effects and risks arising from the transport, storage, and use of explosives for blasting will be assessed in the BAR and safe handling of explosives will be assessed in BMS in accordance with Mines Division Guidance Notes No.7.
- 12.4.2 On arrival of the explosives at a site, the discharge (blasting) permit holder's designated representative (a registered shotfirer) must check and count the explosives against the information shown on the conveyance permit(s) and issue voucher(s), in the presence of a Mines Division representative (an Explosives Officer) and a resident explosives supervisor (RES), a member of the resident site staff registered with Mines Division (or an escorting security guard (ESG) if there is no RES for the project). Loading of explosives into the blast holes must commence immediately, and firing must take place as soon as practicable. The discharge (blasting) permit holder and registered shot firer are responsible for the safety and security of all explosives on a site. In the event of an incident, they must take all necessary steps to protect public safety and maintain the security of explosives in accordance with the method statement. For any matters not specifically covered by the method statement, they must exercise competent judgment.
- 12.4.3 A review of the potential risks related to the use of explosives under the Project and the PHI in the vicinity of the Project has been conducted. During the construction phase, the initial sections of the Main Access Tunnel, which are expected to be less than 30m long from the portals, leading to the Underground Quarry Site, will be excavated using mechanical breaking methods only. The use of explosives will not be adopted for these initial sections during the construction phase; hence, hazard-to-life impact during the construction phase is not anticipated. During the operation phase, the use of explosives is required for the rock excavation within the remaining sections of the Main Access Tunnel and underground quarrying using the D&B method. Considering that blast doors will be installed and kept closed during blasting to ensure safety, minimal hazard to life impacts in relation to the use of explosives is expected. There would be no overnight storage and off-site transport of explosives risk required, and, therefore, risk assessment for overnight storage and off-site transport of explosives is not necessary.
- 12.4.4 Given that there are no existing or potential hazardous sources located in the vicinity of the Project Site and that the nearest PHI is located at about 1.4km south of the Project Boundary, no potential risk impact related to PHI is anticipated during both construction and operation phases of the Project.

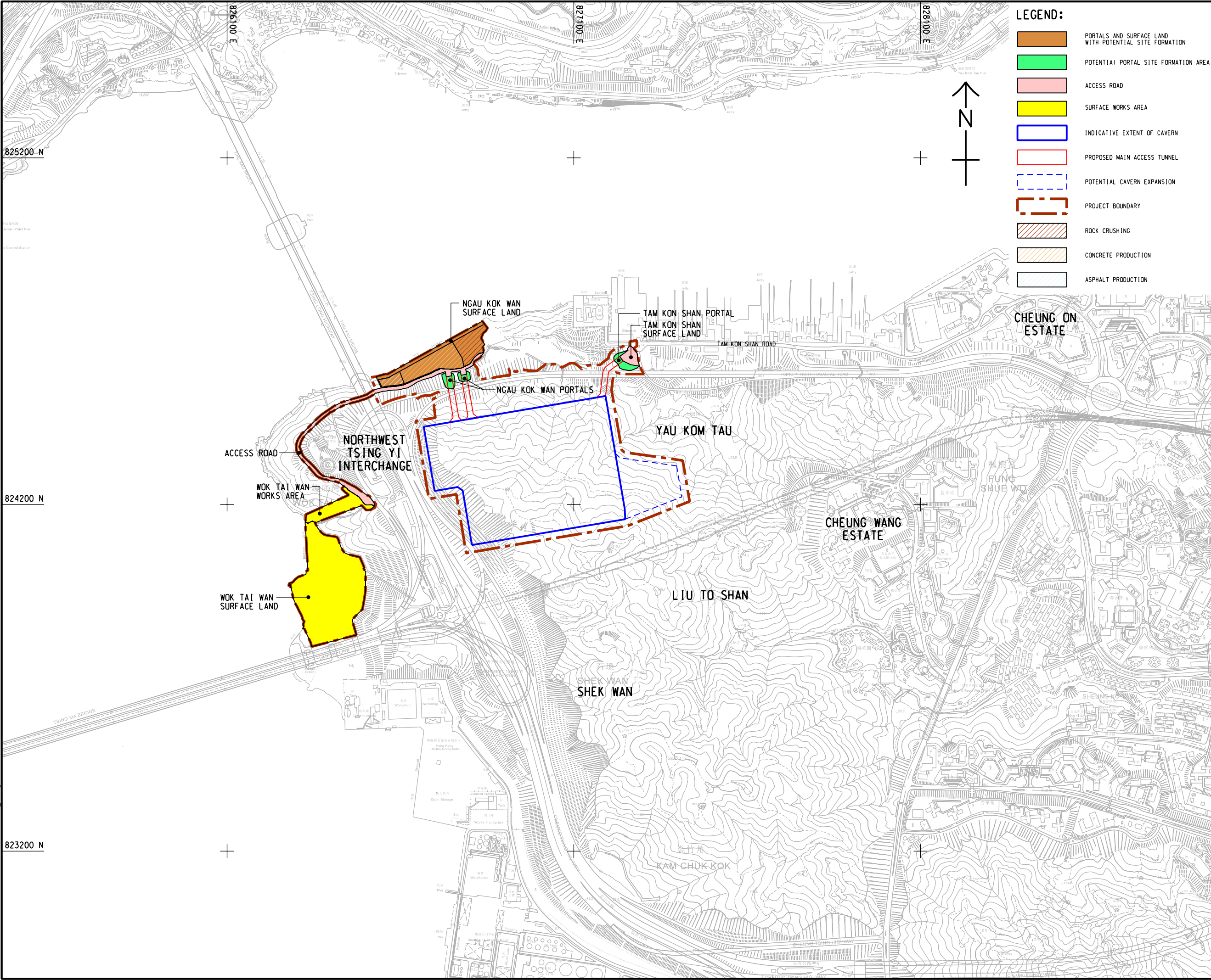
13 OVERALL CONCLUSIONS

- 13.1.1 This PER has examined key environmental aspects related to the construction and operation of the Project, including air quality, noise, water quality, waste management, land contamination, terrestrial ecology, landscape and visual impact, cultural heritage, and hazards to life. Literature reviews were conducted to establish baseline environmental conditions. Major environmental elements and sensitive receivers in the vicinity of the Project Site have been identified and considered. Potential impacts on these sensitive receivers were identified, and a preliminary assessment was carried out based on the best available engineering information. Standard environmental practices and mitigation measures have been proposed to minimize these potential impacts.

Figures

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PROJECT
UNDERGROUND
QUARRYING AT
TSING YI NORTH –
INVESTIGATION,
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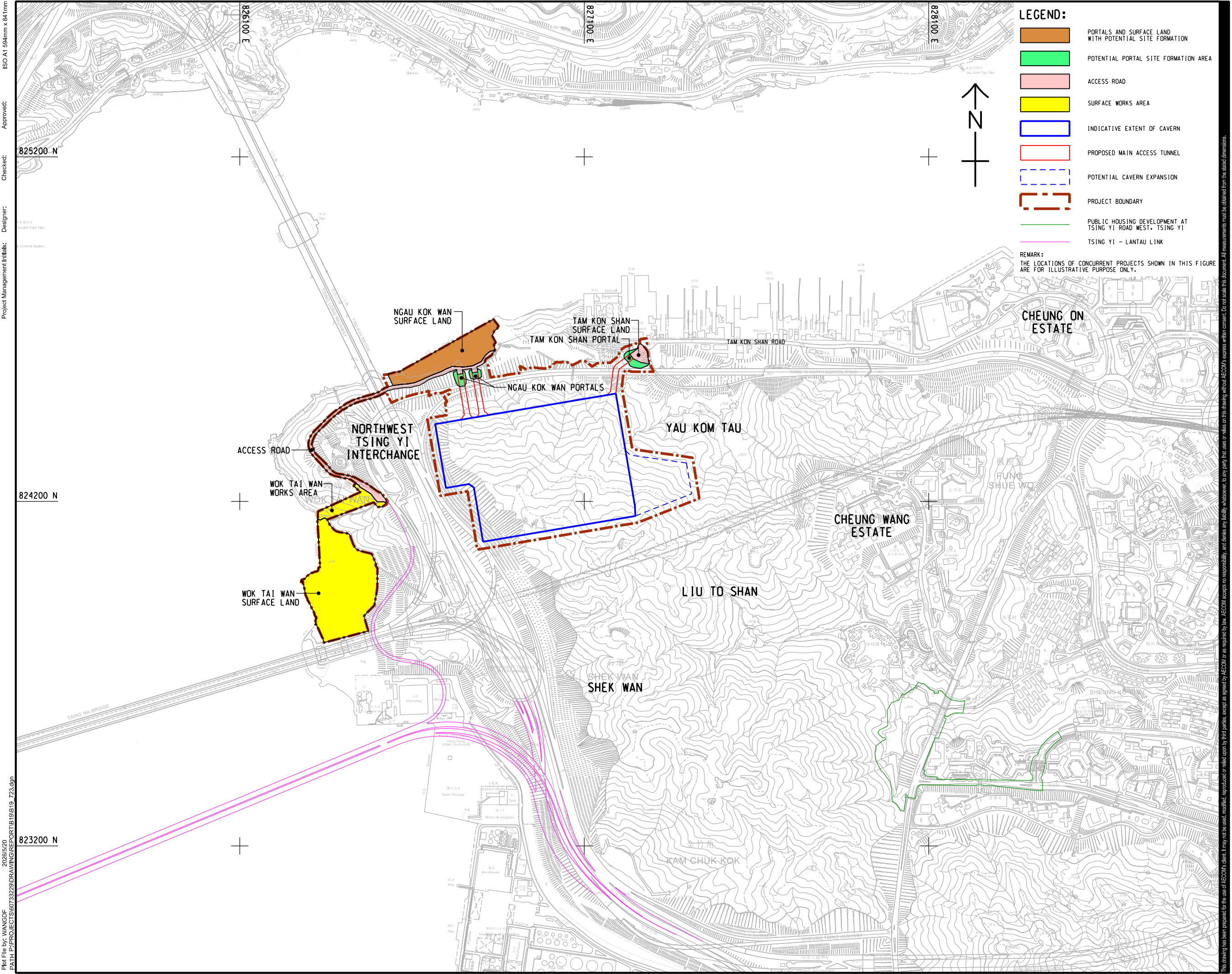
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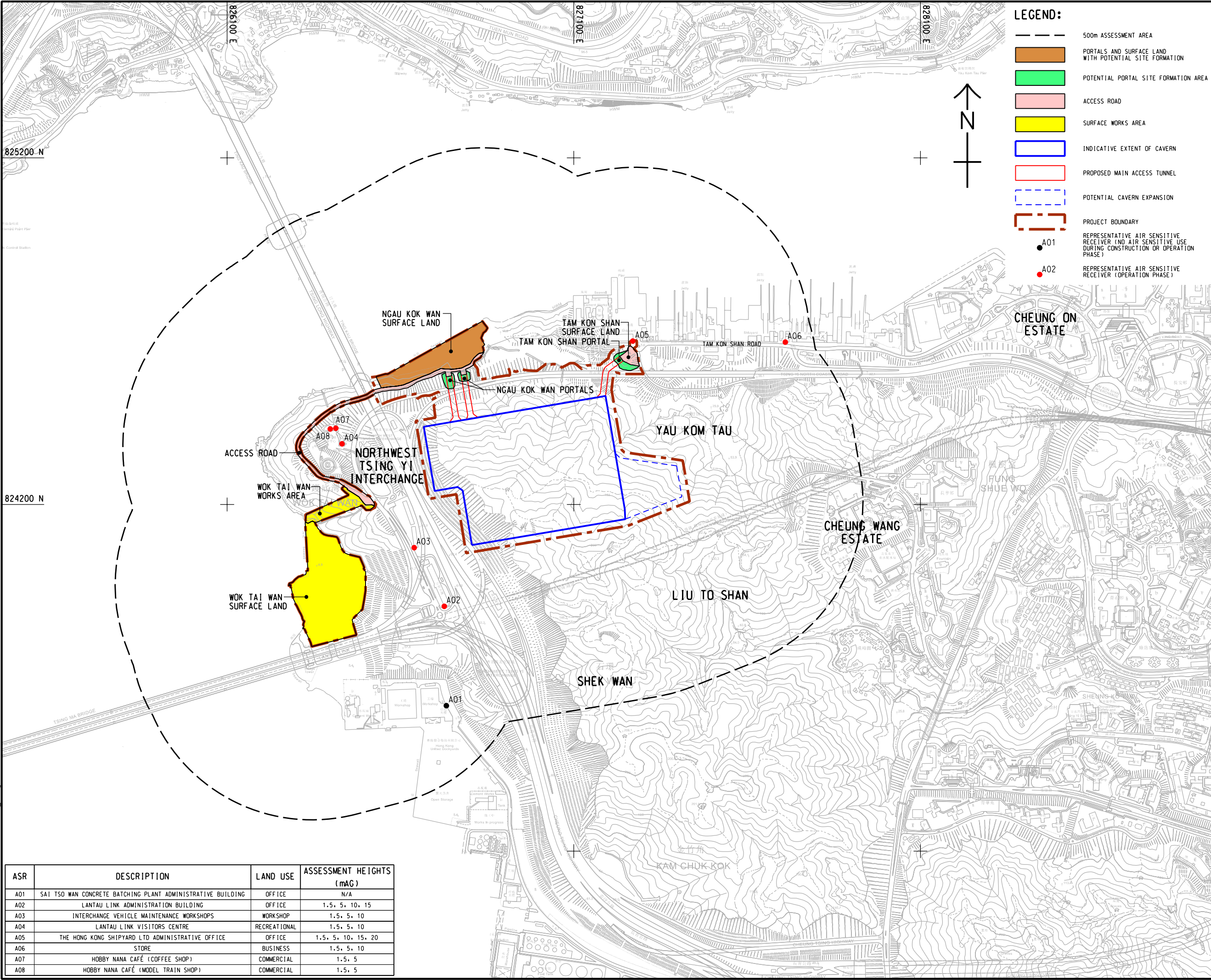
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LOCATION OF CONCURRENT
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ASR	DESCRIPTION	LAND USE	ASSESSMENT HEIGHTS (mAG)
A01	SAI TSO WAN CONCRETE BATCHING PLANT ADMINISTRATIVE BUILDING	OFFICE	N/A
A02	LANTAU LINK ADMINISTRATION BUILDING	OFFICE	1.5, 5, 10, 15
A03	INTERCHANGE VEHICLE MAINTENANCE WORKSHOPS	WORKSHOP	1.5, 5, 10
A04	LANTAU LINK VISITORS CENTRE	RECREATIONAL	1.5, 5, 10
A05	THE HONG KONG SHIPYARD LTD ADMINISTRATIVE OFFICE	OFFICE	1.5, 5, 10, 15, 20
A06	STORE	BUSINESS	1.5, 5, 10
A07	HOBBY NANA CAFÉ (COFFEE SHOP)	COMMERCIAL	1.5, 5
A08	HOBBY NANA CAFÉ (MODEL TRAIN SHOP)	COMMERCIAL	1.5, 5

- LEGEND:**
- 500m ASSESSMENT AREA
 - PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)

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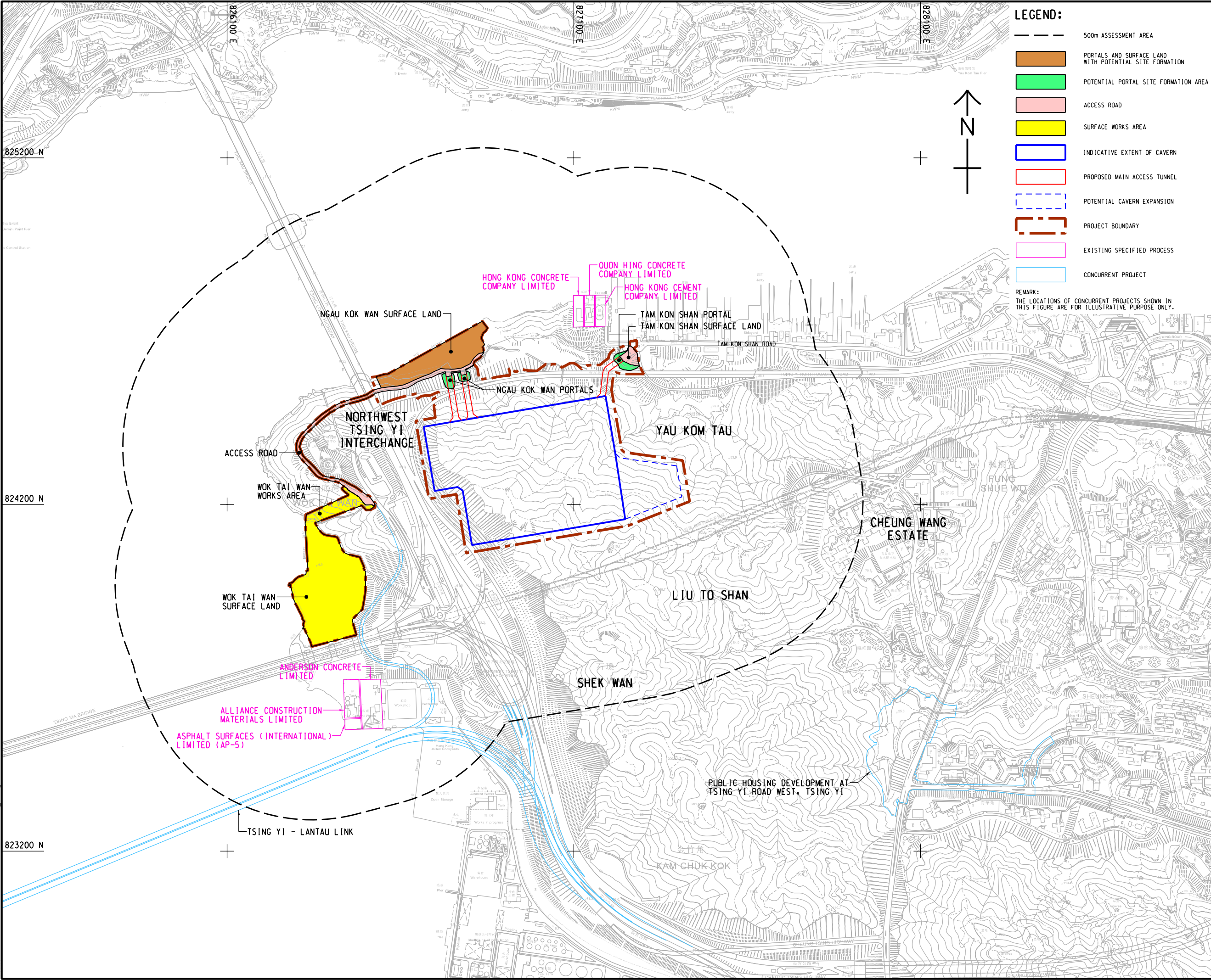
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LEGEND:

- 500m ASSESSMENT AREA
- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
- POTENTIAL PORTAL SITE FORMATION AREA
- ACCESS ROAD
- SURFACE WORKS AREA
- INDICATIVE EXTENT OF CAVERN
- PROPOSED MAIN ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION
- PROJECT BOUNDARY
- EXISTING SPECIFIED PROCESS
- CONCURRENT PROJECT

REMARK:
THE LOCATIONS OF CONCURRENT PROJECTS SHOWN IN THIS FIGURE ARE FOR ILLUSTRATIVE PURPOSE ONLY.

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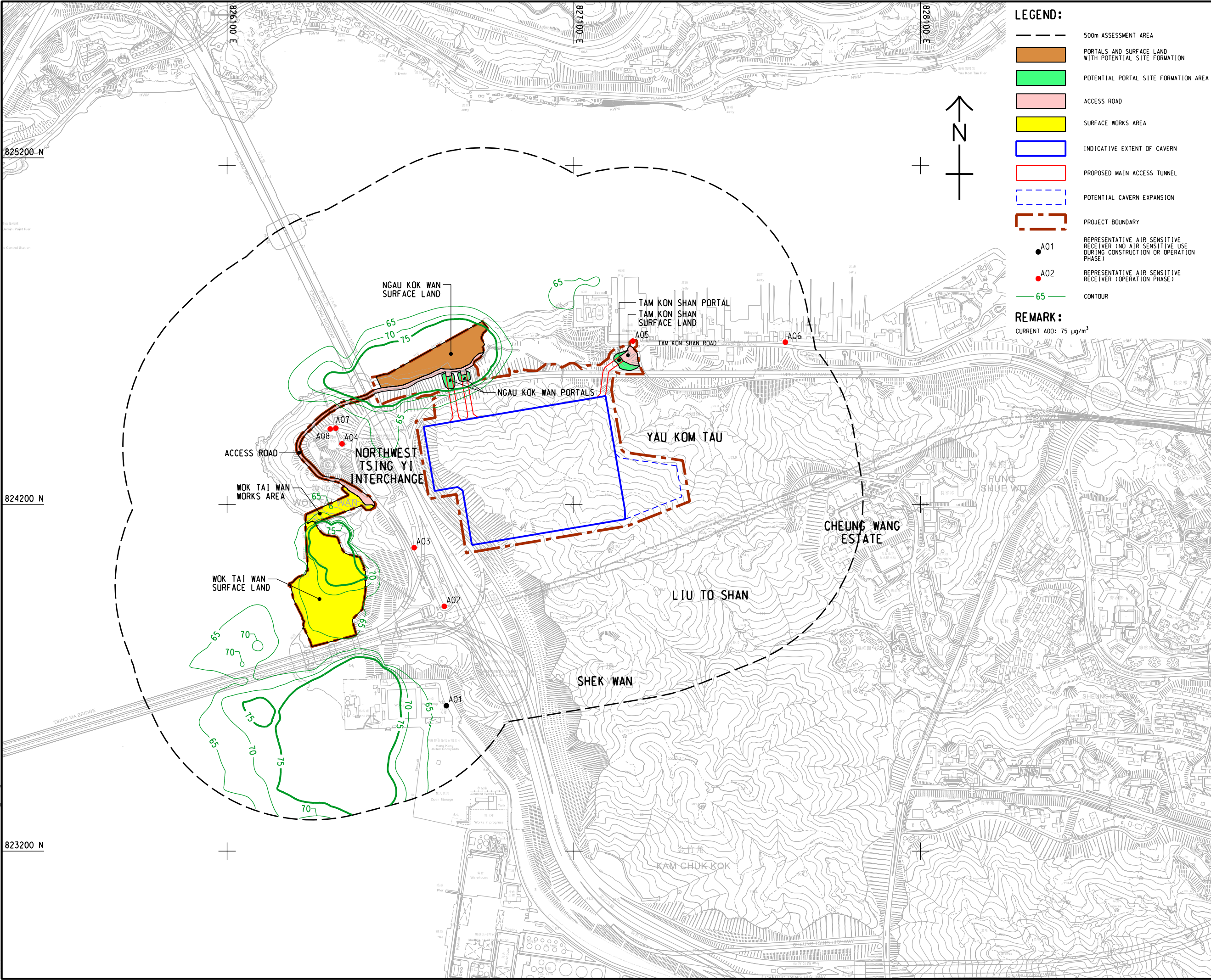
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SHEET TITLE
LOCATION OF EXISTING EMISSION SOURCES AND CONCURRENT PROJECTS

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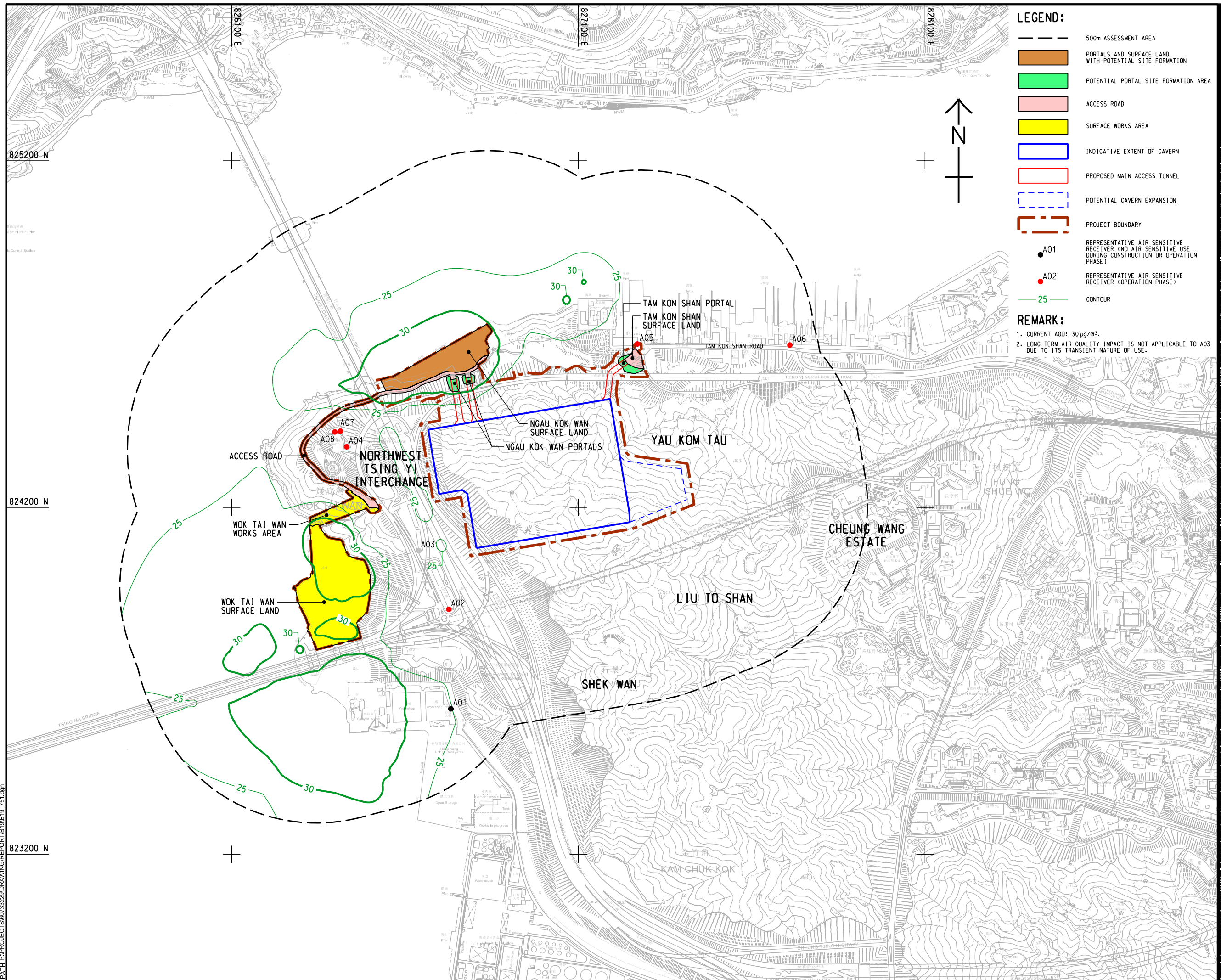
KEY PLAN

PROJECT NO.
60733229

AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED 10th
HIGHEST CUMULATIVE DAILY RSP
CONCENTRATION AT 1.5 mAG (µg/m³)
(OPERATION PHASE, YEAR 2028)

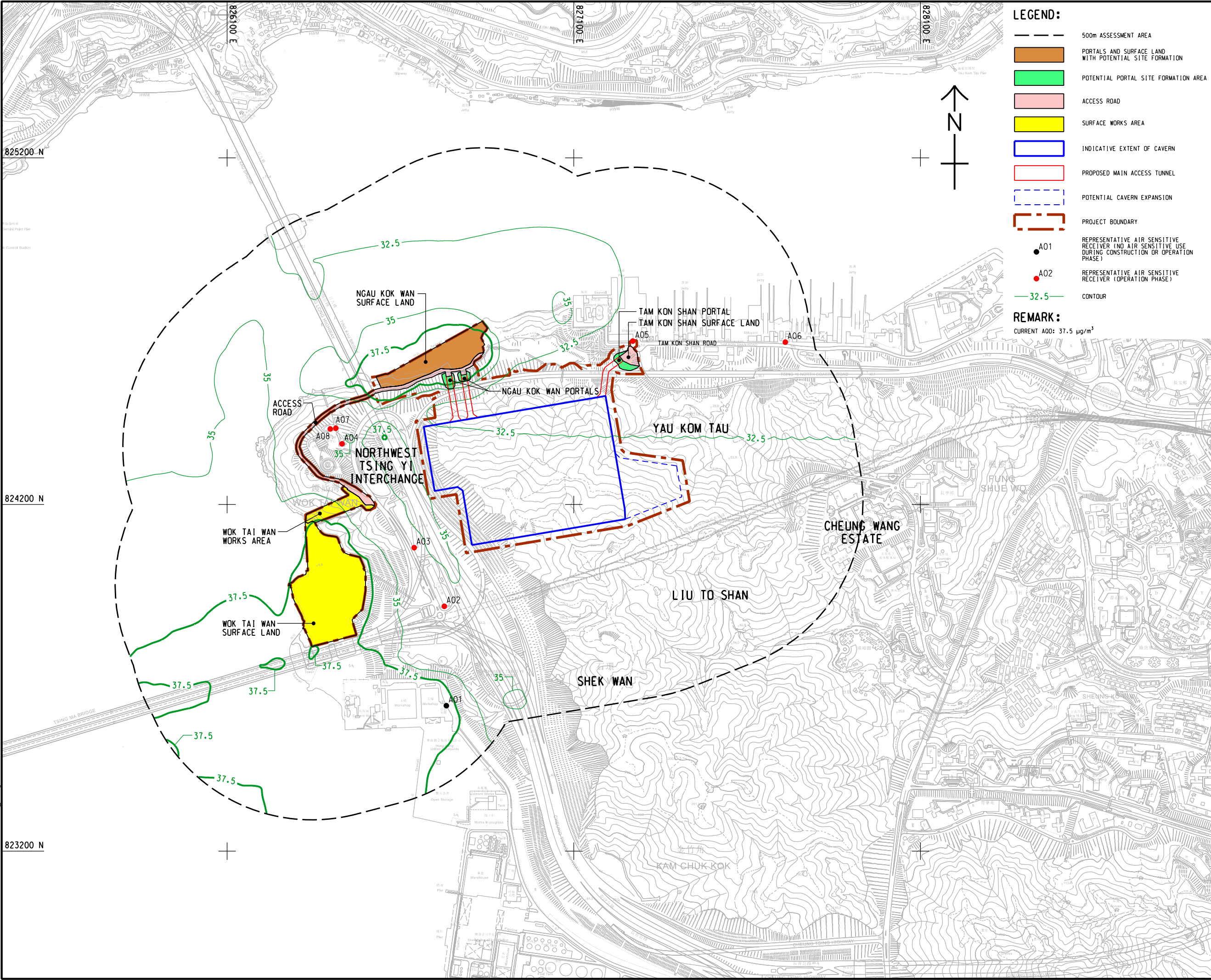
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60733229/B19/FIGURE 4.03



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- LEGEND:**
- 500m ASSESSMENT AREA
 - PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
 - CONTOUR
- REMARK:**
CURRENT A00: 37.5 $\mu\text{g}/\text{m}^3$



PROJECT
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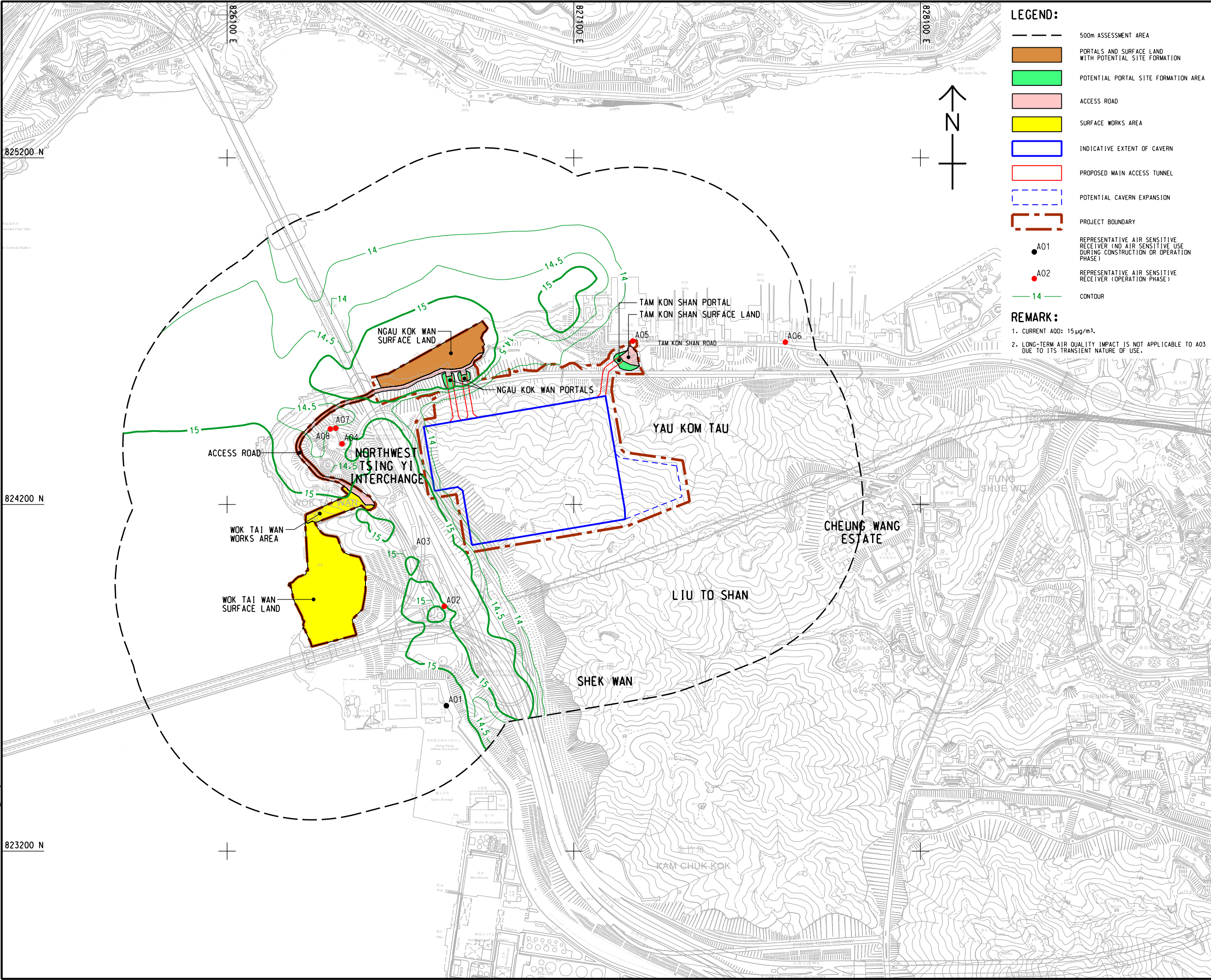
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KEY PLAN	

PROJECT NO.	AGREEMENT NO.
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SHEET TITLE	
CONTOUR OF PREDICTED 19 th HIGHEST CUMULATIVE DAILY FSP CONCENTRATION AT 1.5 mAG ($\mu\text{g}/\text{m}^3$) (OPERATION PHASE, YEAR 2028)	
SHEET NUMBER	
60733229/B19/FIGURE 4.05	

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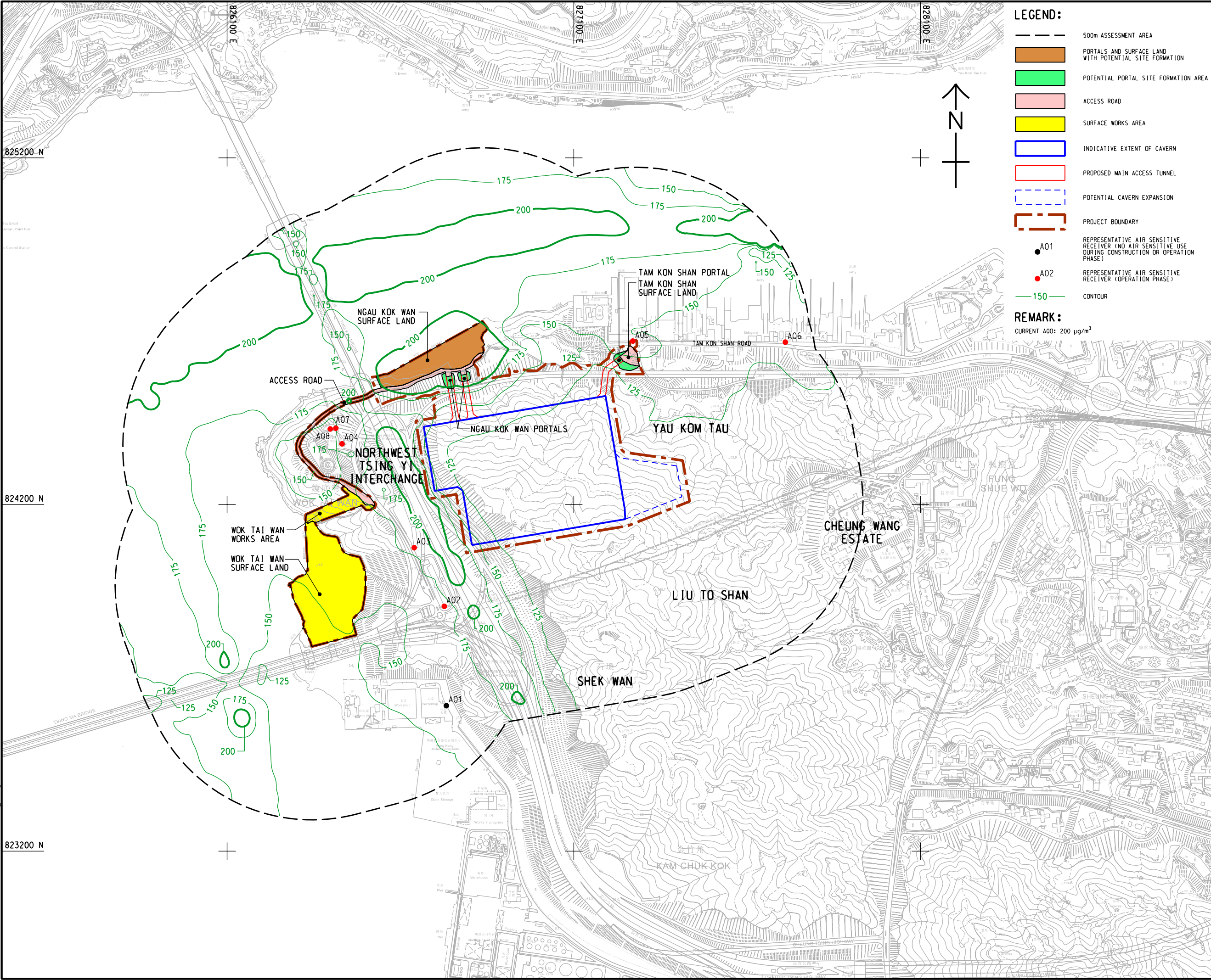
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SHEET TITLE
CONTOUR OF PREDICTED CUMULATIVE ANNUAL FSP CONCENTRATION AT 1.5 mAG ($\mu\text{g}/\text{m}^3$) (OPERATION PHASE, YEAR 2028)

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60733229/B19/FIGURE 4.06

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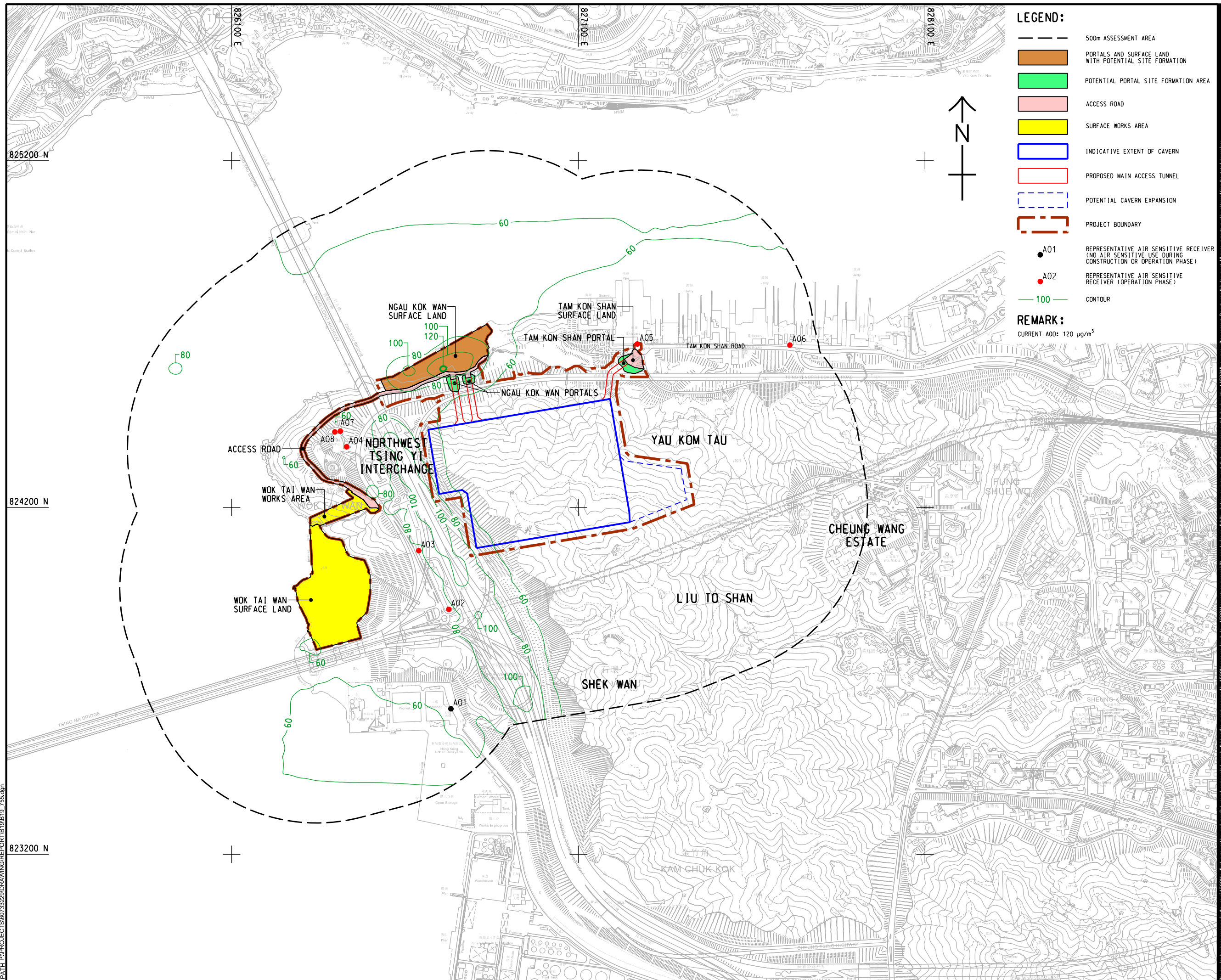
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60733229

AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED 19th HIGHEST CUMULATIVE HOURLY NO₂ CONCENTRATION AT 1.5 mAG ($\mu\text{g}/\text{m}^3$) (OPERATION PHASE, YEAR 2028)

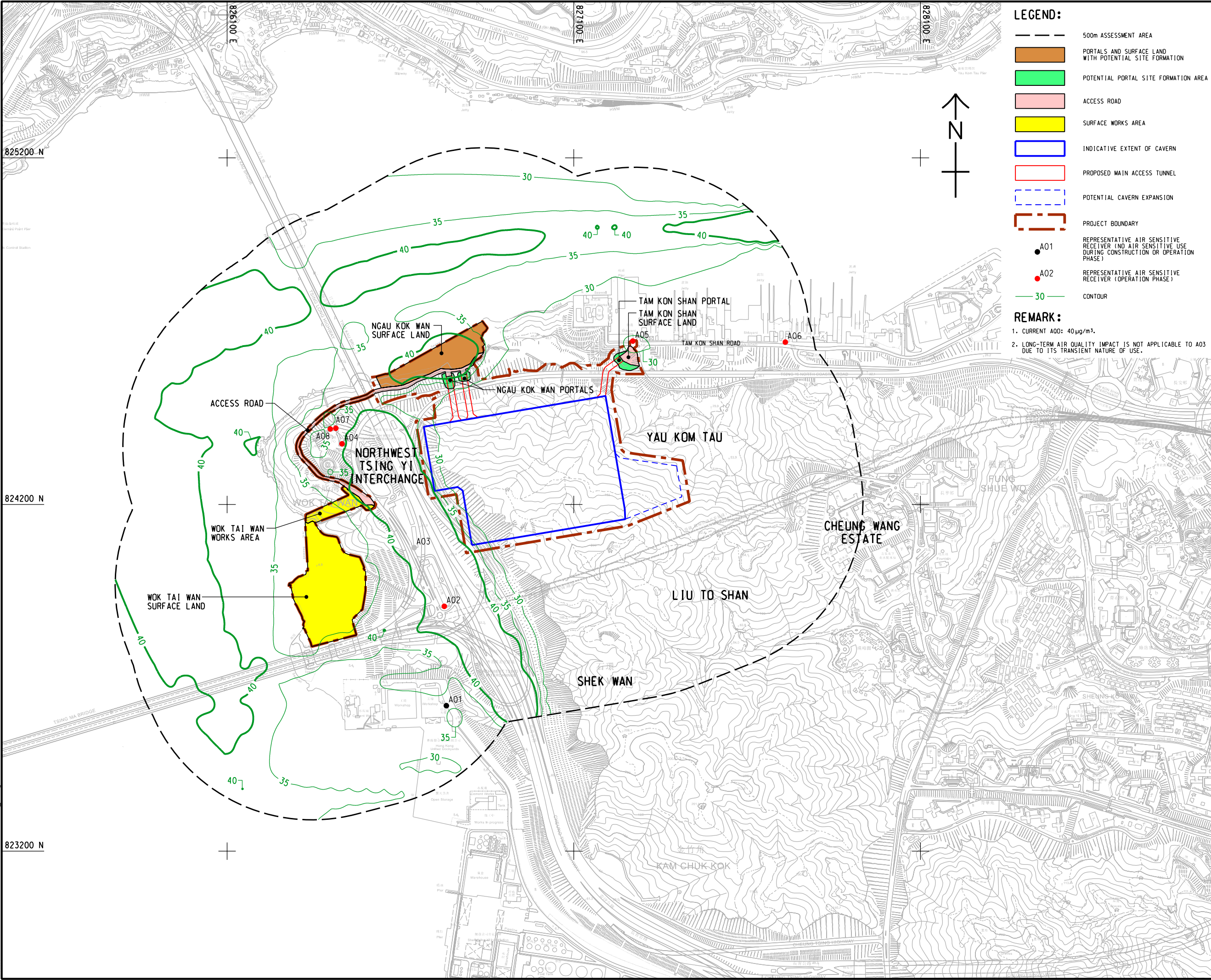
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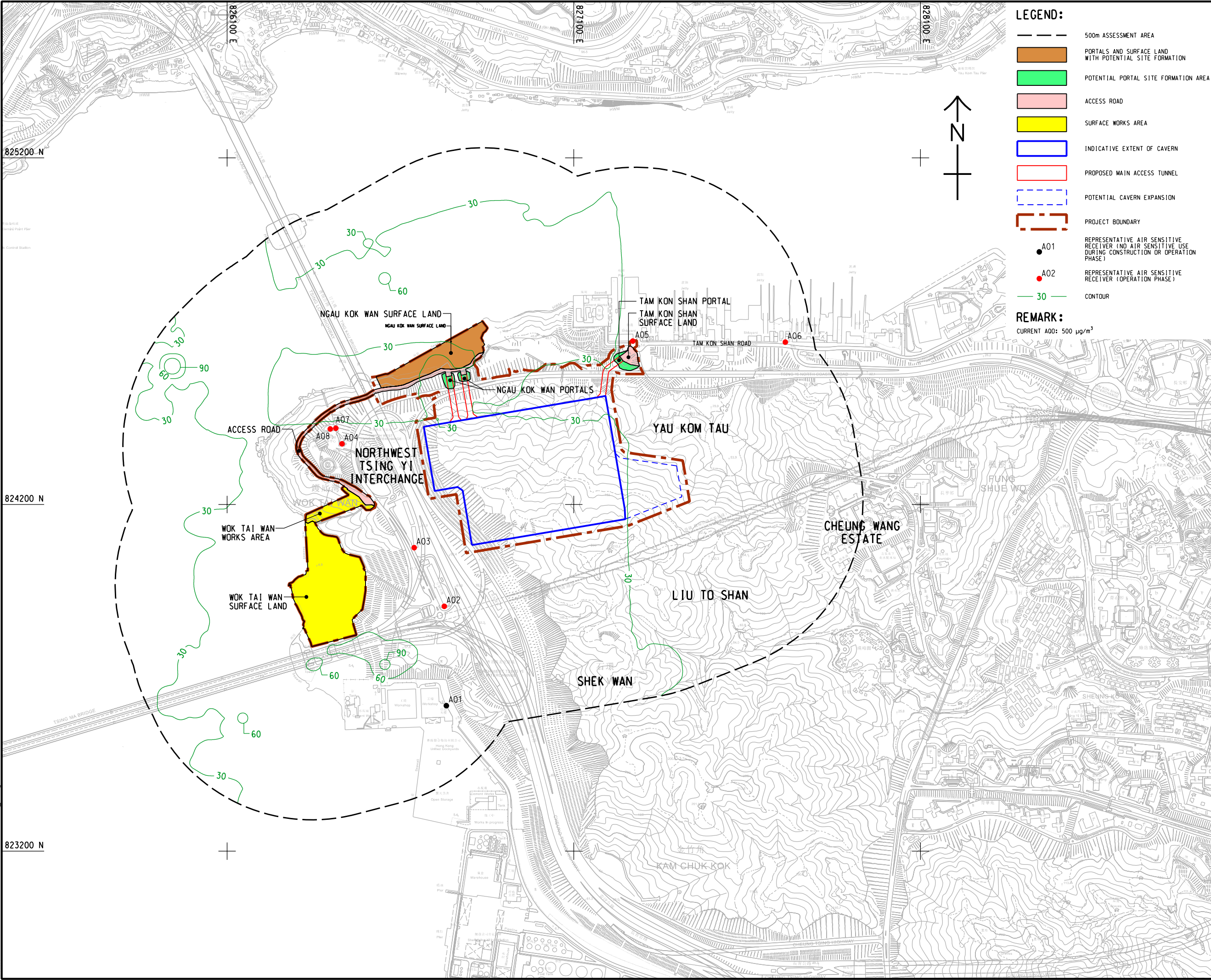
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60733229	CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED
CUMULATIVE ANNUAL NO₂
CONCENTRATION AT 1.5 mAG (µg/m³)
(OPERATION PHASE, YEAR 2028)

SHEET NUMBER
60733229/B19/FIGURE 4.09

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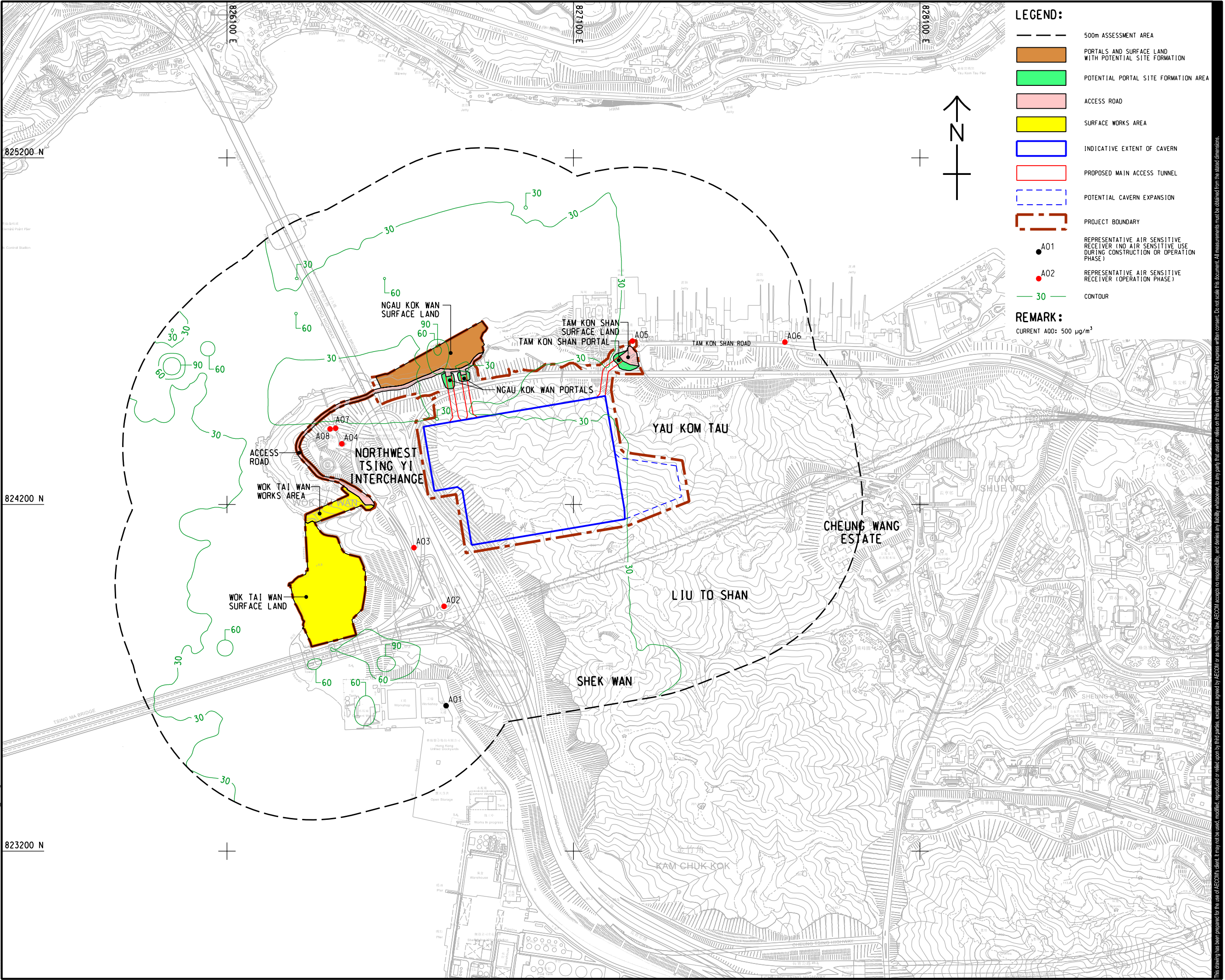
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60733229	CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED 4th
HIGHEST CUMULATIVE 10-MIN SO₂
CONCENTRATION AT 1.5 mAG (µg/m³)
(OPERATION PHASE, YEAR 2028)

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60733229/B19/FIGURE 4.10

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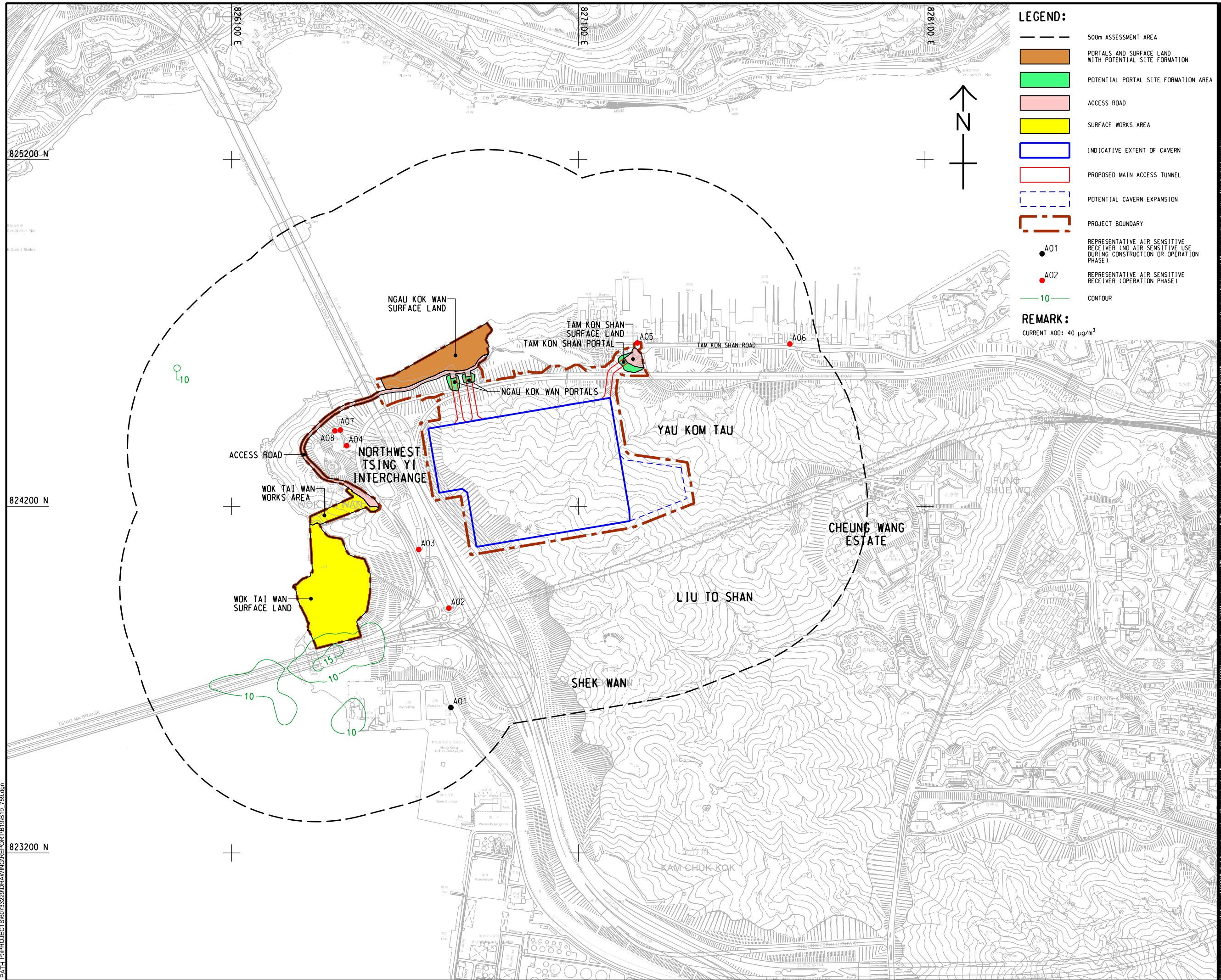
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AGREEMENT NO.
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SHEET TITLE
CONTOUR OF PREDICTED 4th
HIGHEST CUMULATIVE 10-MIN SO₂
CONCENTRATION AT 5 mAG (µg/m³)
(OPERATION PHASE, YEAR 2028)

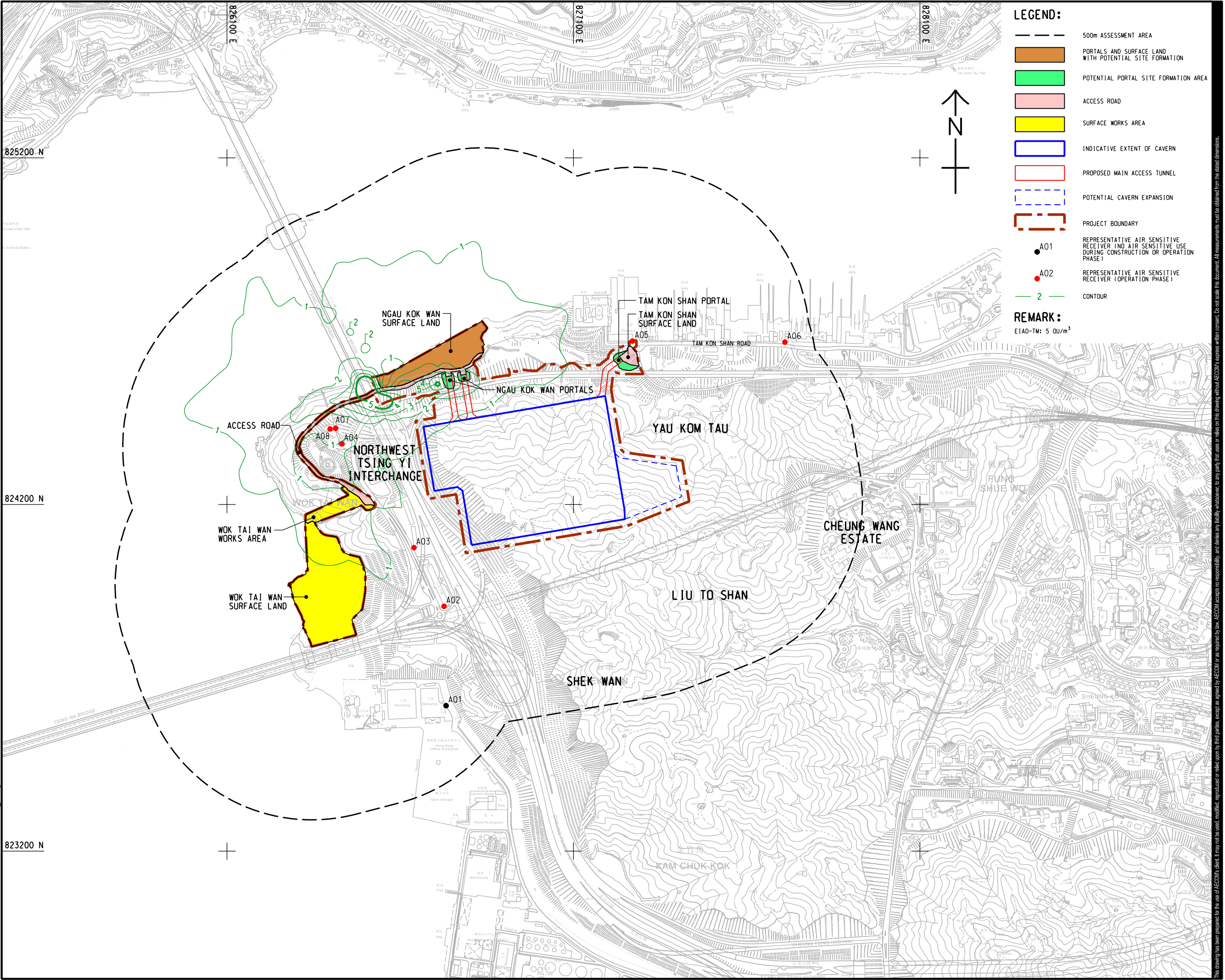
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LEGEND:

- 500m ASSESSMENT AREA
- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
- POTENTIAL PORTAL SITE FORMATION AREA
- ACCESS ROAD
- SURFACE WORKS AREA
- INDICATIVE EXTENT OF CAVERN
- PROPOSED MAIN ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION
- PROJECT BOUNDARY
- REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
- REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
- CONTOUR

REMARK:
E1A0-TM: 5 OU/m³

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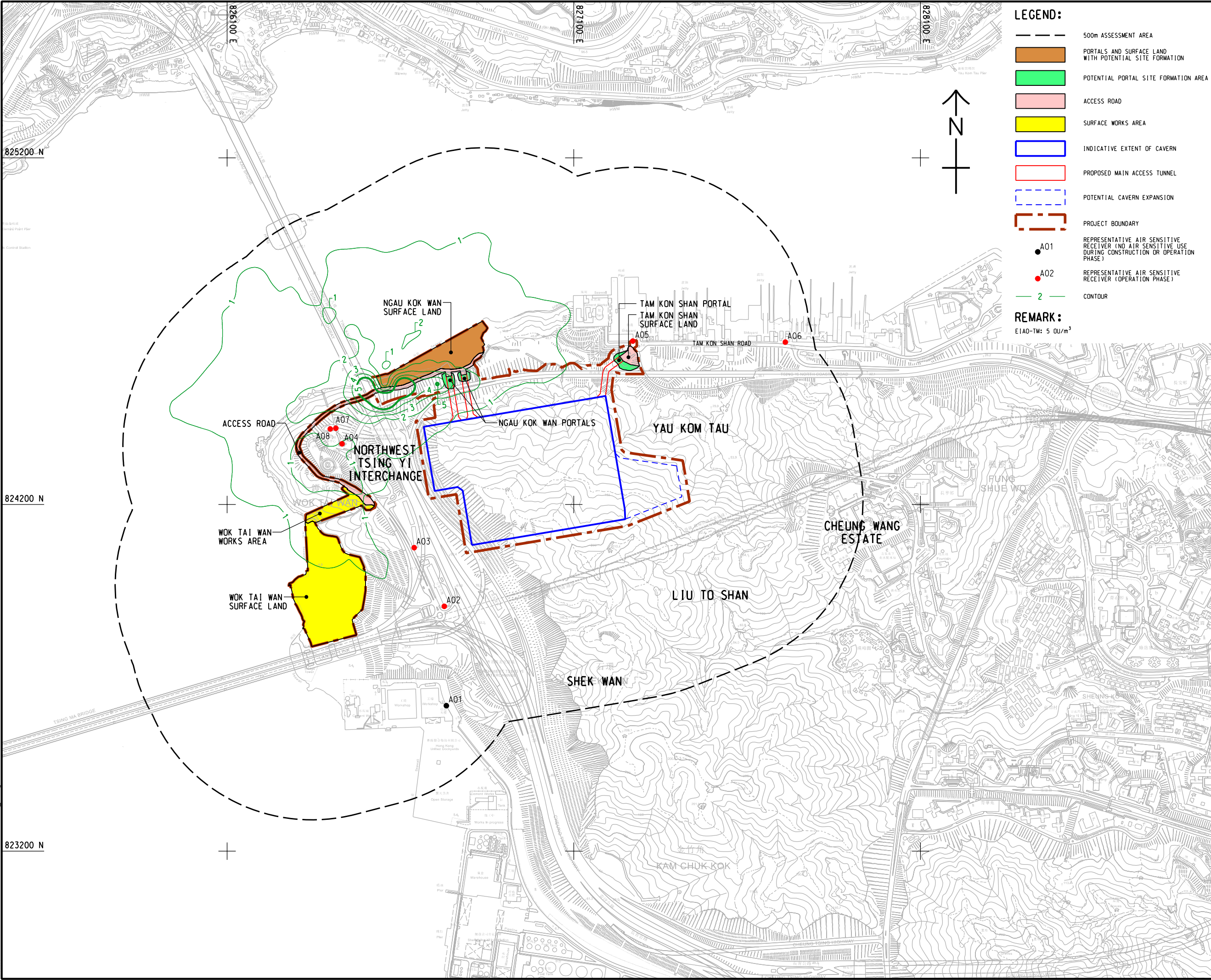
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SHEET TITLE
CONTOUR OF PREDICTED HIGHEST CUMULATIVE 5-SECOND ODOUR CONCENTRATION AT 1.5 mAG (OU/m³) (OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.24

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LEGEND:

- 500m ASSESSMENT AREA
- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
- POTENTIAL PORTAL SITE FORMATION AREA
- ACCESS ROAD
- SURFACE WORKS AREA
- INDICATIVE EXTENT OF CAVERN
- PROPOSED MAIN ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION
- PROJECT BOUNDARY
- REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
- REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
- CONTOUR

REMARK:
E1A0-TM: 5 OU/m³

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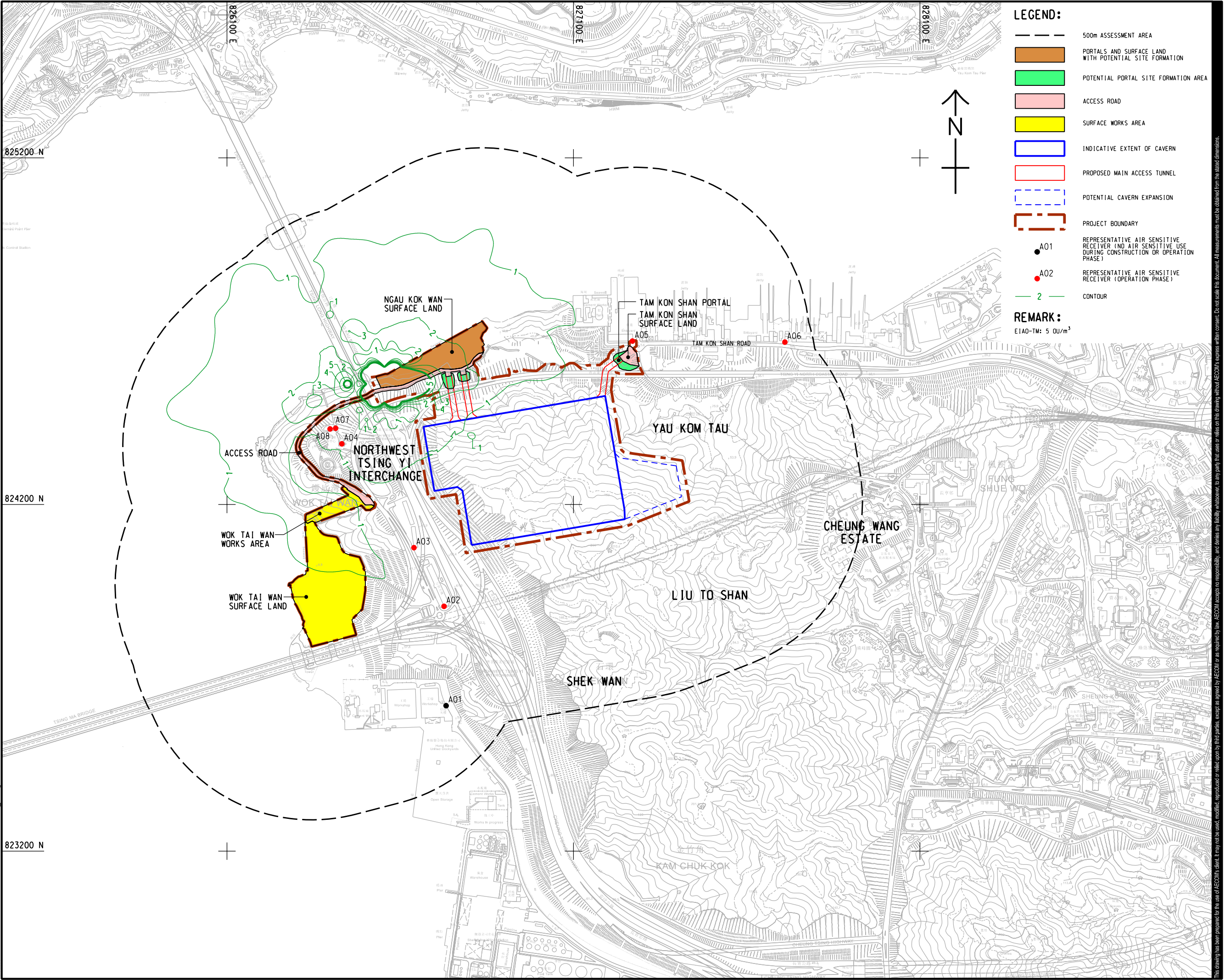
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SHEET TITLE
CONTOUR OF PREDICTED HIGHEST CUMULATIVE 5-SECOND ODOUR CONCENTRATION AT 5 mAG (OU/m³) (OPERATION PHASE)

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60733229/B19/FIGURE 4.25

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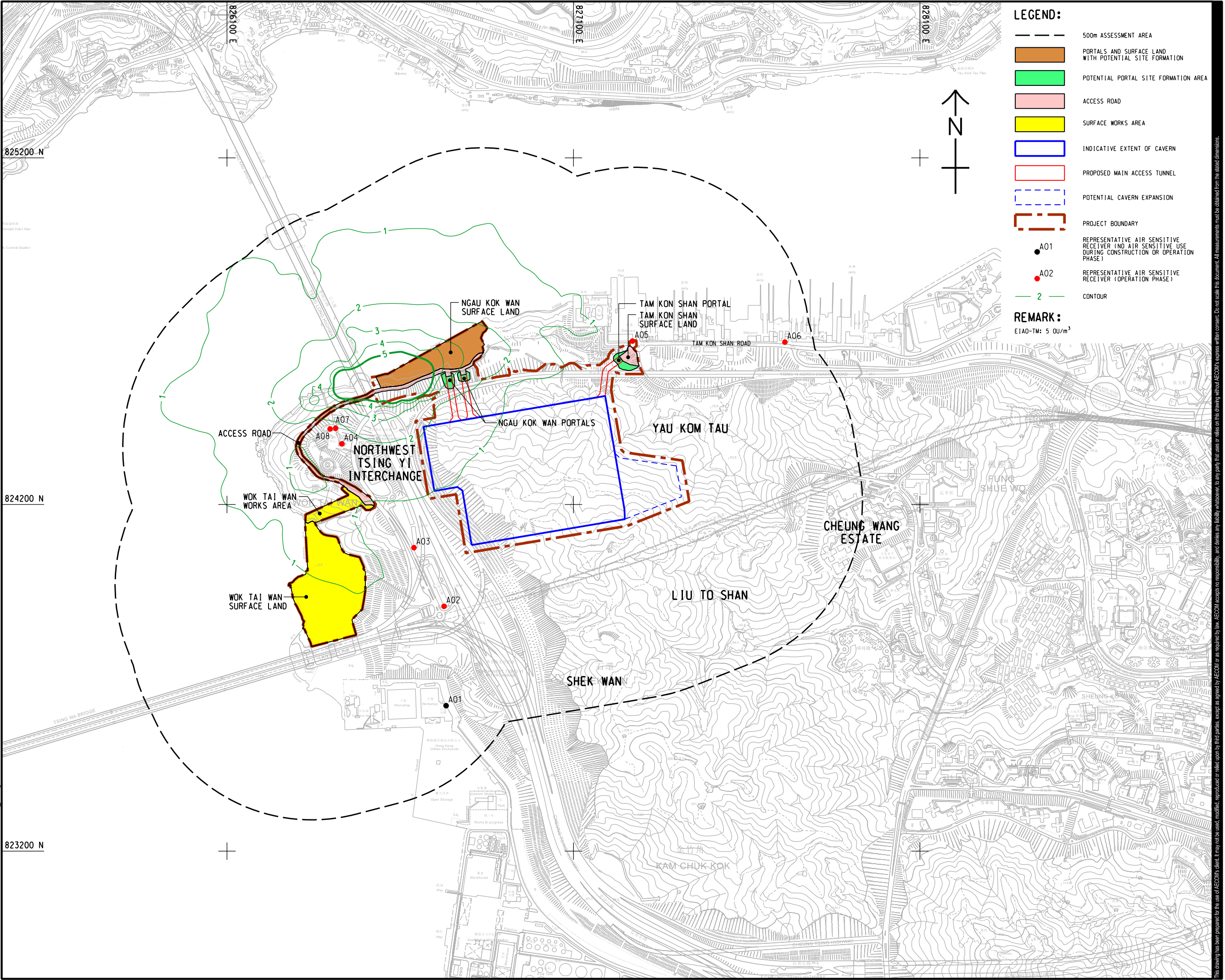
PROJECT NO.
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AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 5-SECOND ODOUR
CONCENTRATION AT 10 mAG (OU/m³)
(OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.26

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LEGEND:

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- POTENTIAL PORTAL SITE FORMATION AREA
- ACCESS ROAD
- SURFACE WORKS AREA
- INDICATIVE EXTENT OF CAVERN
- PROPOSED MAIN ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION
- PROJECT BOUNDARY
- REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
- REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
- CONTOUR

REMARK:
E1A0-TM: 5 OU/m³

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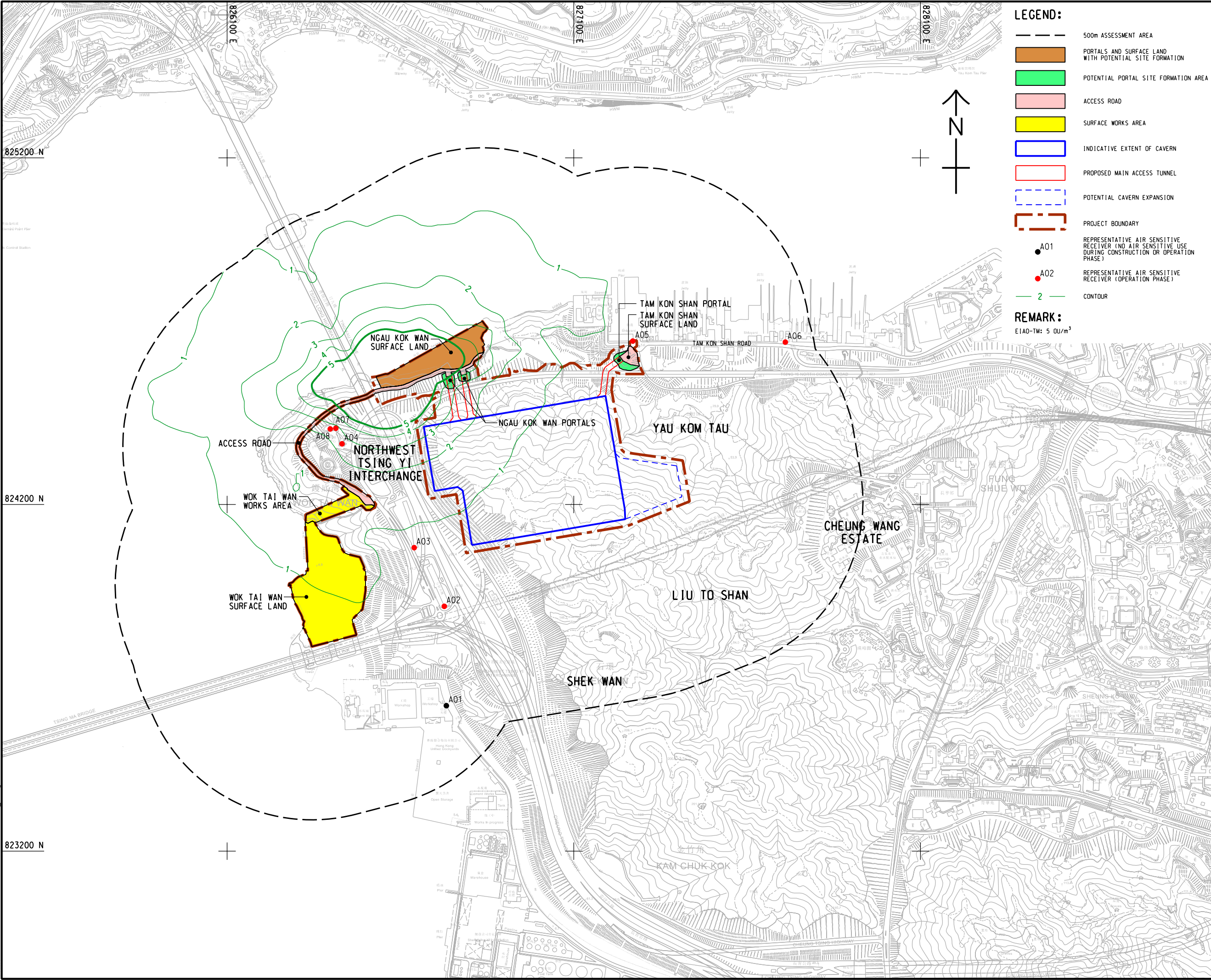
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CONTOUR OF PREDICTED HIGHEST CUMULATIVE 5-SECOND ODOUR CONCENTRATION AT 15 mAG (OU/m³) (OPERATION PHASE)

SHEET NUMBER
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LEGEND:

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- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
- POTENTIAL PORTAL SITE FORMATION AREA
- ACCESS ROAD
- SURFACE WORKS AREA
- INDICATIVE EXTENT OF CAVERN
- PROPOSED MAIN ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION
- PROJECT BOUNDARY
- REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
- REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
- CONTOUR

REMARK:
E1A0-TM: 5 OU/m³

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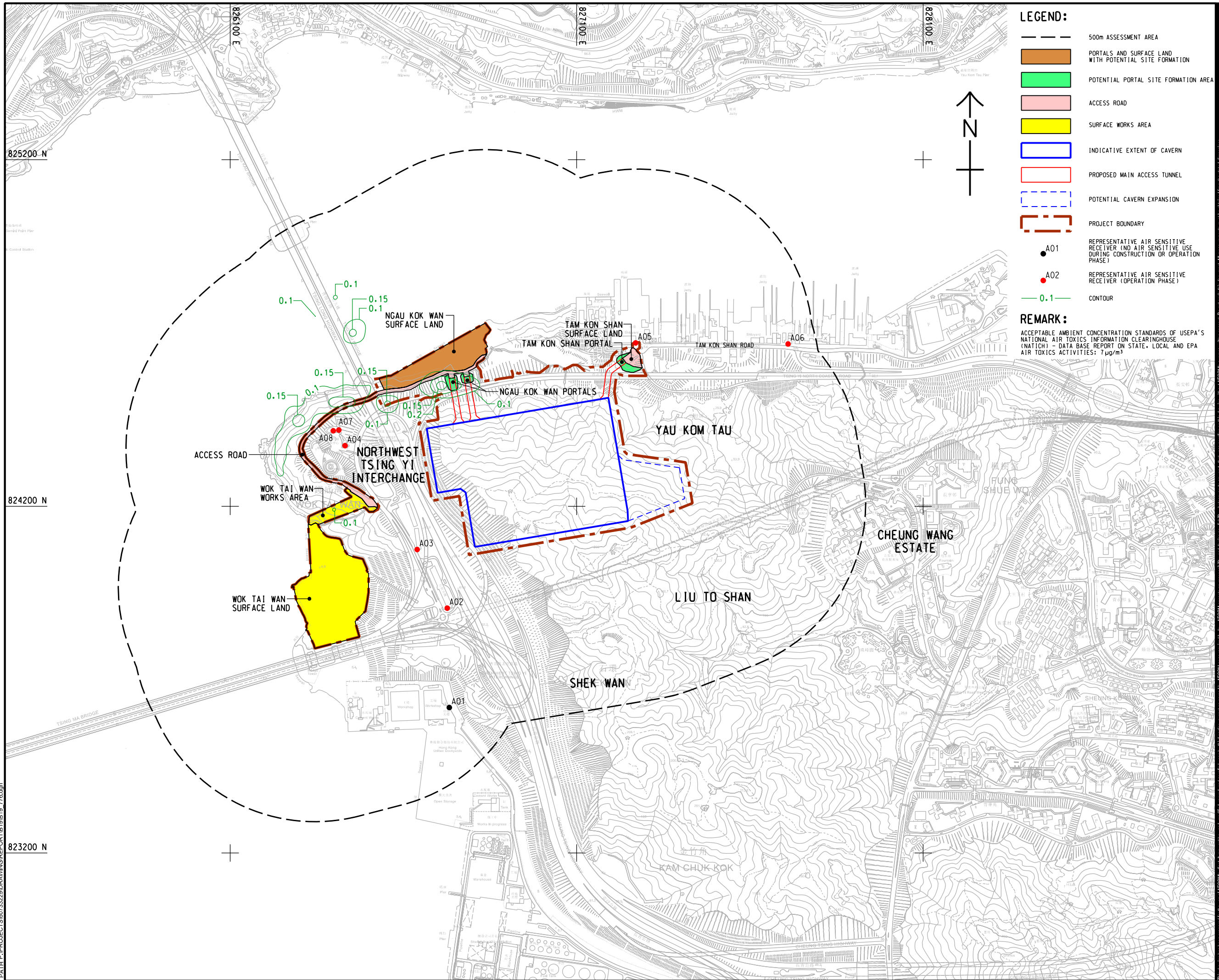
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SHEET TITLE
CONTOUR OF PREDICTED HIGHEST CUMULATIVE 5-SECOND ODOUR CONCENTRATION AT 20 mAG (OU/m³) (OPERATION PHASE)

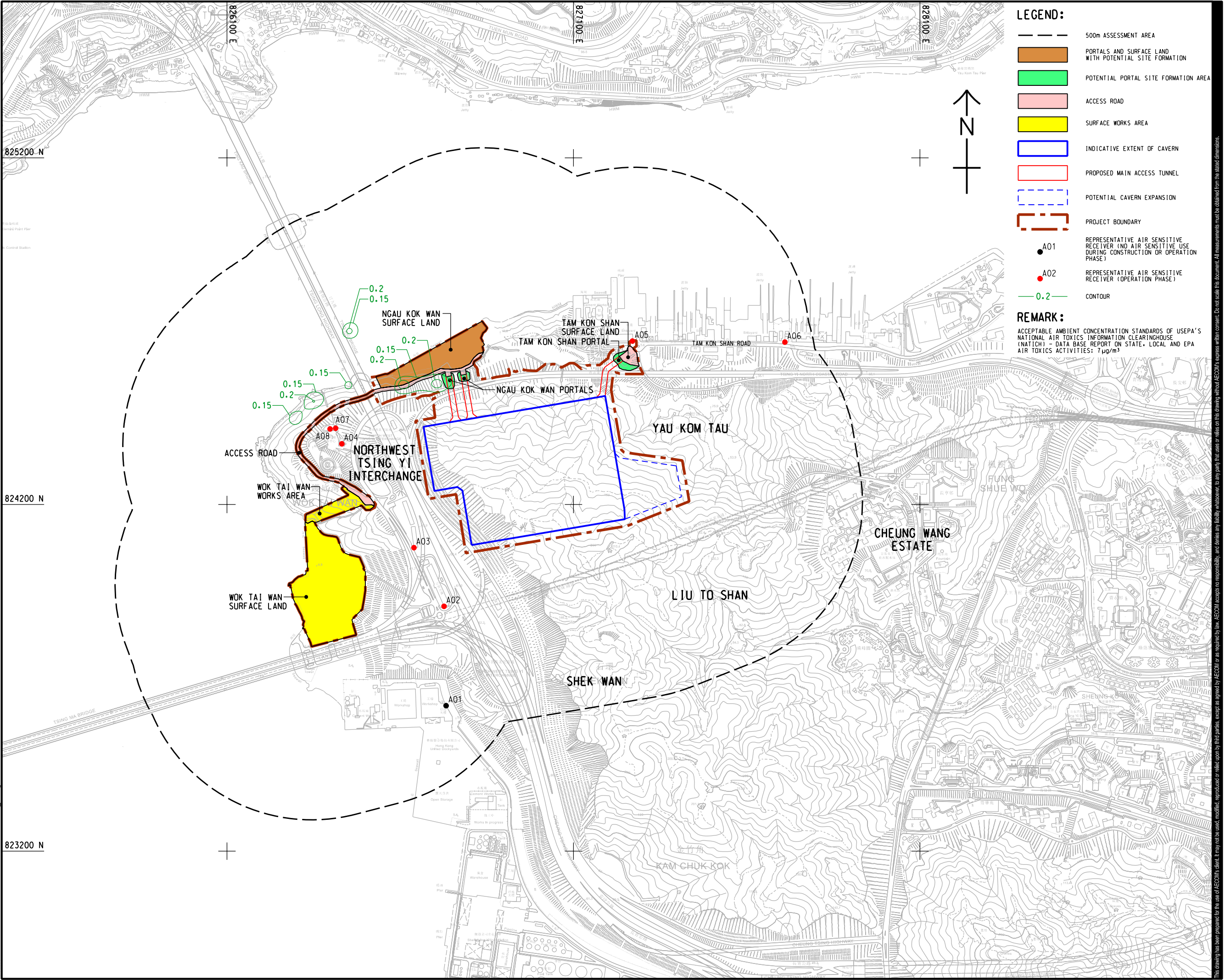
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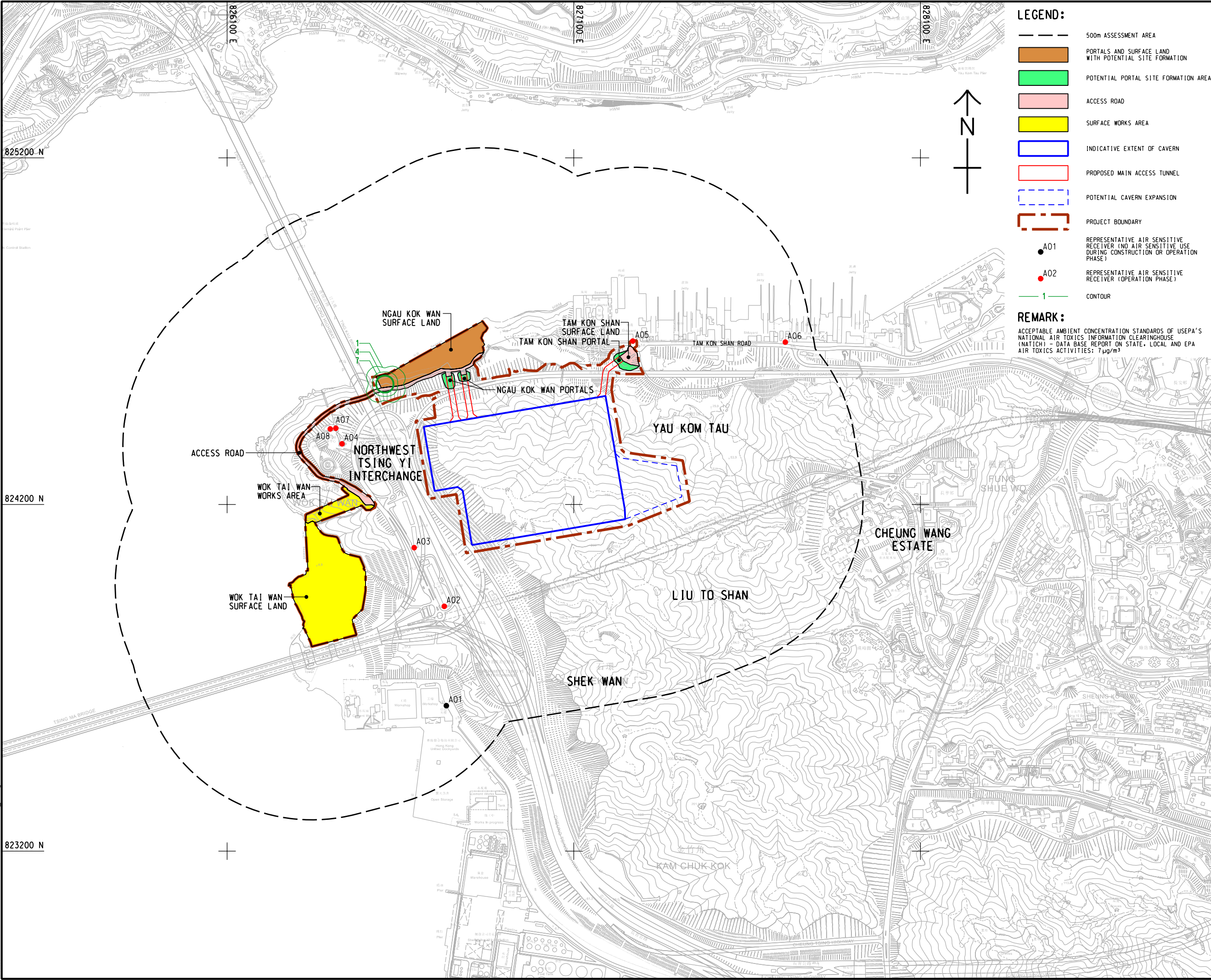
KEY PLAN

PROJECT NO.
60733229
AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE DAILY BITUMEN FUME
CONCENTRATION AT 5 mAG (µg/m³)
(OPERATION PHASE)
SHEET NUMBER
60733229/B19/FIGURE 4.30

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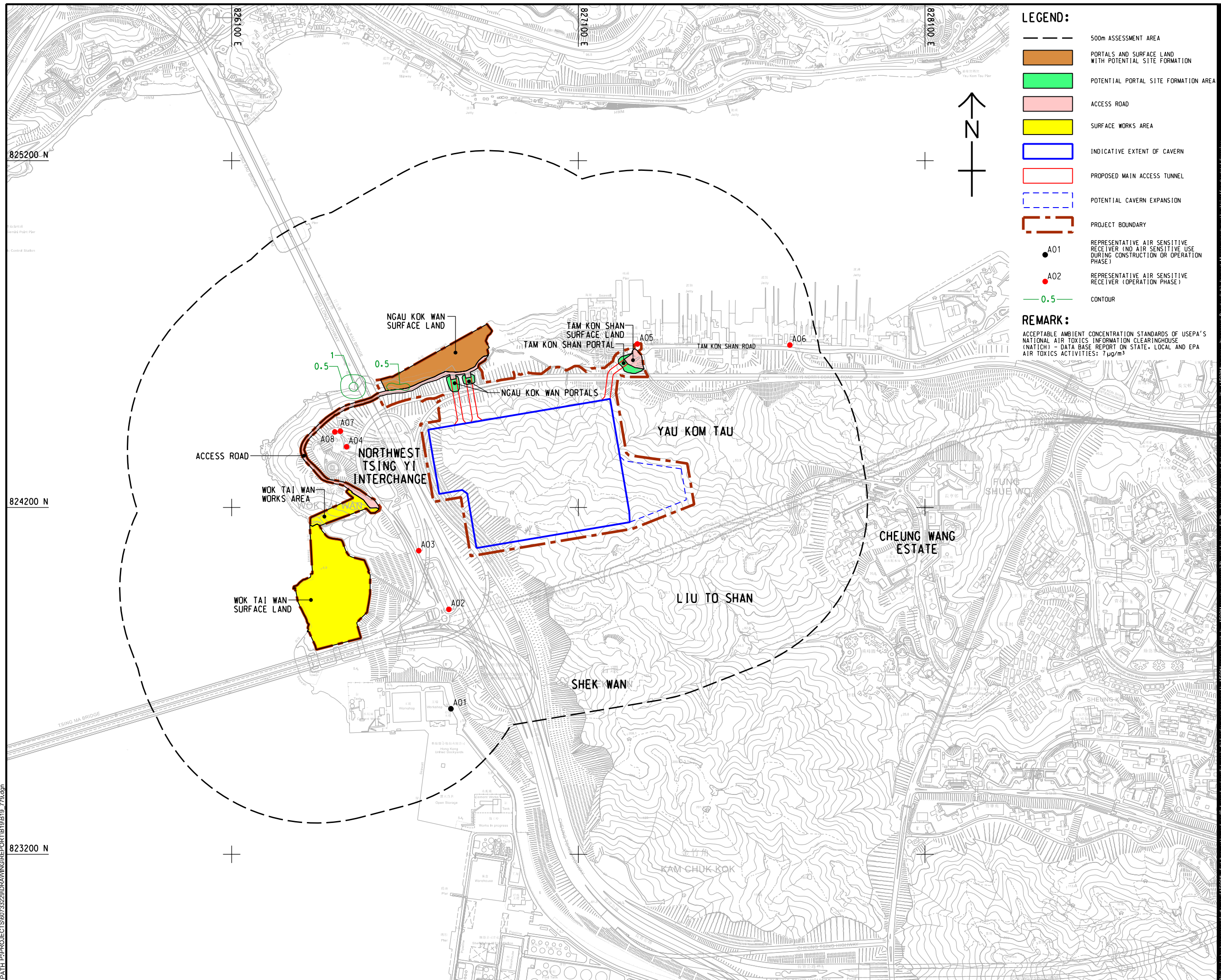
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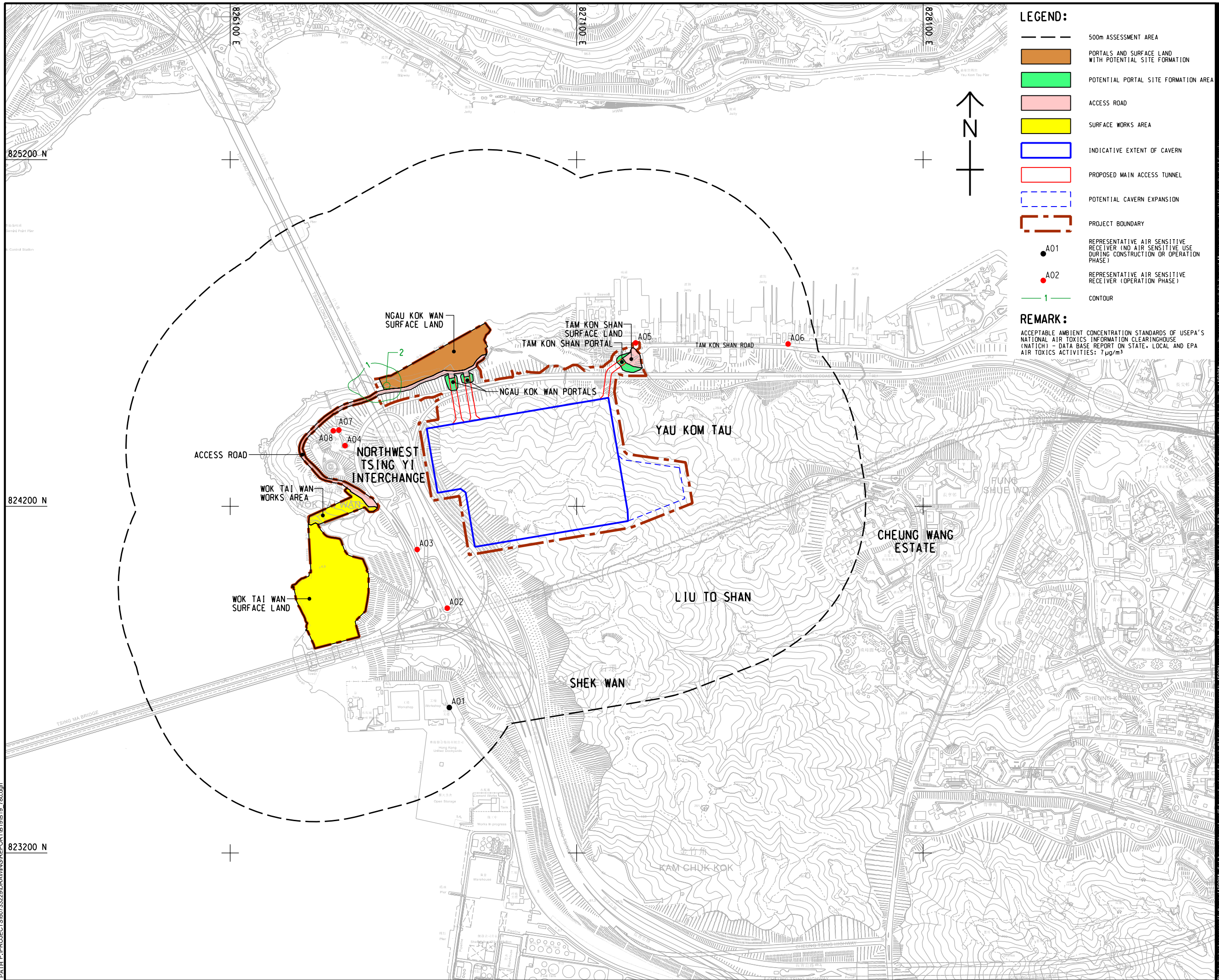
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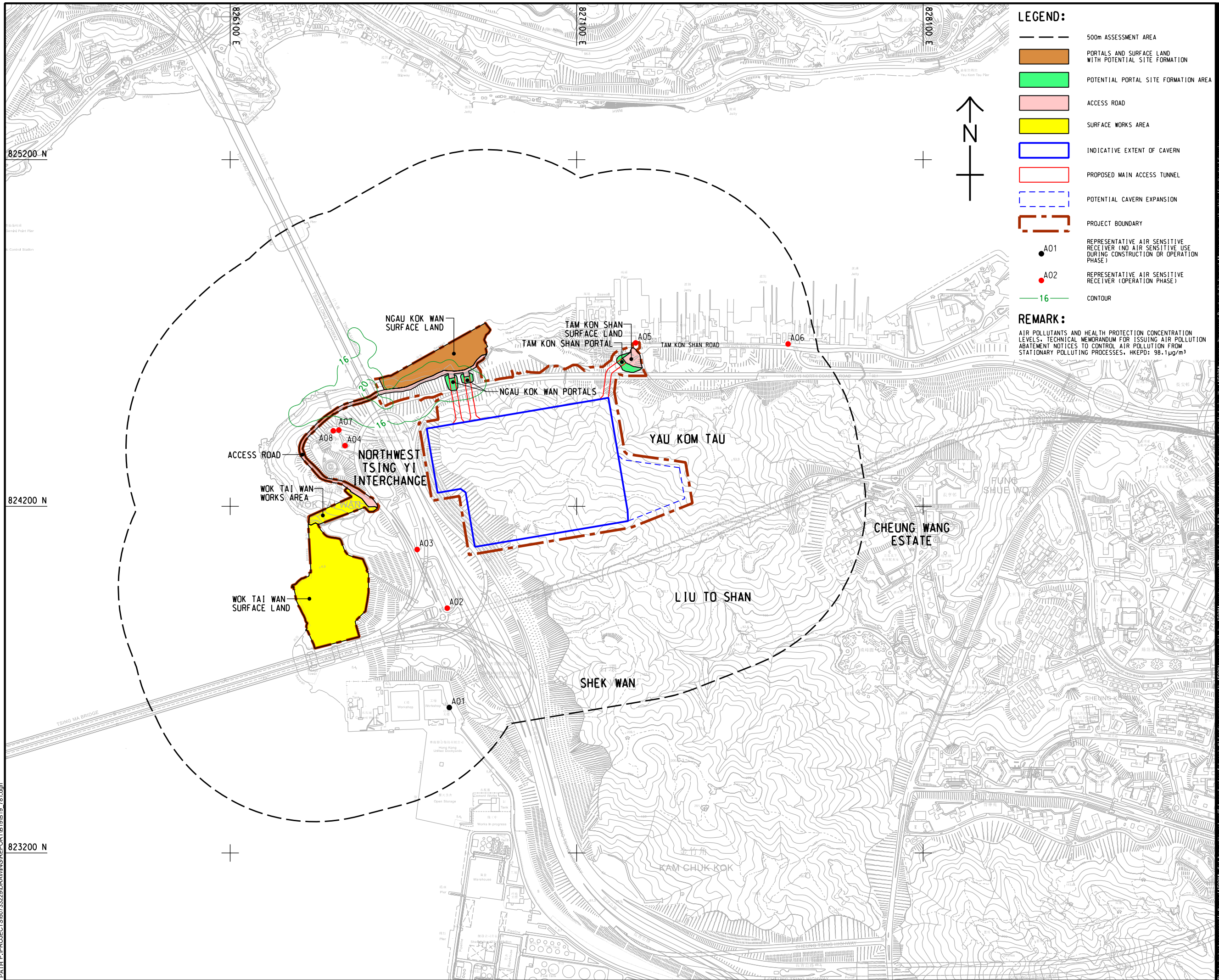
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60733229/B19/FIGURE 4.31



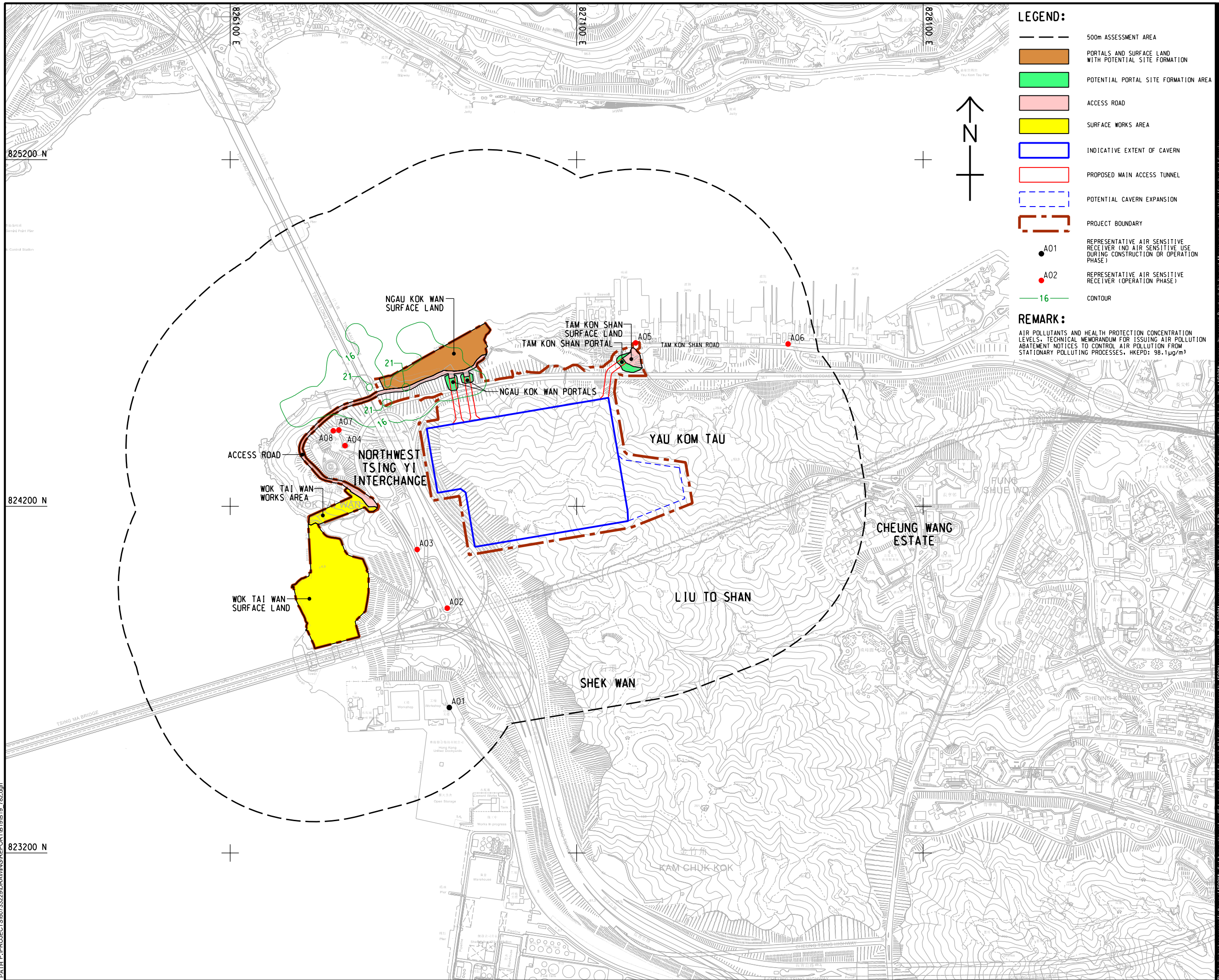
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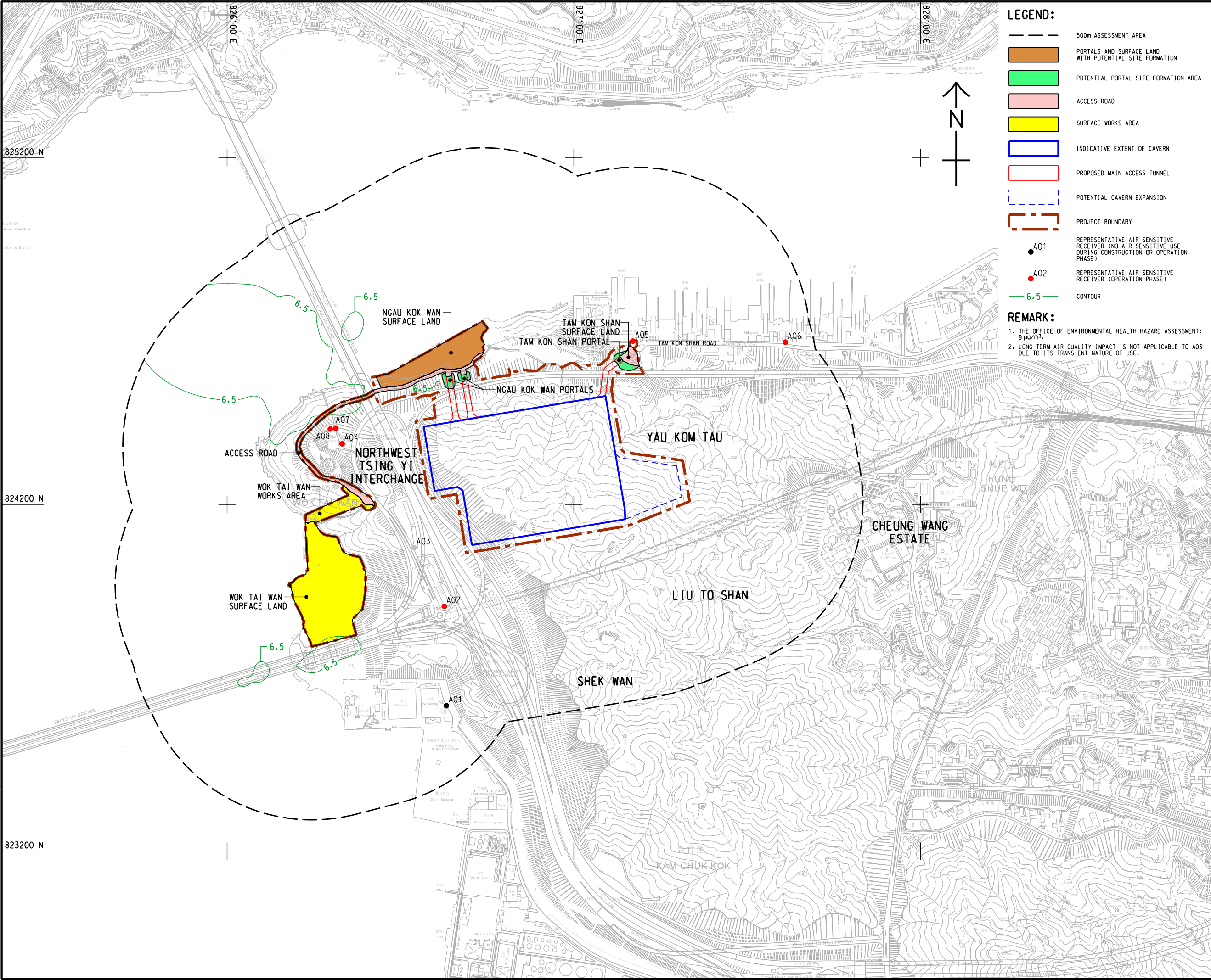
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KEY PLAN

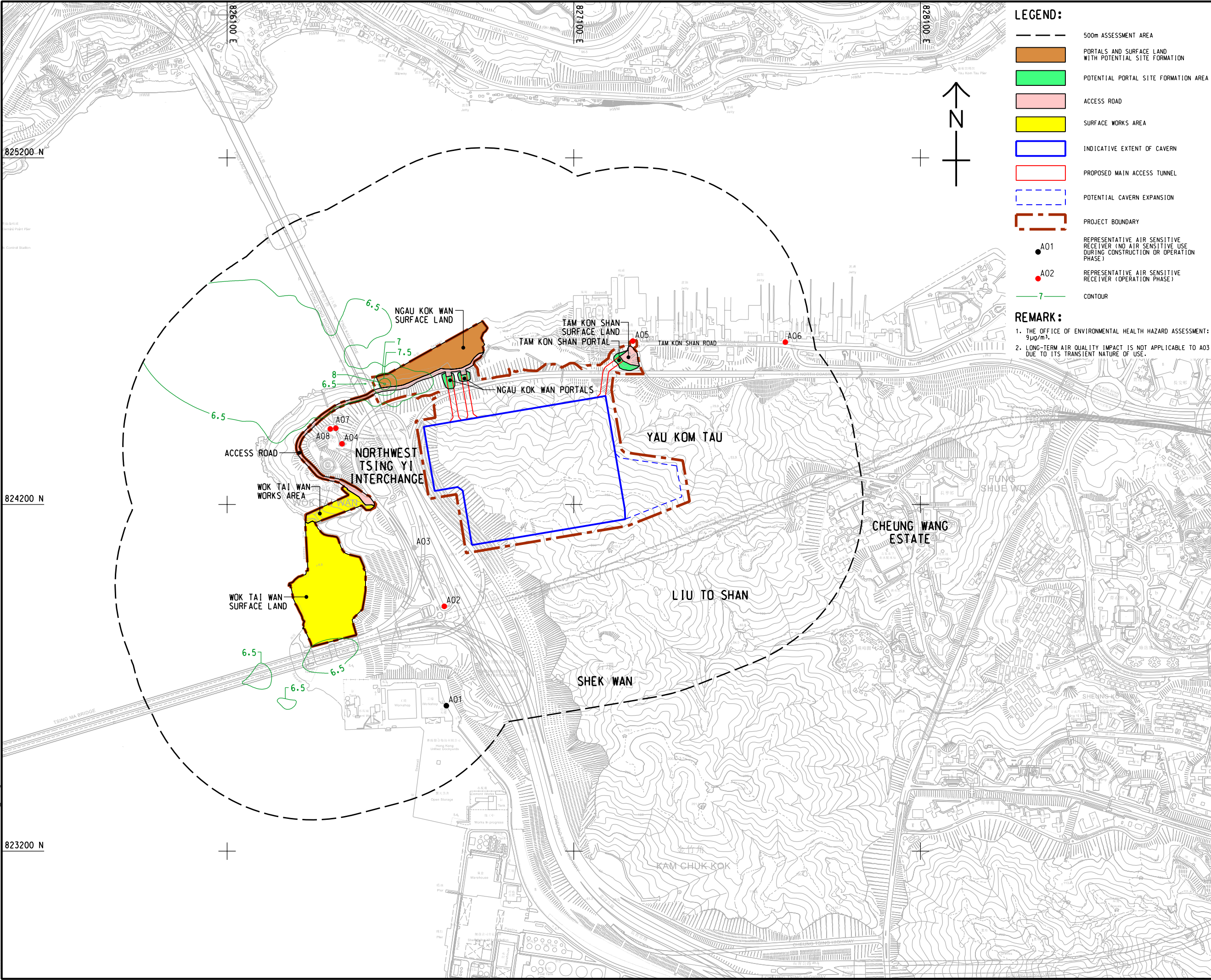
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60733229
AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED
CUMULATIVE ANNUAL FORMALDEHYDE
CONCENTRATION AT 1.5 mAG ($\mu\text{g}/\text{m}^3$)
(OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.36

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- LEGEND:**
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 - PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
 - CONTOUR
- REMARK:**
- THE OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT: $9\mu\text{g}/\text{m}^3$.
 - LONG-TERM AIR QUALITY IMPACT IS NOT APPLICABLE TO A03 DUE TO ITS TRANSIENT NATURE OF USE.

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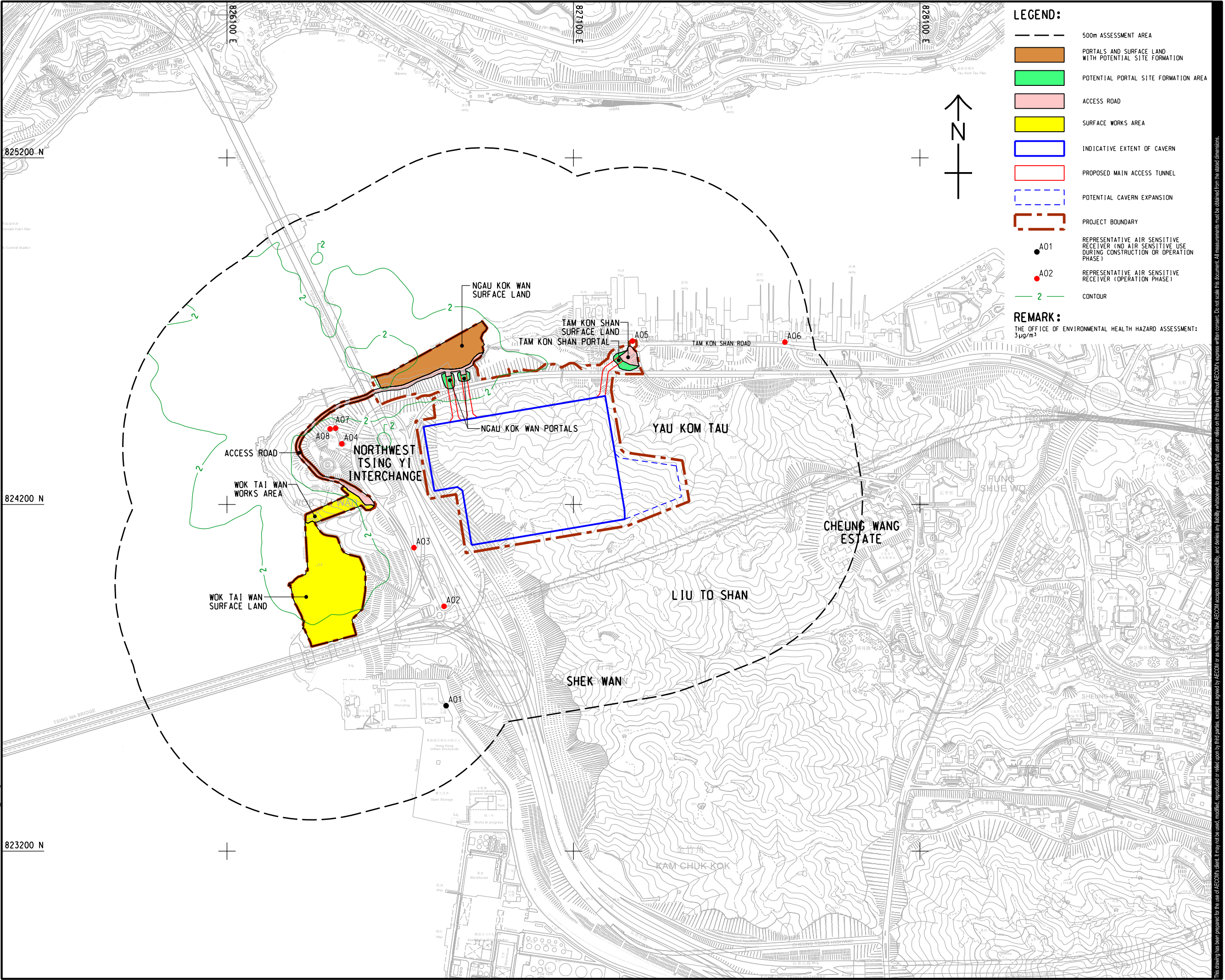
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SCALE	DIMENSION UNIT
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KEY PLAN	

PROJECT NO.	AGREEMENT NO.
60733229	CE 79/2023 (GE)
SHEET TITLE	
CONTOUR OF PREDICTED CUMULATIVE ANNUAL FORMALDEHYDE CONCENTRATION AT 10 mAG ($\mu\text{g}/\text{m}^3$) (OPERATION PHASE)	
SHEET NUMBER	
60733229/B19/FIGURE 4.37	

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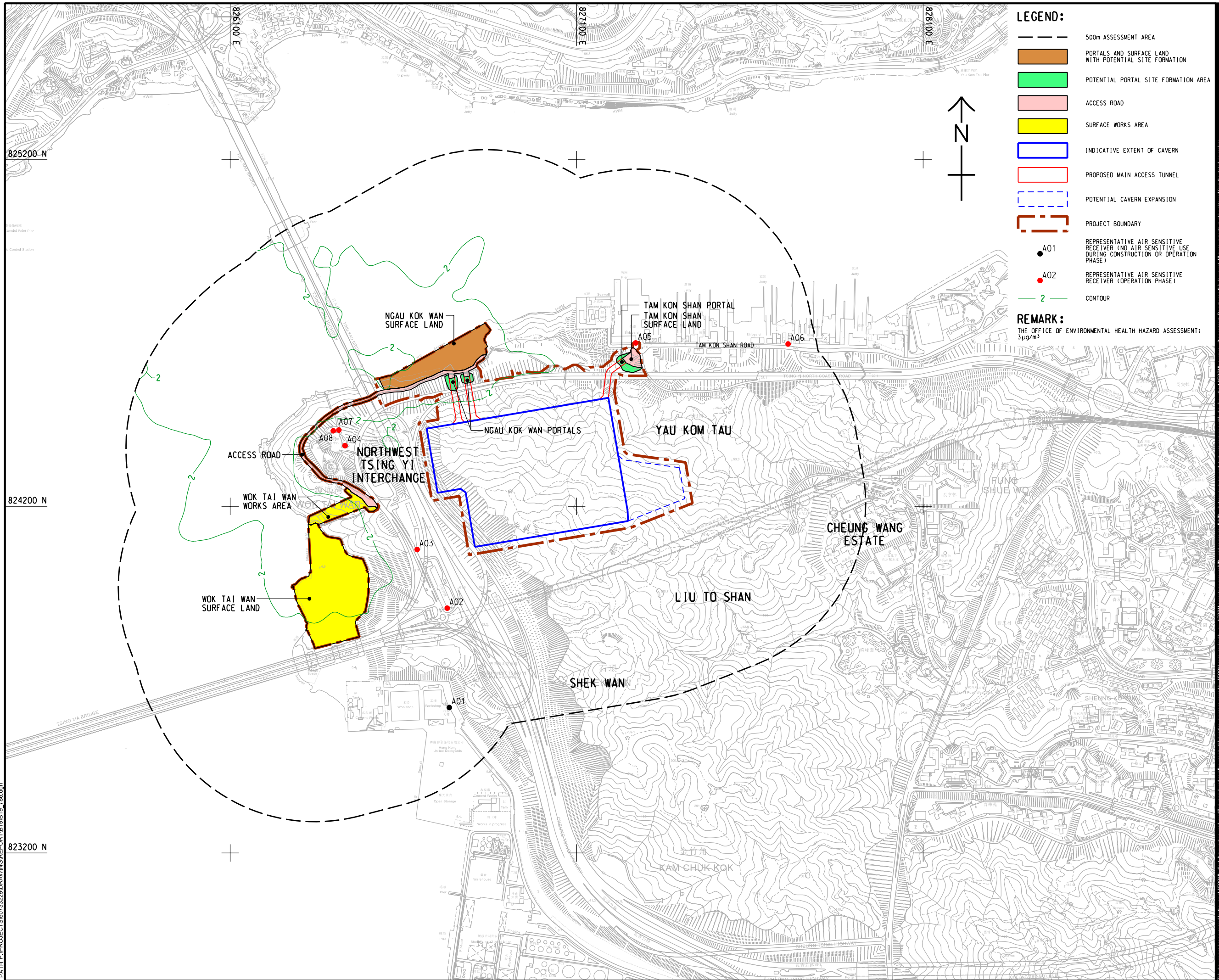
KEY PLAN

PROJECT NO.
60733229

AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR BENZENE
CONCENTRATION AT 1.5 mAG (µg/m³)
(OPERATION PHASE)

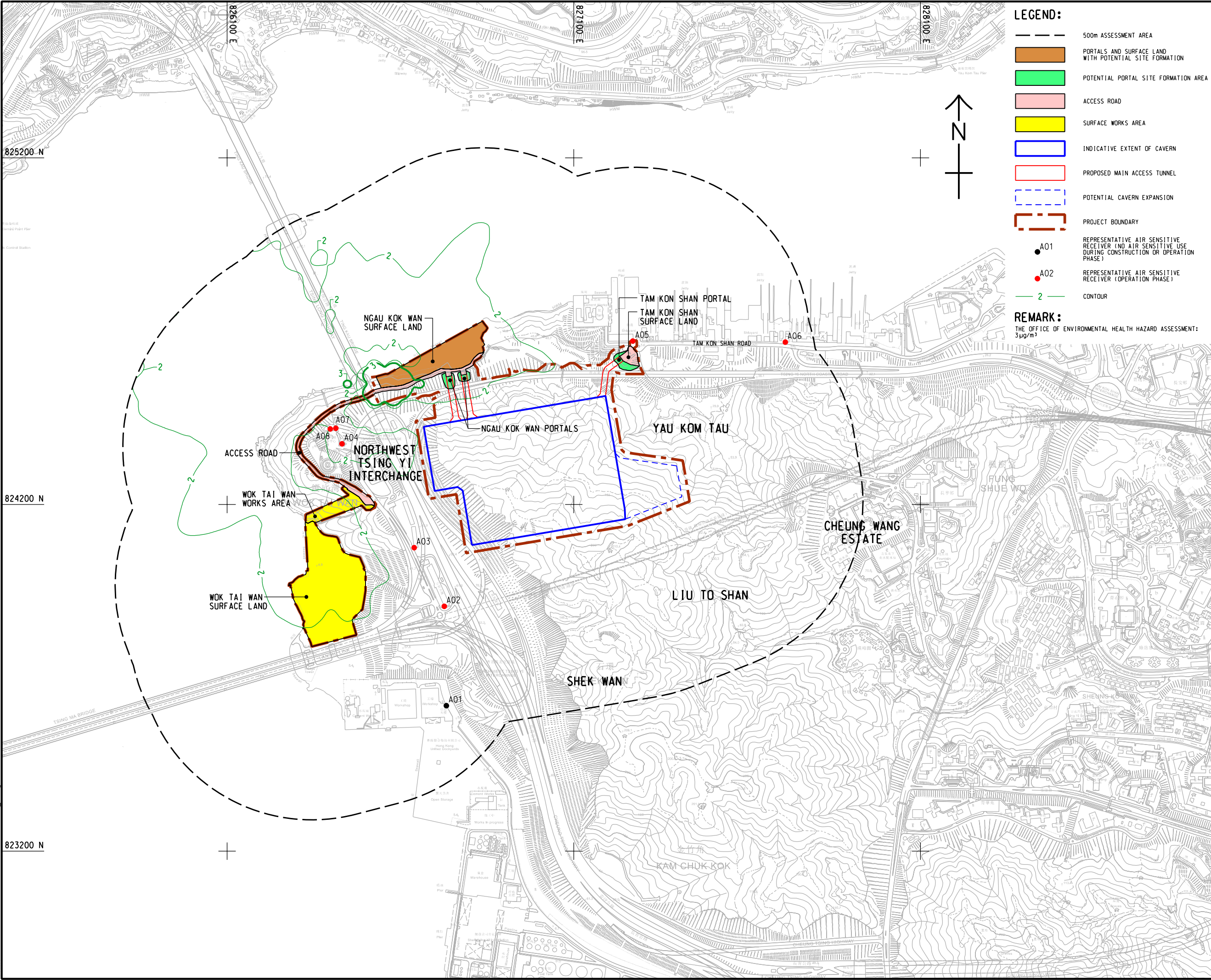
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60733229/B19/FIGURE 4.38



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KEY PLAN

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SHEET TITLE

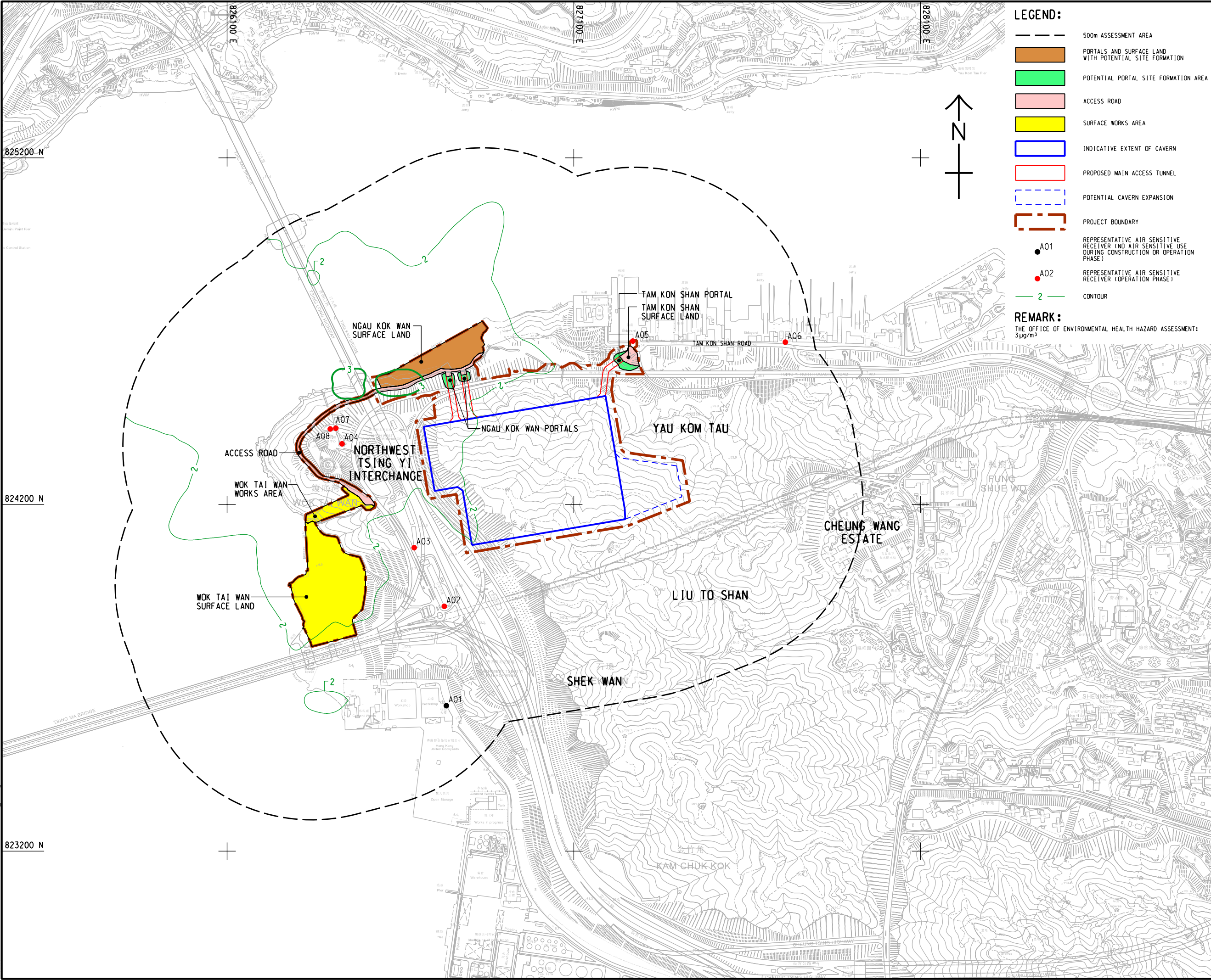
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR BENZENE
CONCENTRATION AT 10 mAG (µg/m³)
(OPERATION PHASE)

SHEET NUMBER

60733229/B19/FIGURE 4.40

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SHEET TITLE

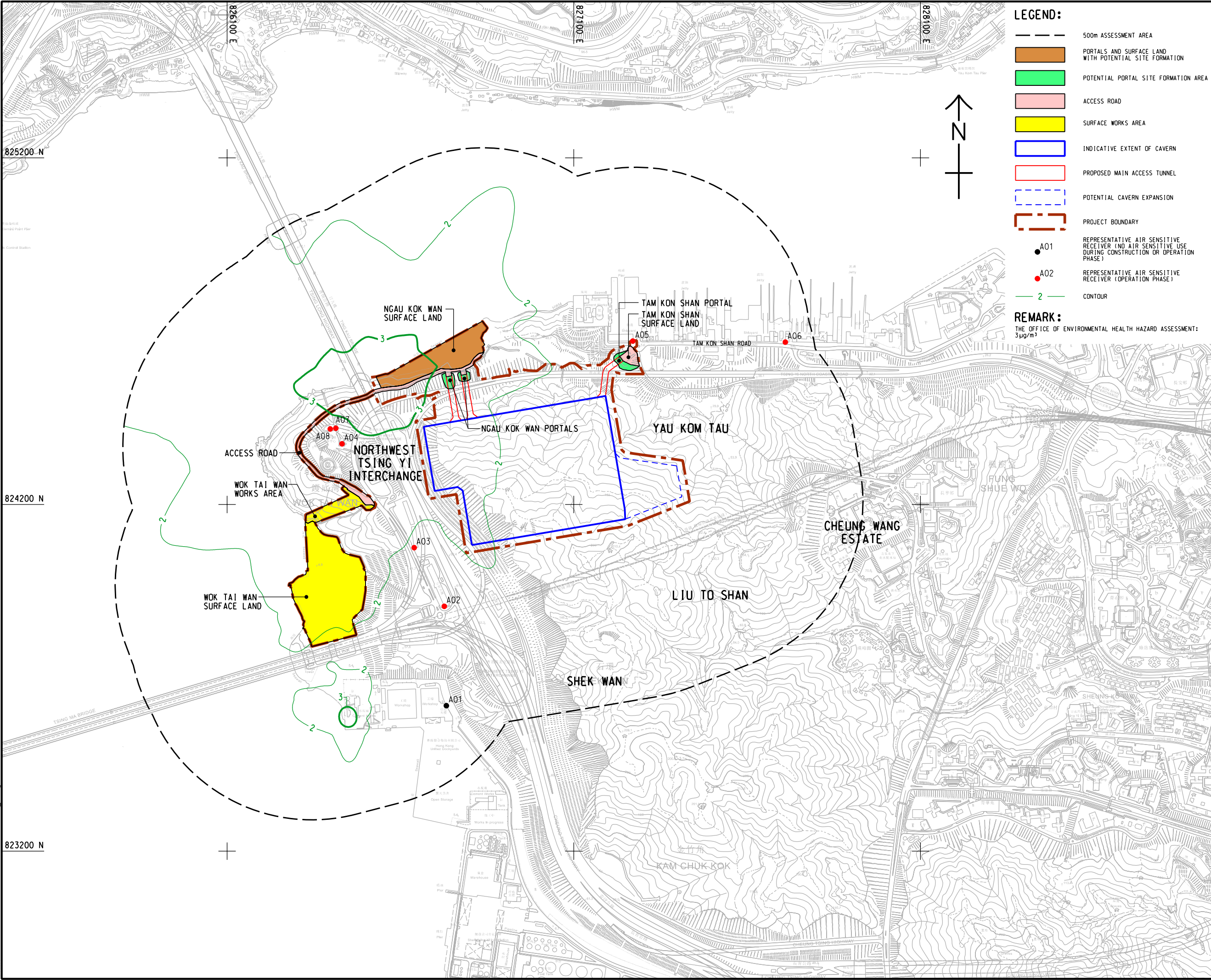
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR BENZENE
CONCENTRATION AT 15 mAG (µg/m³)
(OPERATION PHASE)

SHEET NUMBER

60733229/B19/FIGURE 4.41

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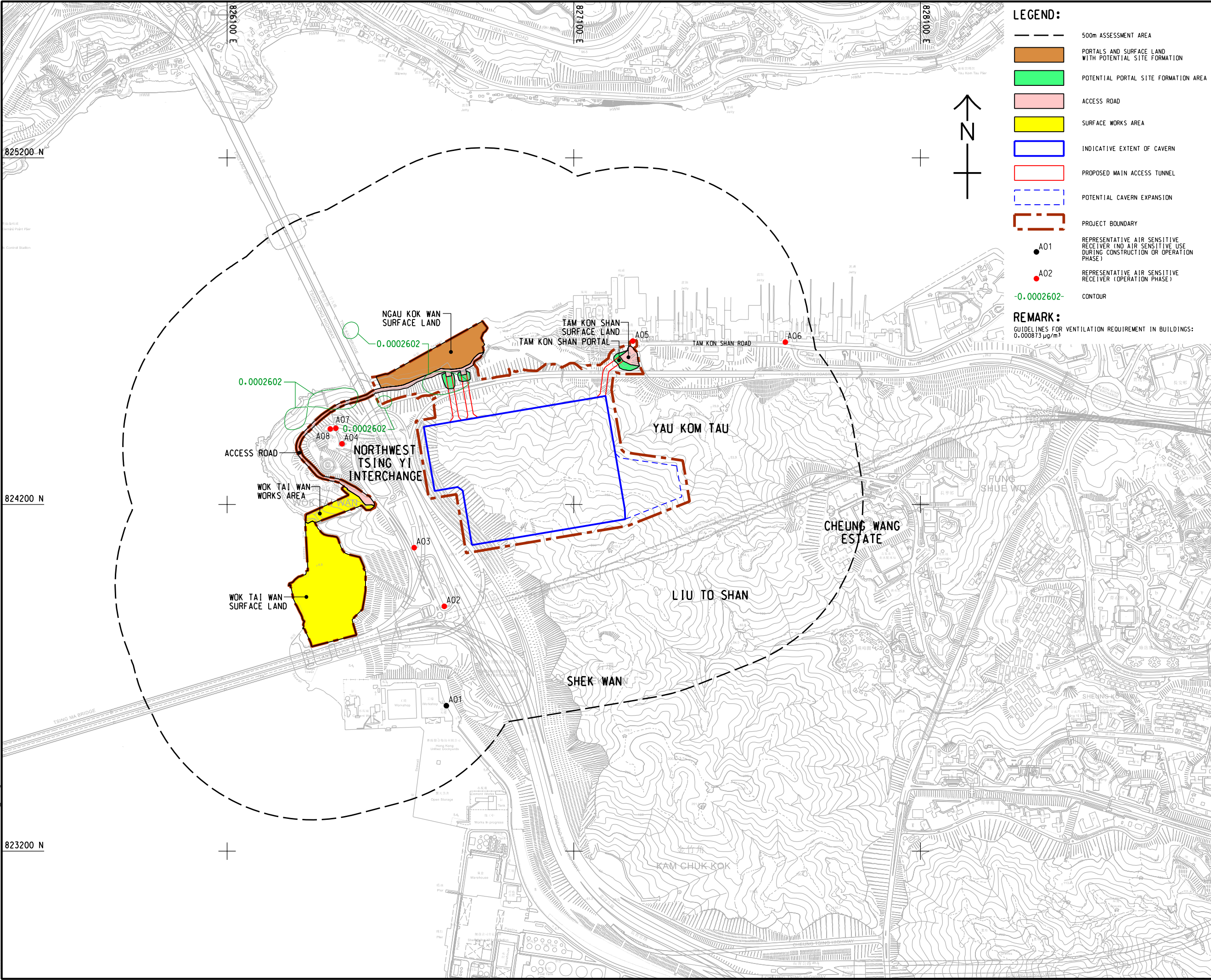
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AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR BENZENE
CONCENTRATION AT 20 mAG (µg/m³)
(OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.42

ISO A1 594mm x 841mm
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AGREEMENT NO.
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圖紙名稱

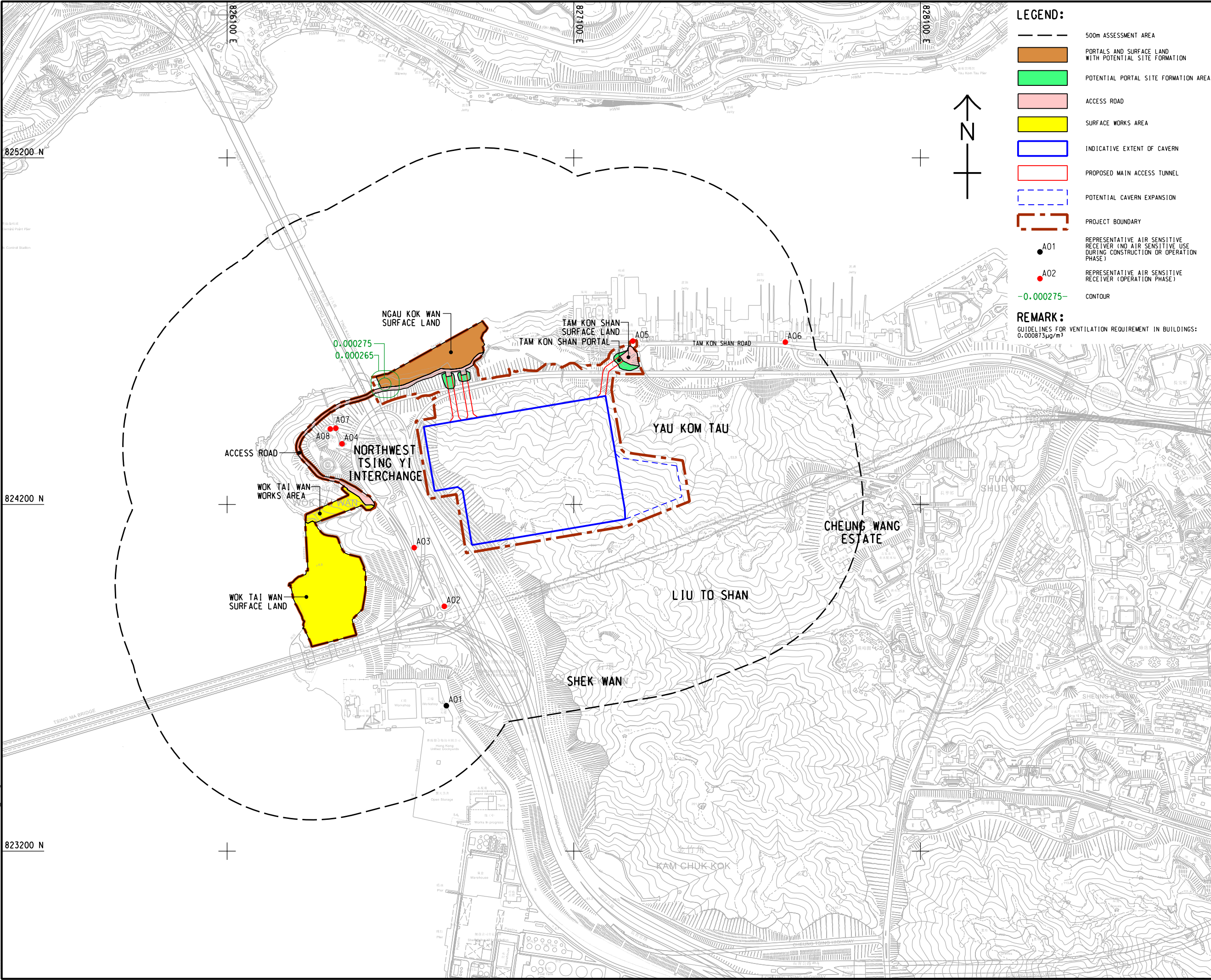
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE DAILY BENZO(A)PYRENE
CONCENTRATION AT 1.5 mA (µg/m³)
(OPERATION PHASE)

SHEET NUMBER
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60733229/B19/FIGURE 4.43

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- LEGEND:**
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 - PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (NO AIR SENSITIVE USE DURING CONSTRUCTION OR OPERATION PHASE)
 - REPRESENTATIVE AIR SENSITIVE RECEIVER (OPERATION PHASE)
 - CONTOUR
- REMARK:**
GUIDELINES FOR VENTILATION REQUIREMENT IN BUILDINGS:
0.000873µg/m³

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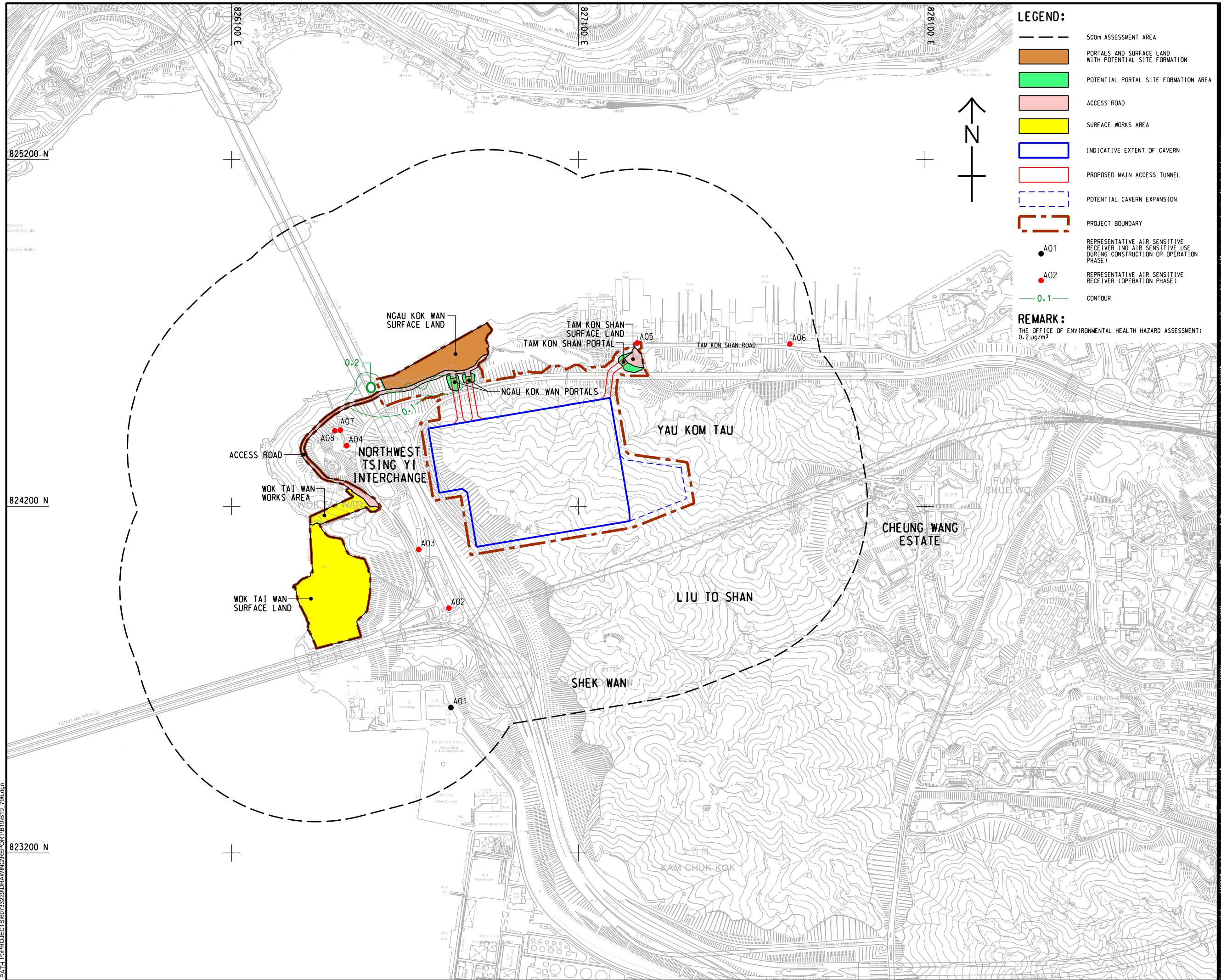
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SHEET TITLE
CONTOUR OF PREDICTED HIGHEST CUMULATIVE DAILY BENZO(A)PYRENE CONCENTRATION AT 10 mAG (µg/m³) (OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.44

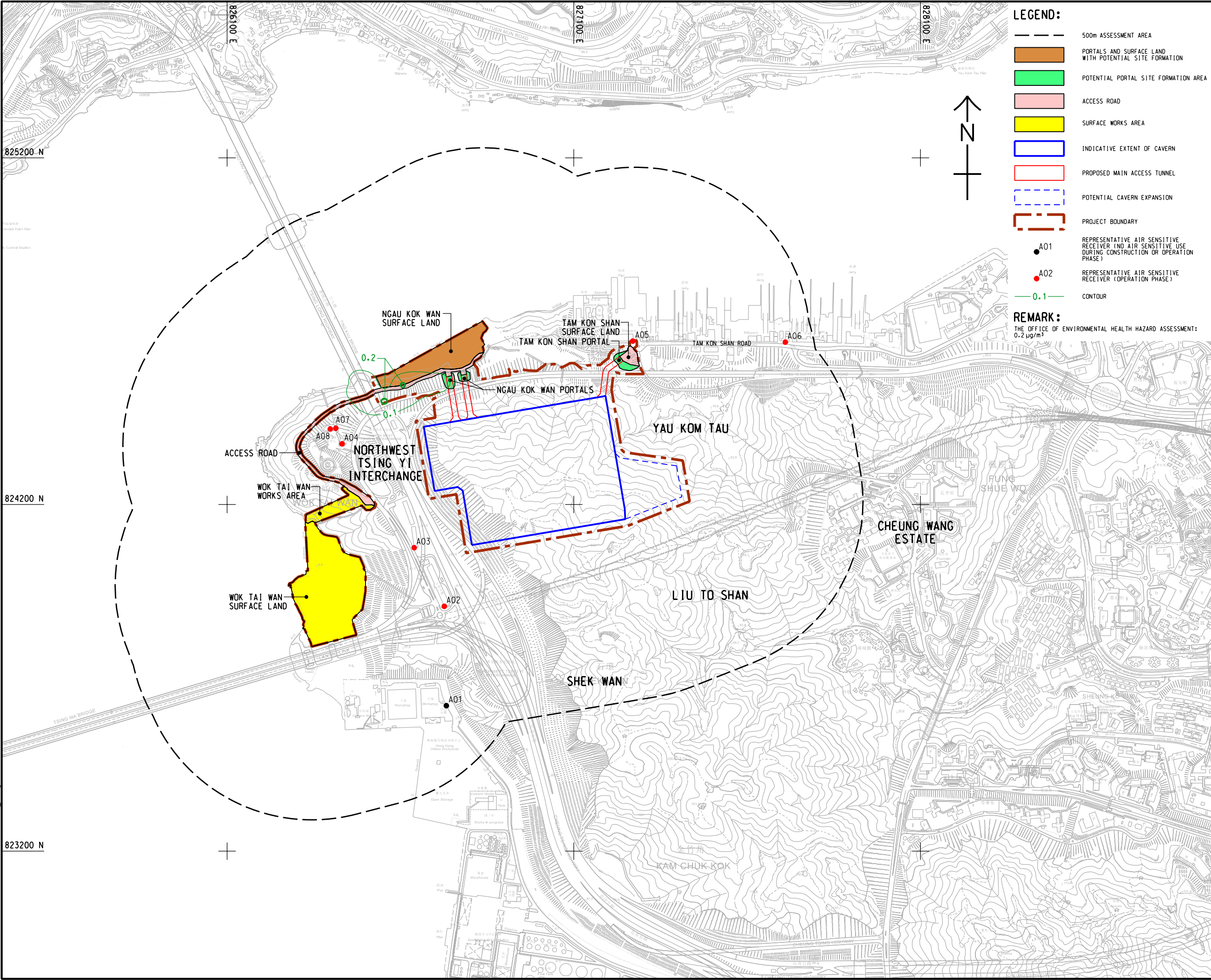


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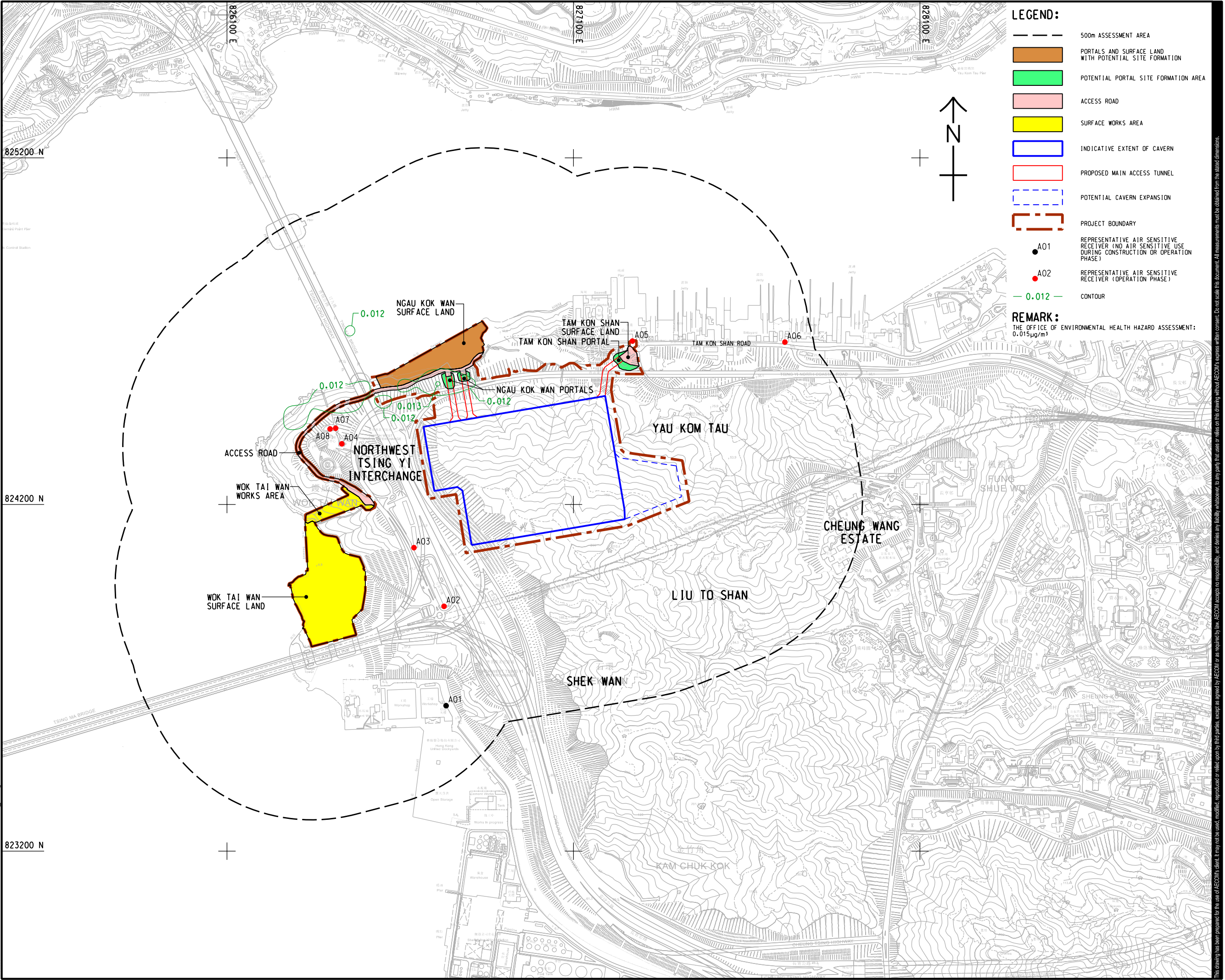
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AGREEMENT NO.
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SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE HOURLY NICKEL
CONCENTRATION AT 5 mAG (µg/m³)
(OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.46

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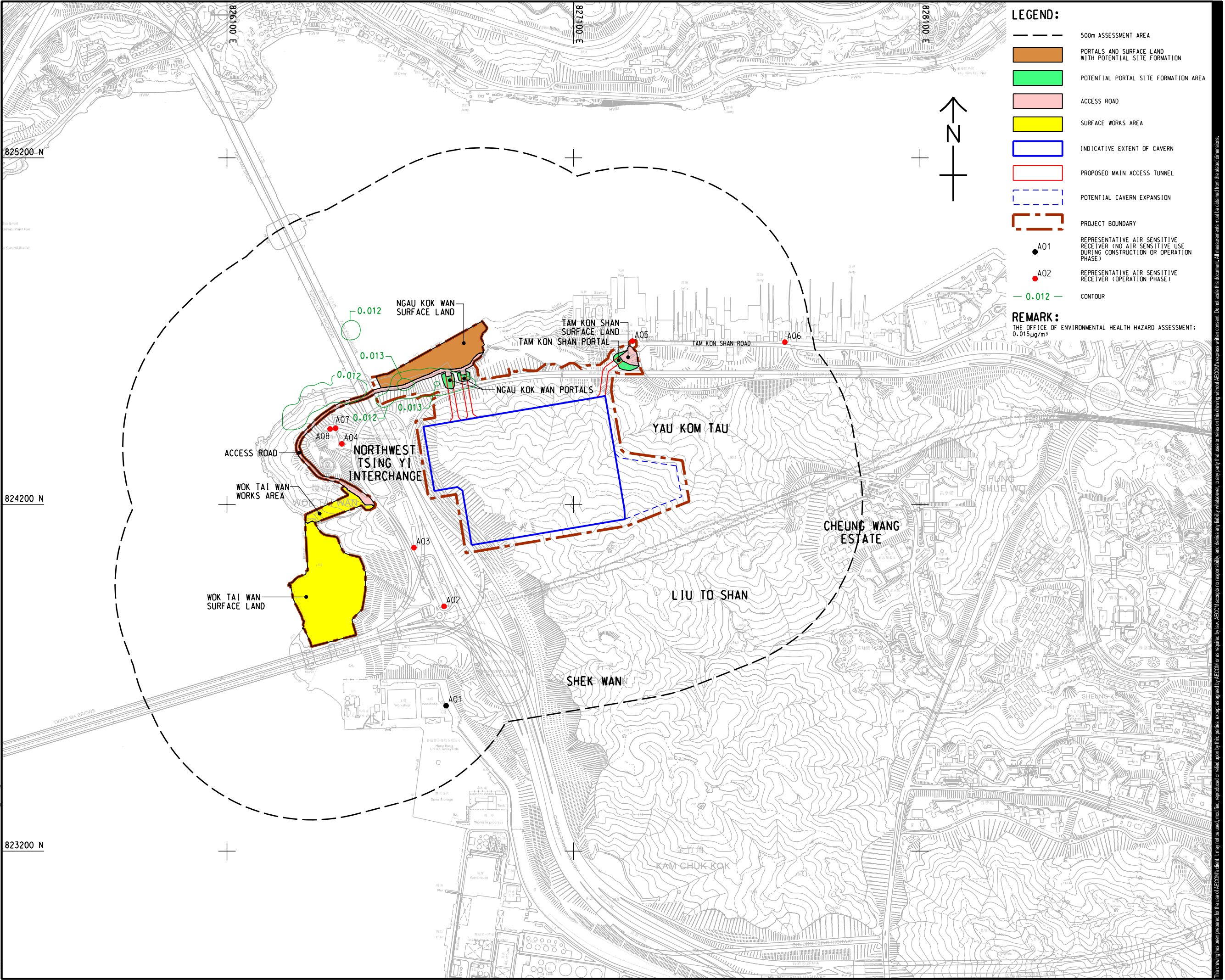
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60733229
AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR ARSENIC
CONCENTRATION AT 1.5 mAG (µg/m³)
(OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.47

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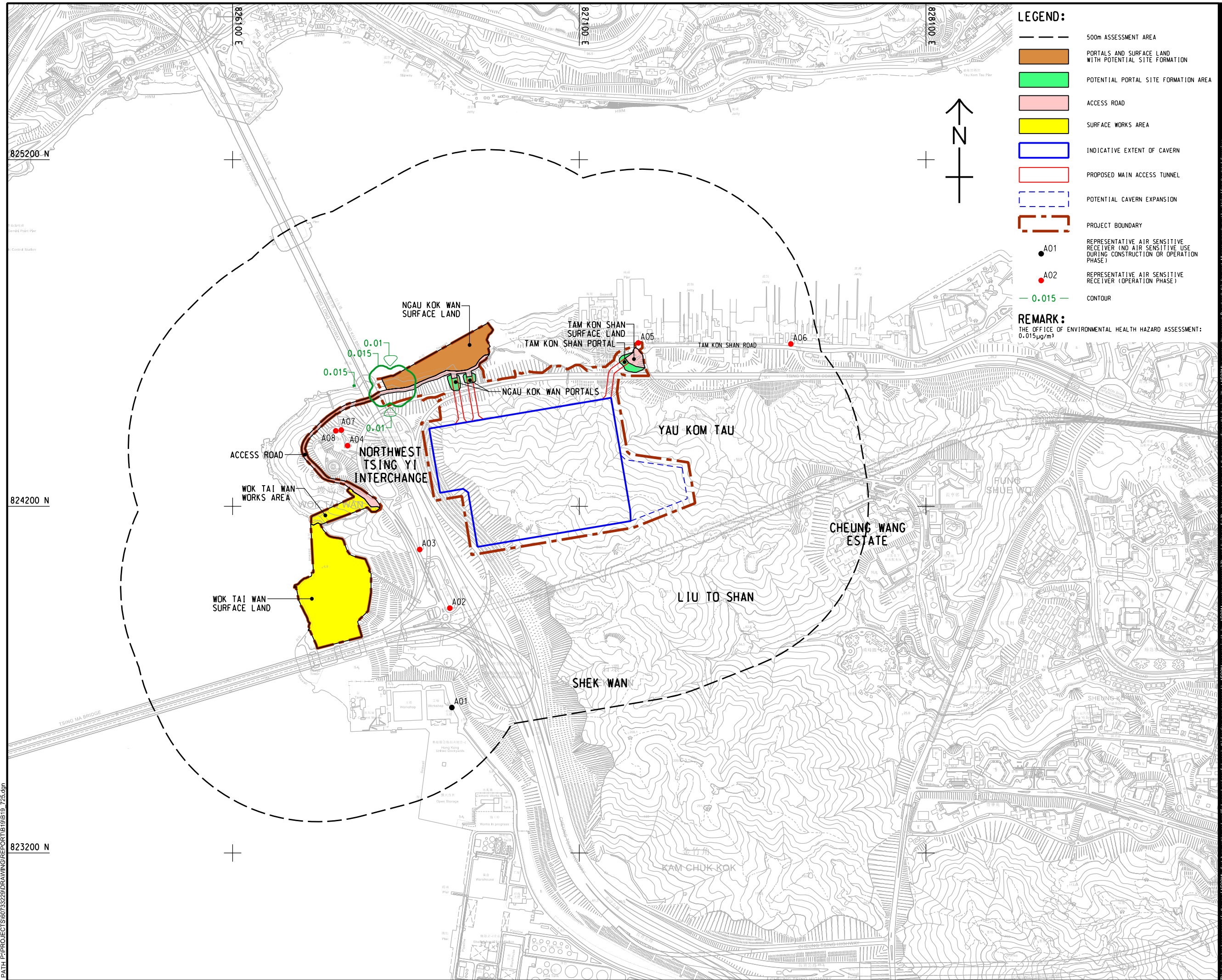
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60733229

AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR ARSENIC
CONCENTRATION AT 5 mAG (µg/m³)
(OPERATION PHASE)

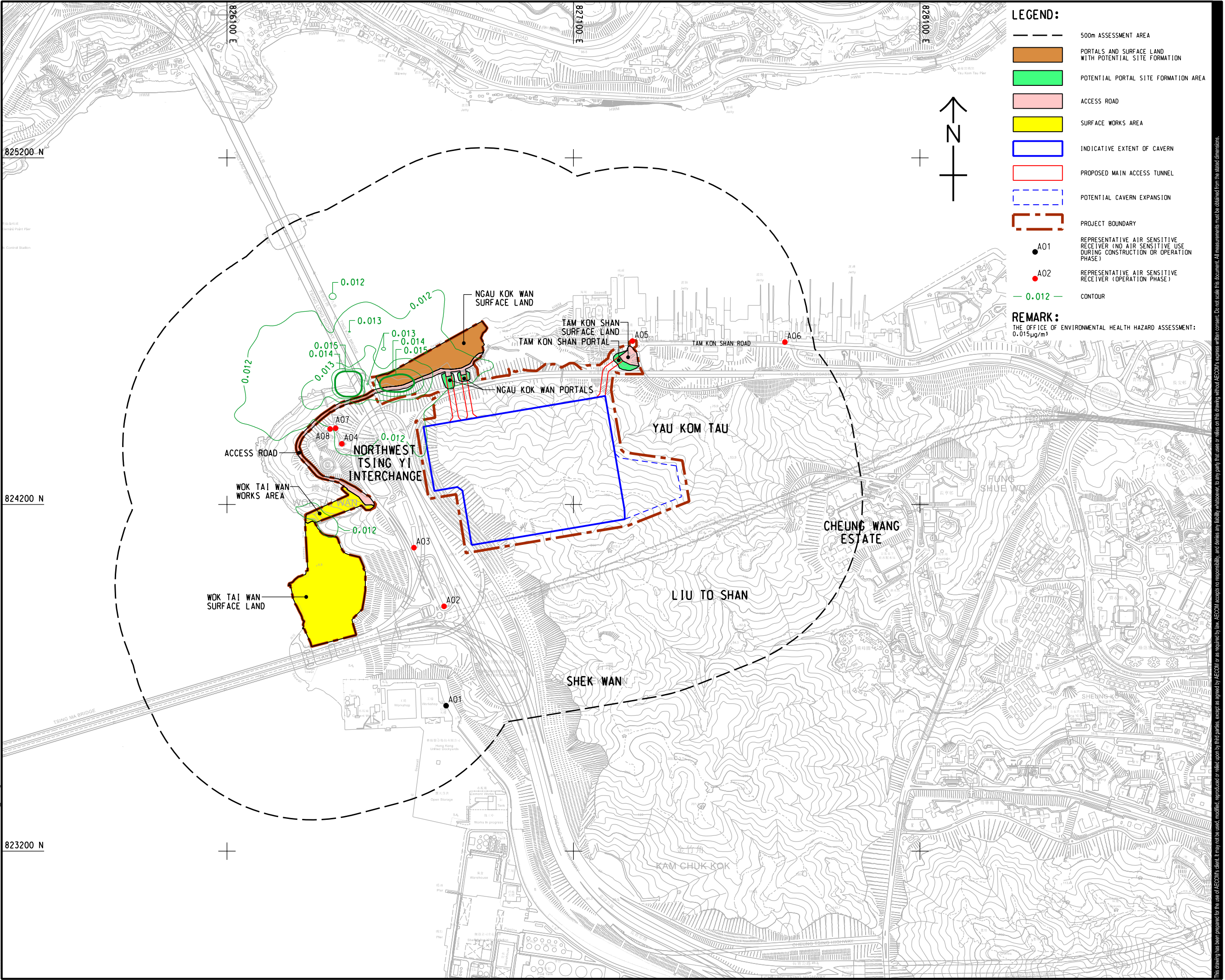
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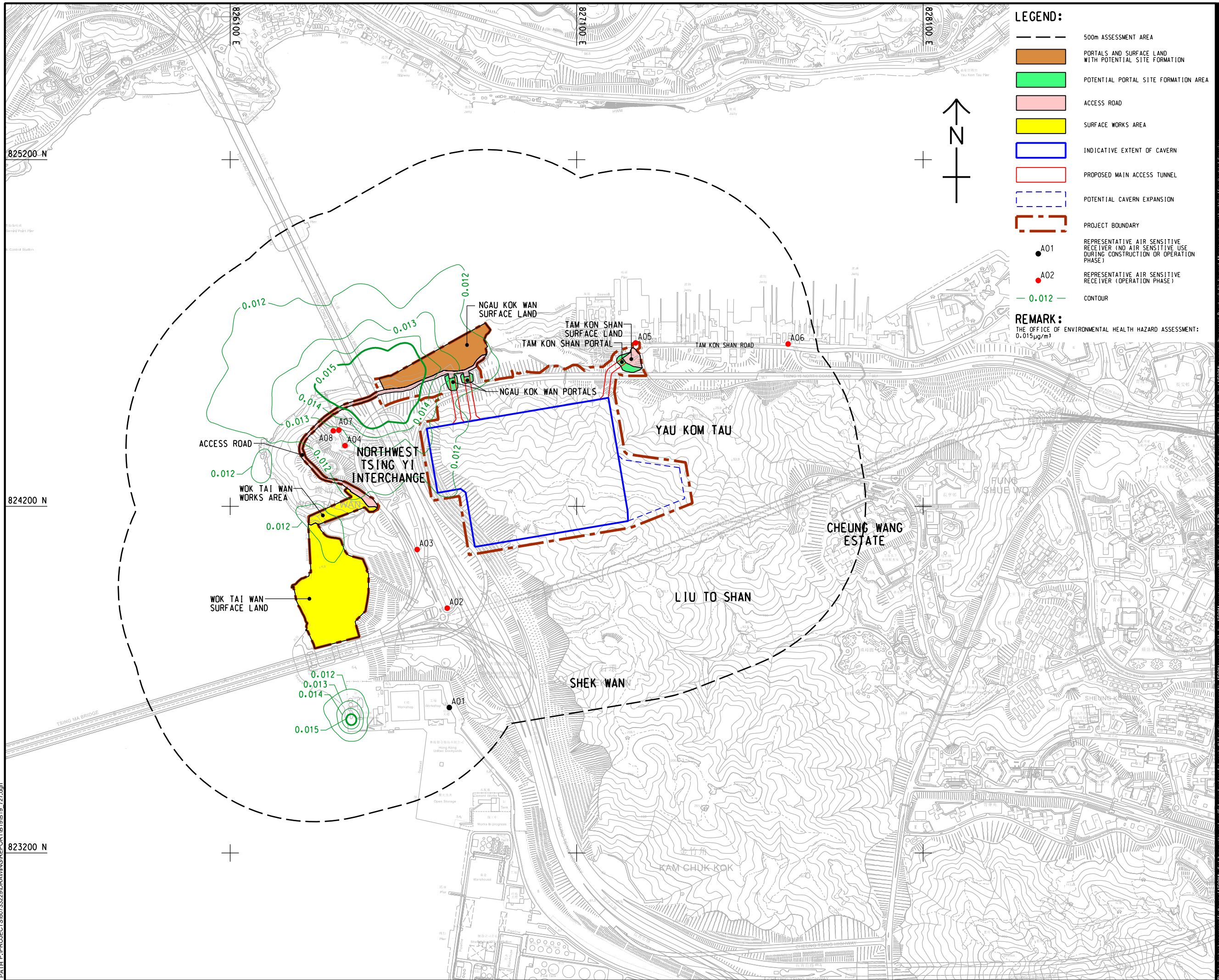
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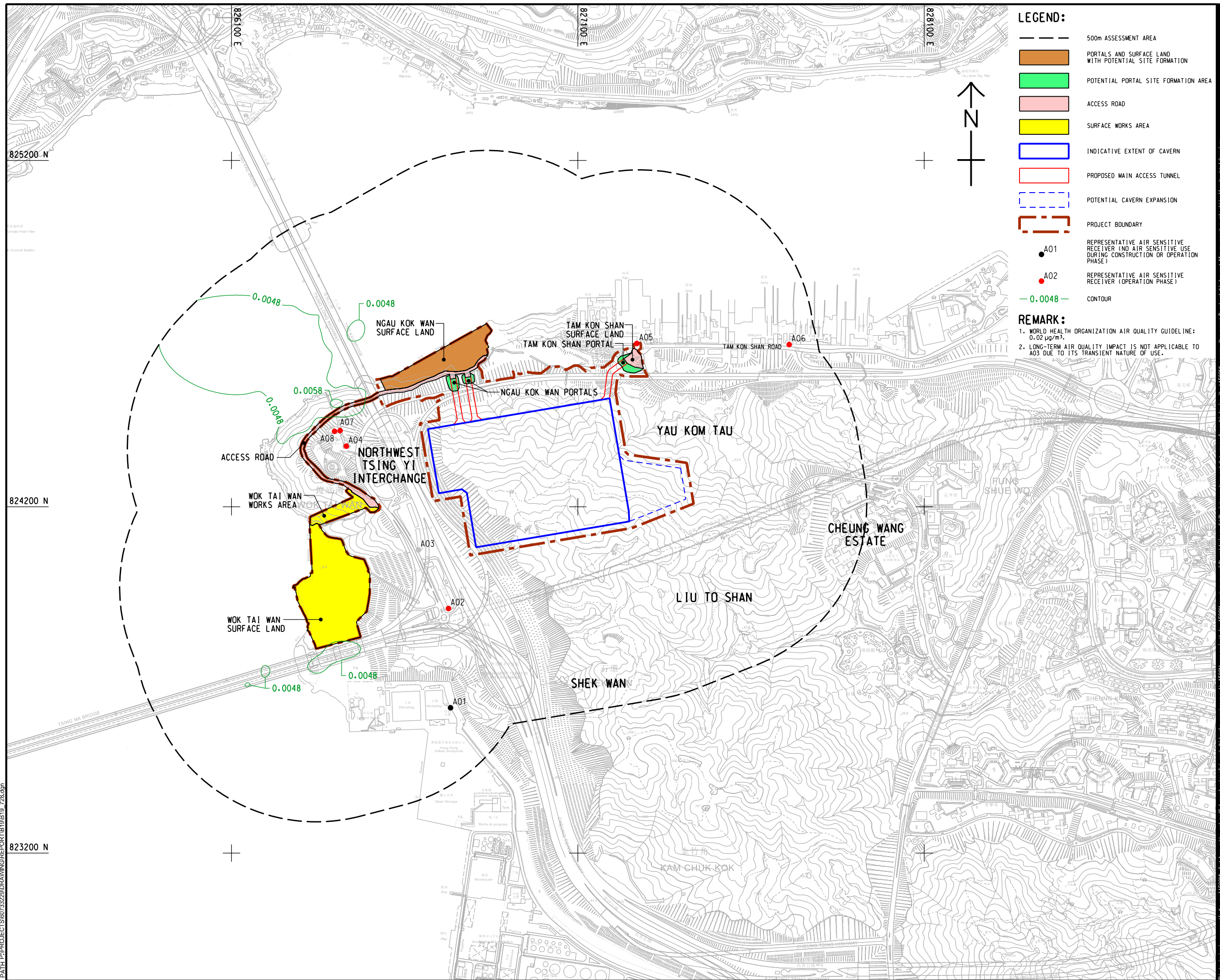
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SHEET TITLE
CONTOUR OF PREDICTED HIGHEST
CUMULATIVE 8-HOUR ARSENIC
CONCENTRATION AT 15 mAG (µg/m³)
(OPERATION PHASE)

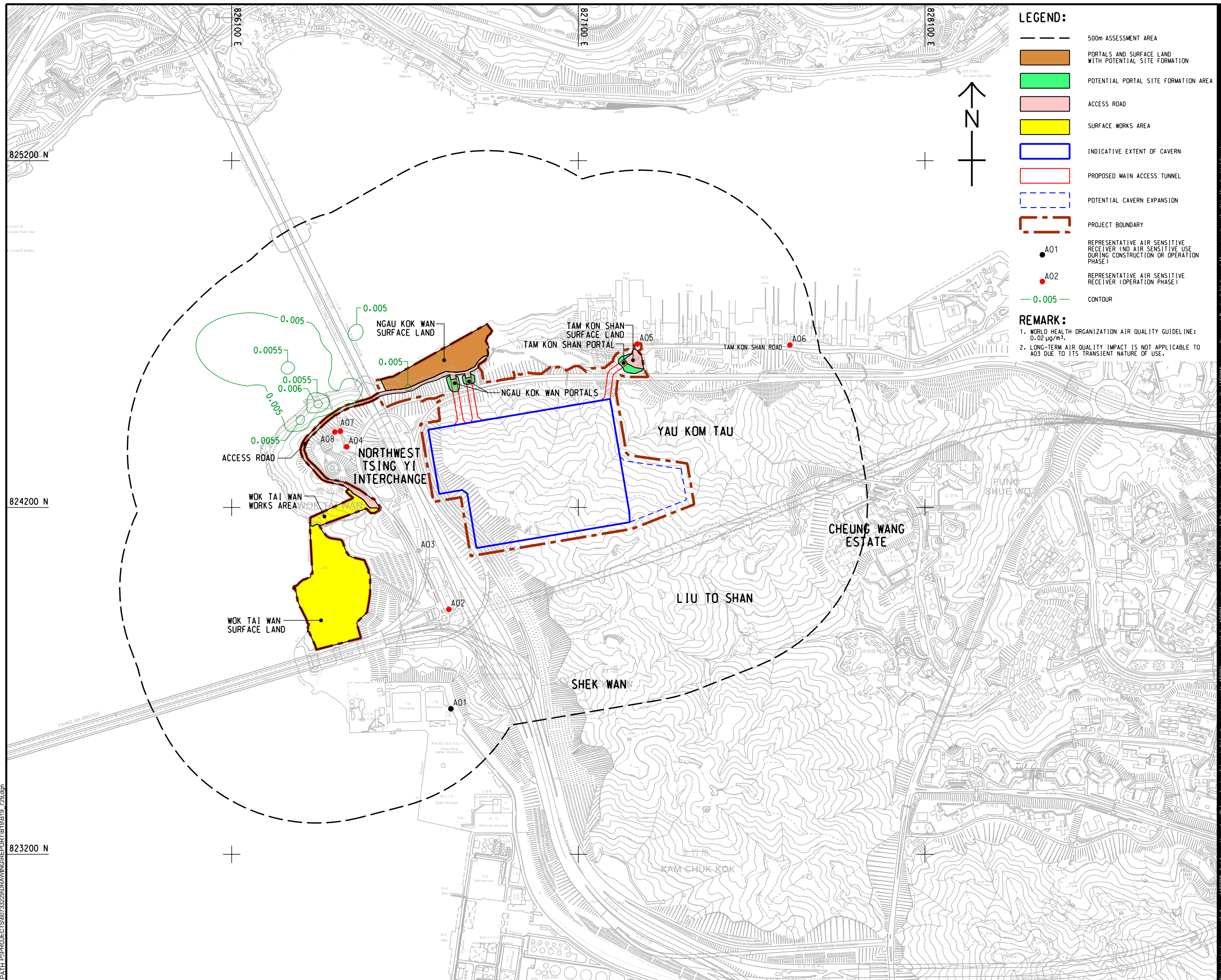
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60733229/B19/FIGURE 4.50



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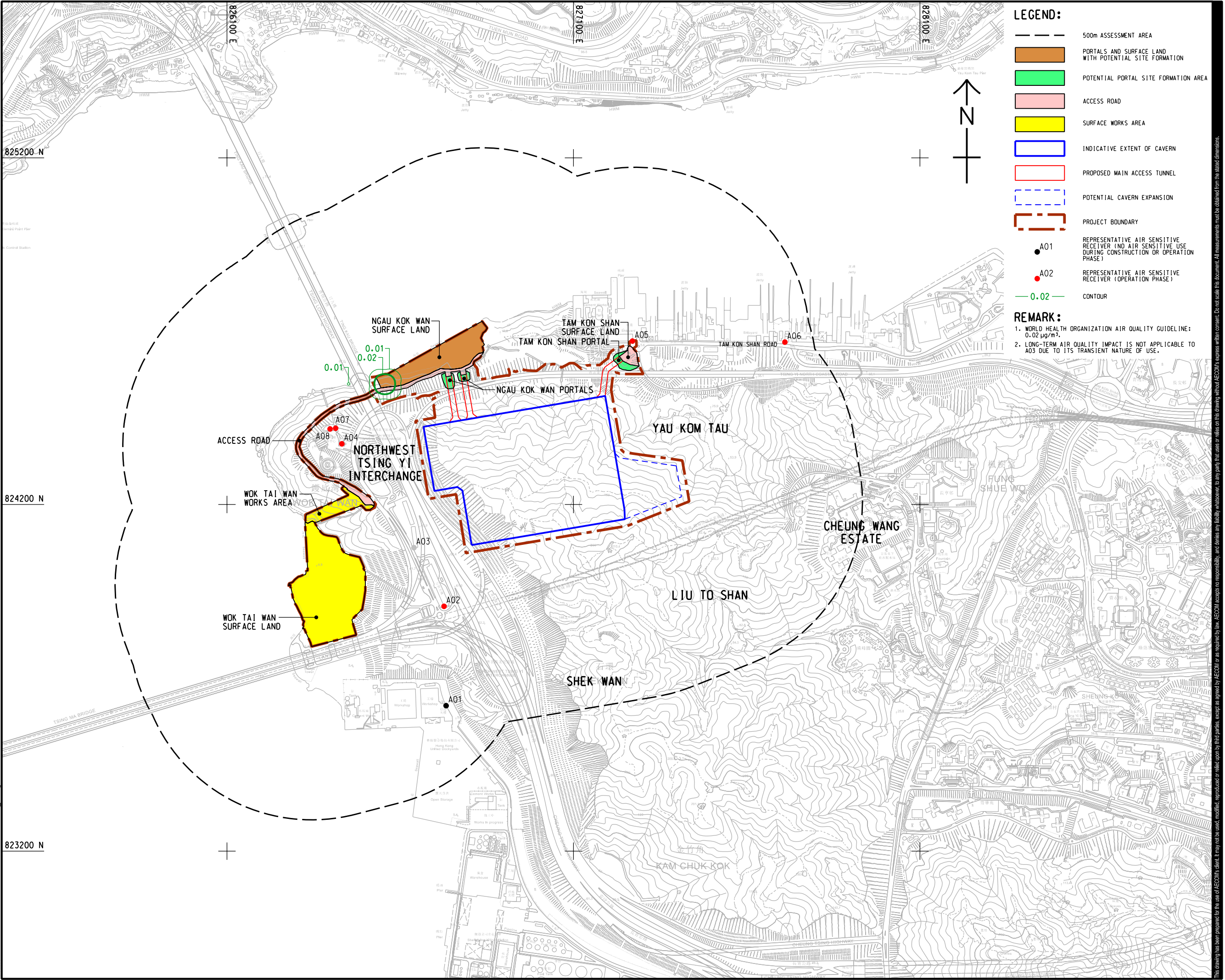
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SCALE
A3 1 : 10000
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METRES

KEY PLAN

PROJECT NO.
60733229
AGREEMENT NO.
CE 79/2023 (GE)

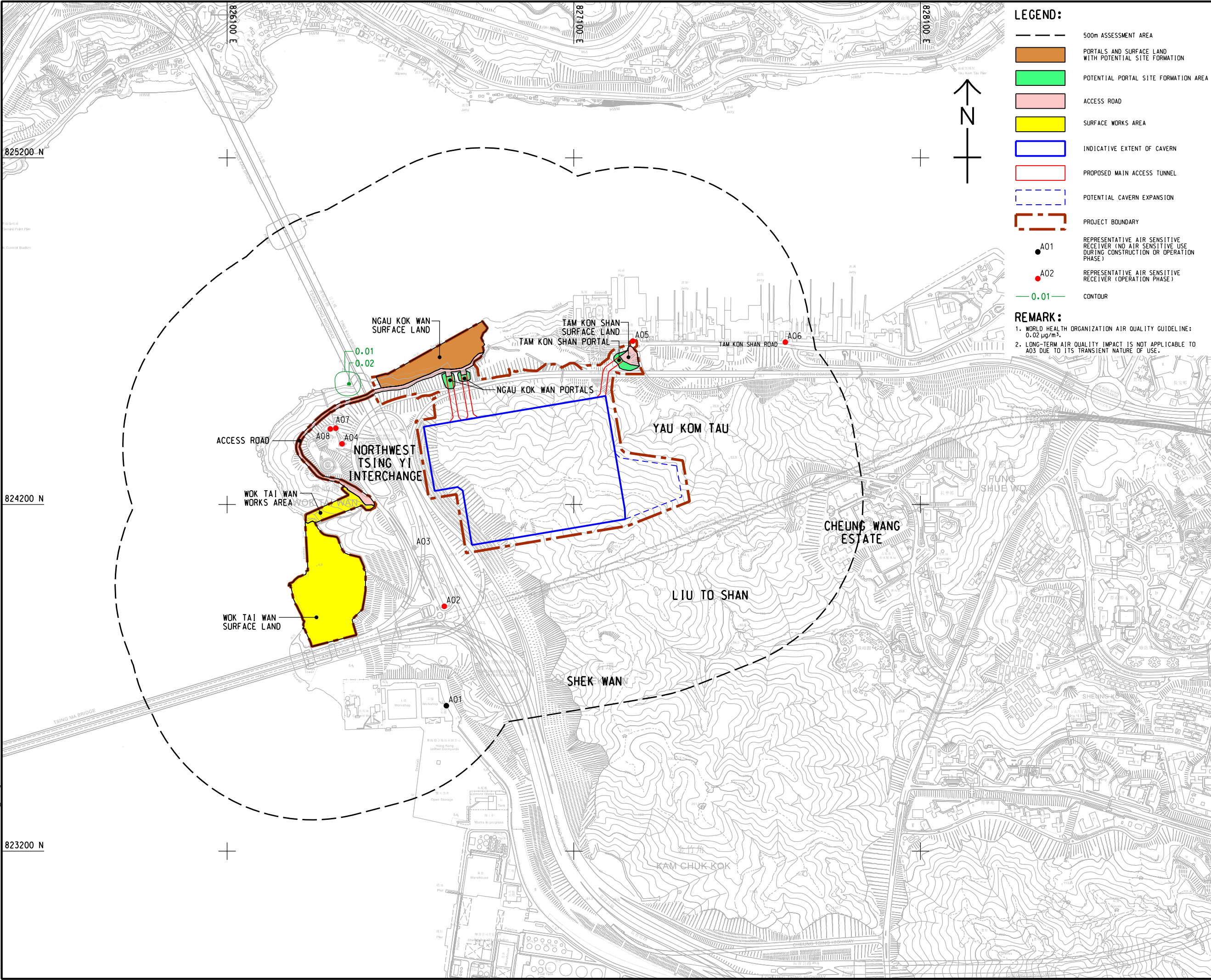
SHEET TITLE
CONTOUR OF PREDICTED
CUMULATIVE ANNUAL NICKEL
CONCENTRATION AT 10 mAG (µg/m³)
(OPERATION PHASE)

SHEET NUMBER
60733229/B19/FIGURE 4.54

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PROJECT
UNDERGROUND
QUARRYING AT
TSING YI NORTH –
INVESTIGATION,
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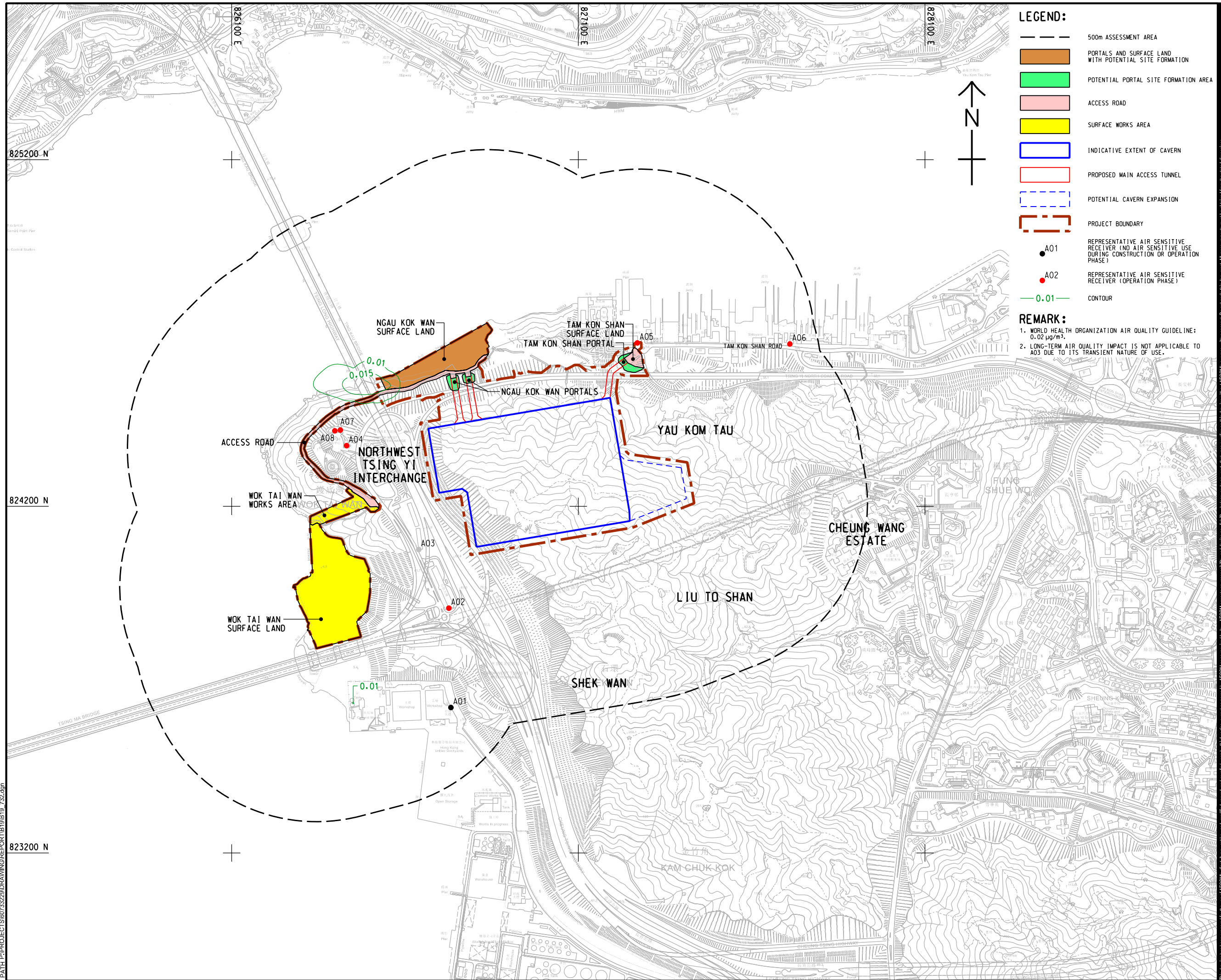
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SCALE
A3 1: 10000
DIMENSION UNIT
METRES

KEY PLAN

PROJECT NO.
60733229
AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
CONTOUR OF PREDICTED
CUMULATIVE ANNUAL NICKEL
CONCENTRATION AT 15 mAG ($\mu\text{g}/\text{m}^3$)
(OPERATION PHASE)
SHEET NUMBER
60733229/B19/FIGURE 4.55

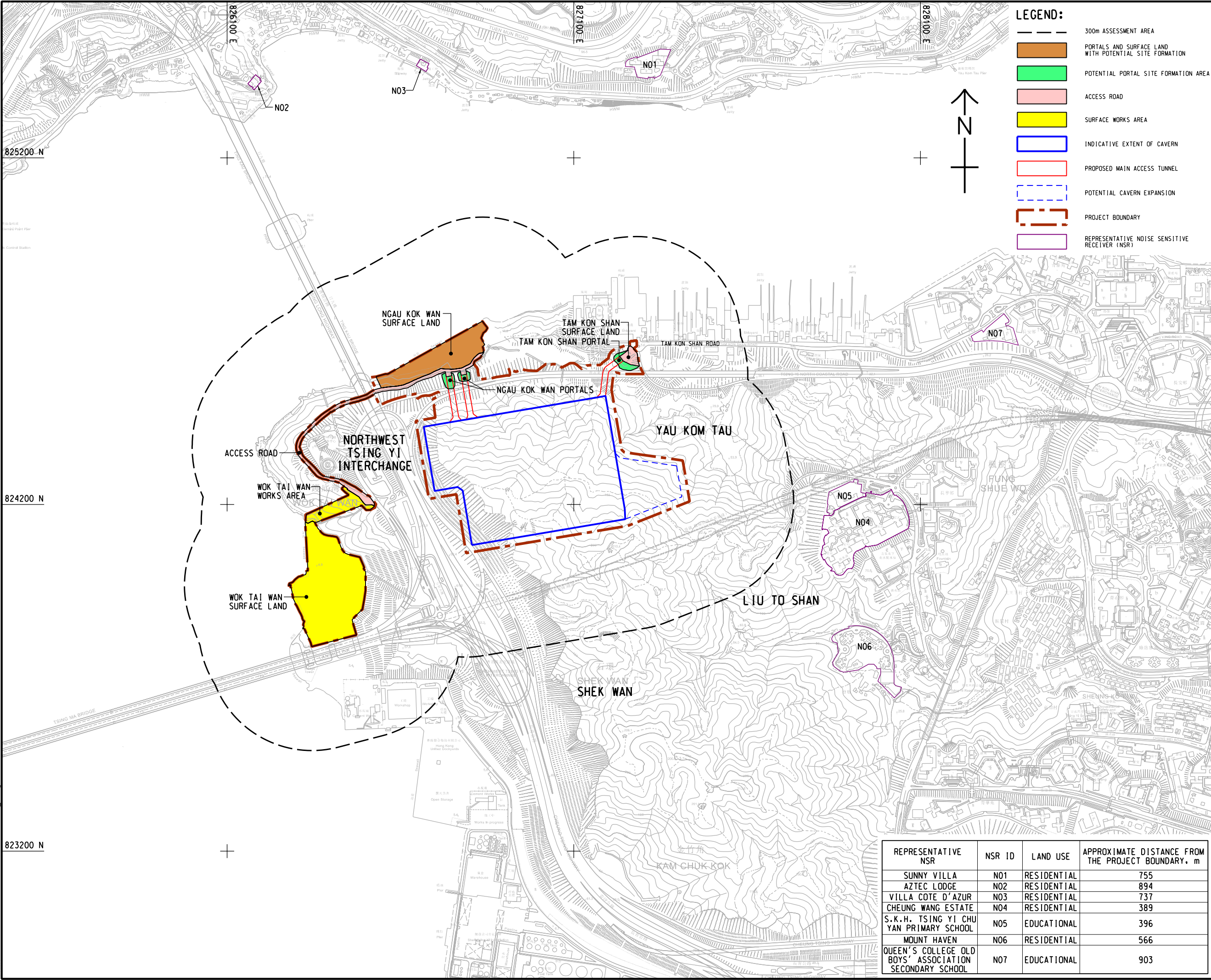


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Plot File by: WANGDF
PATH P:\PROJECTS\60733229\DRAWING\REPORT\B19\B19_703.dgn



REPRESENTATIVE NSR	NSR ID	LAND USE	APPROXIMATE DISTANCE FROM THE PROJECT BOUNDARY, m
SUNNY VILLA	N01	RESIDENTIAL	755
AZTEC LODGE	N02	RESIDENTIAL	894
VILLA COTE D'AZUR	N03	RESIDENTIAL	737
CHEUNG WANG ESTATE	N04	RESIDENTIAL	389
S.K.H. TSING YI CHU YAN PRIMARY SCHOOL	N05	EDUCATIONAL	396
MOUNT HAVEN	N06	RESIDENTIAL	566
QUEEN'S COLLEGE OLD BOYS' ASSOCIATION SECONDARY SCHOOL	N07	EDUCATIONAL	903

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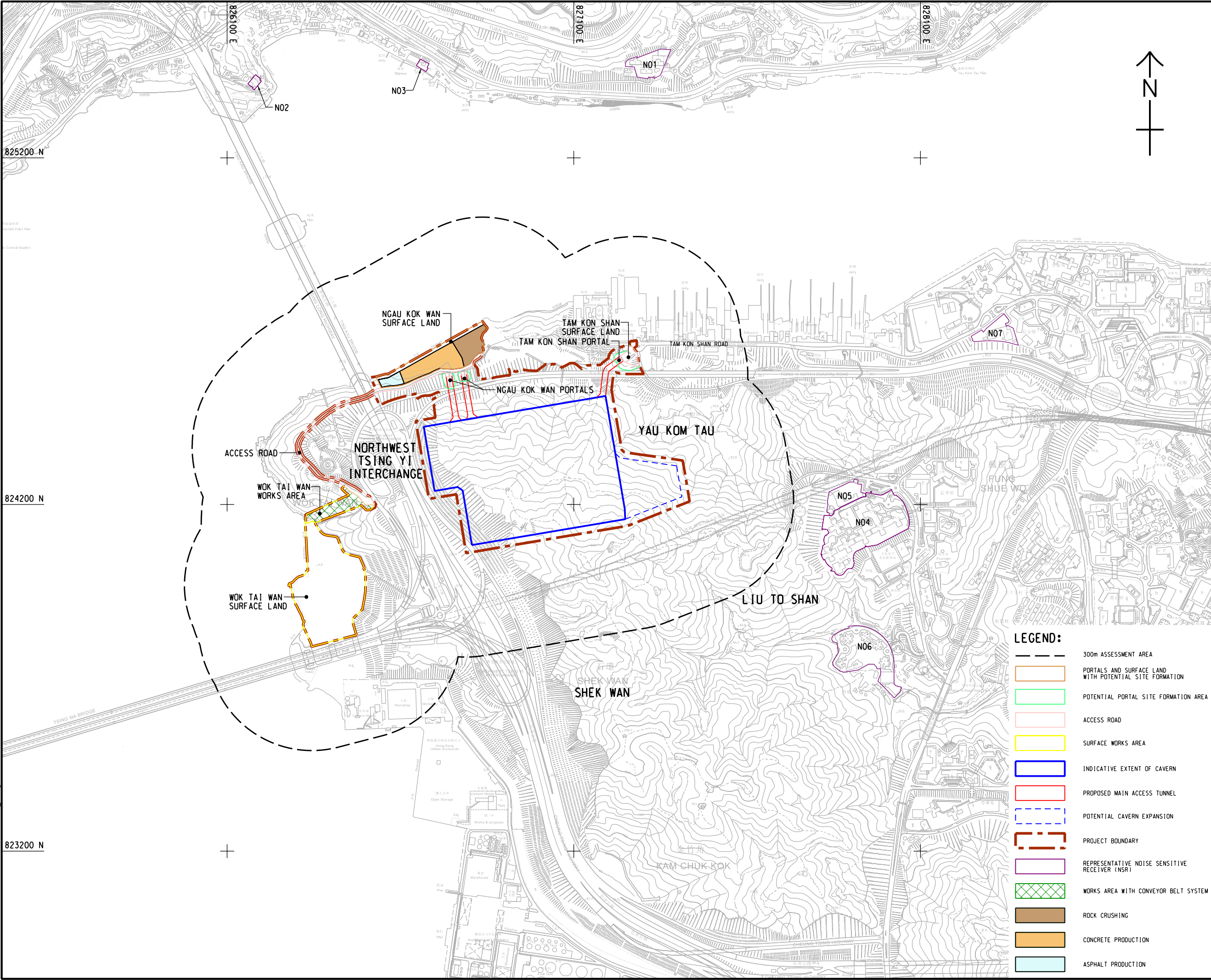
PROJECT NO.
60733229

AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
LOCATION OF REPRESENTATIVE NOISE SENSITIVE RECEIVERS

SHEET NUMBER
60733229/B19/FIGURE 5.01

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KEY PLAN

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CE 79/2023 (GE)

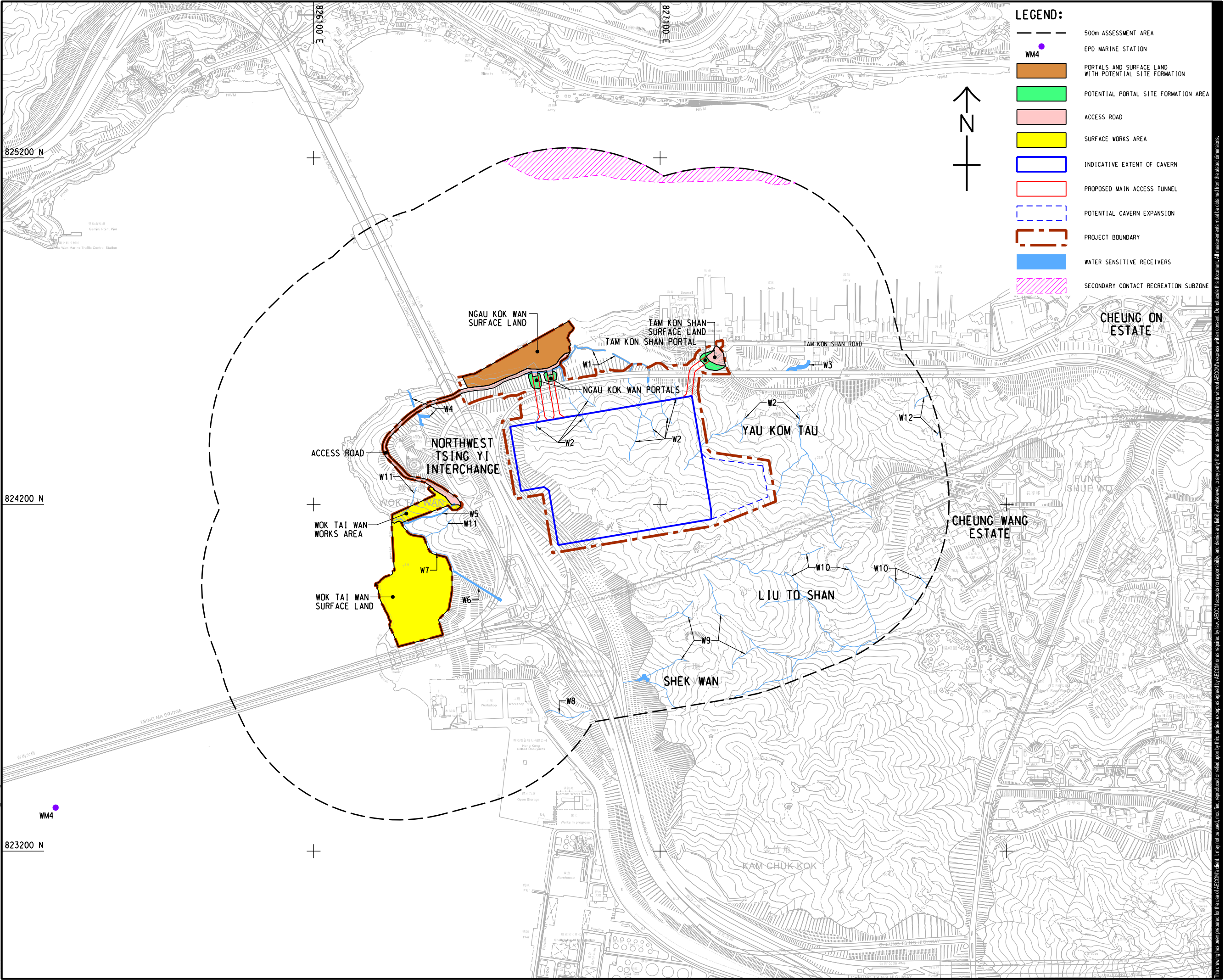
SHEET TITLE
LOCATIONS OF MAJOR FIXED
NOISE SOURCES

SHEET NUMBER
60733229/B19/FIGURE 5.02

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Plot File by: WANGDF
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ISO A1 594mm x 841mm
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Plot File by: WANGDF
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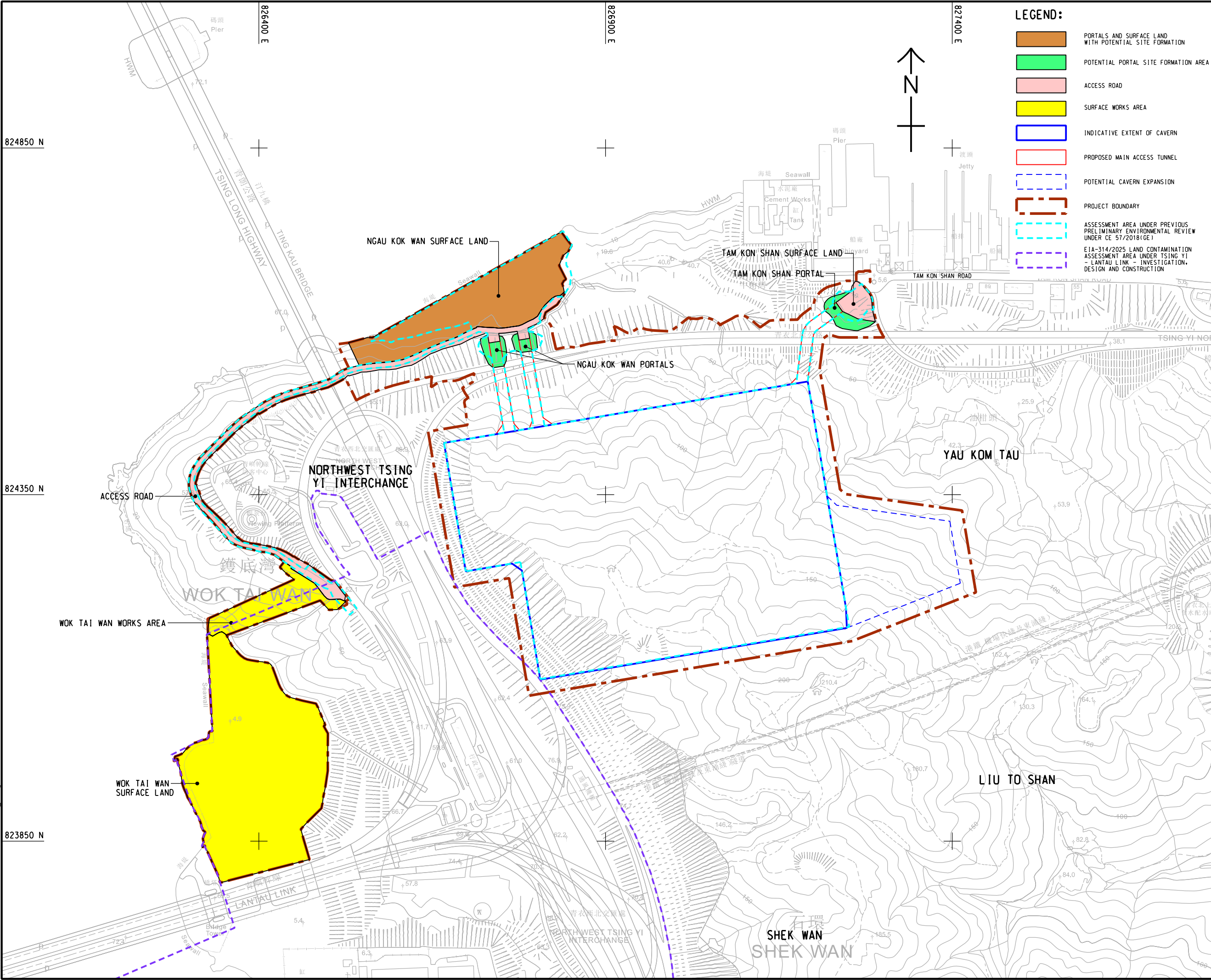
PROJECT NO.
60733229
AGREEMENT NO.
CE 79/2023 (GE)

SHEET TITLE
LOCATION OF WATER SENSITIVE
RECEIVERS AND EPD MARINE
WATER QUALITY MONITORING
STATIONS

SHEET NUMBER
60733229/B19/FIGURE 6.01

ISO A1 594mm x 841mm
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DIMENSION UNIT
METRES

KEY PLAN

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AGREEMENT NO.
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SHEET TITLE
SITE LOCATION PLAN AND LAND
CONTAMINATION ASSESSMENT
AREA UNDER PREVIOUS STUDY

SHEET NUMBER
60733229/B19/FIGURE 8.01

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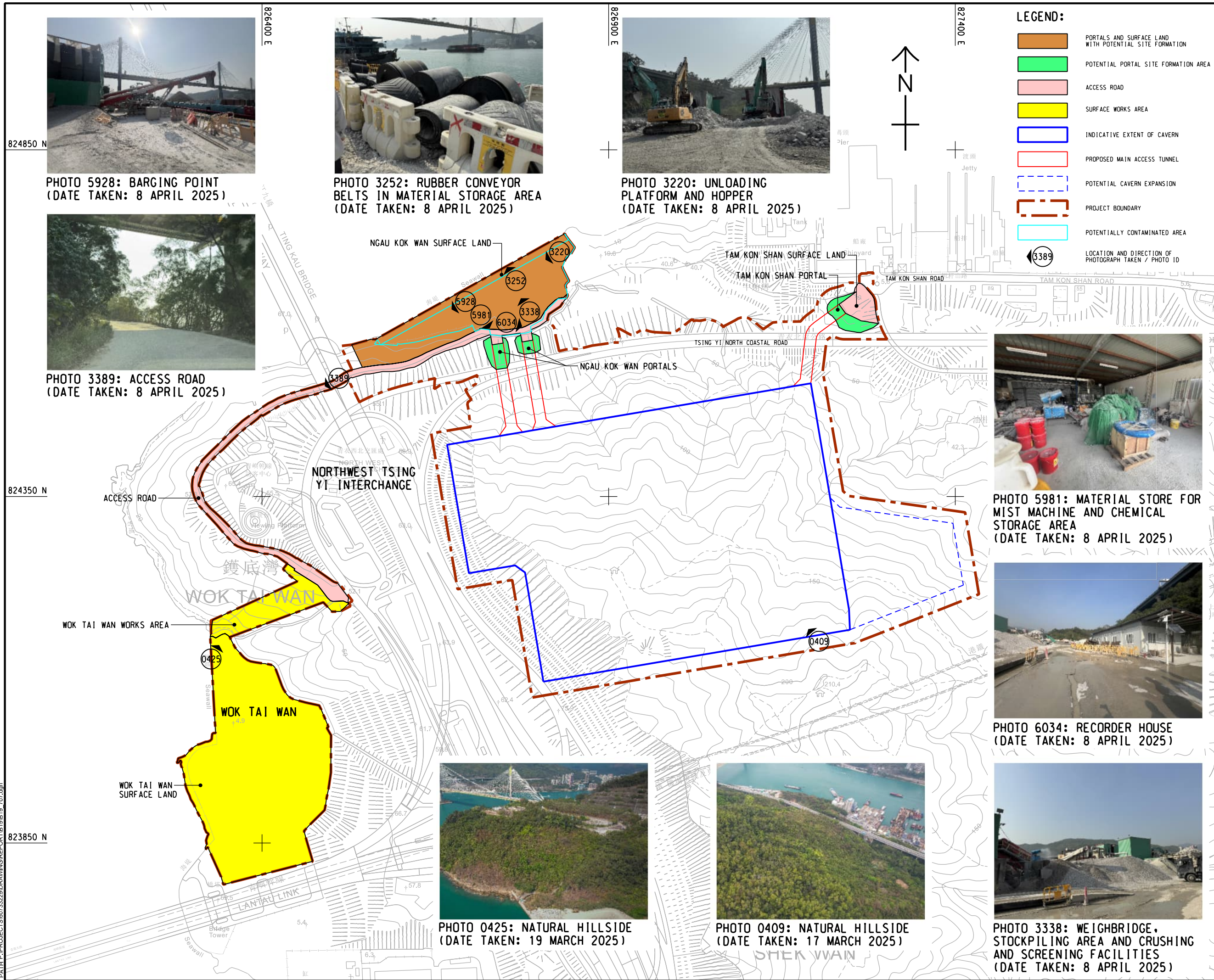


PHOTO 5928: BARGING POINT
(DATE TAKEN: 8 APRIL 2025)



PHOTO 3389: ACCESS ROAD
(DATE TAKEN: 8 APRIL 2025)



PHOTO 3252: RUBBER CONVEYOR
BELTS IN MATERIAL STORAGE AREA
(DATE TAKEN: 8 APRIL 2025)



PHOTO 3220: UNLOADING
PLATFORM AND HOPPER
(DATE TAKEN: 8 APRIL 2025)

- LEGEND:**
- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - POTENTIALLY CONTAMINATED AREA
 - LOCATION AND DIRECTION OF PHOTOGRAPH TAKEN / PHOTO ID



PHOTO 5981: MATERIAL STORE FOR
MIST MACHINE AND CHEMICAL
STORAGE AREA
(DATE TAKEN: 8 APRIL 2025)



PHOTO 6034: RECORDER HOUSE
(DATE TAKEN: 8 APRIL 2025)



PHOTO 3338: WEIGHBRIDGE,
STOCKPILING AREA AND CRUSHING
AND SCREENING FACILITIES
(DATE TAKEN: 8 APRIL 2025)



PHOTO 0425: NATURAL HILLSIDE
(DATE TAKEN: 19 MARCH 2025)



PHOTO 0409: NATURAL HILLSIDE
(DATE TAKEN: 17 MARCH 2025)

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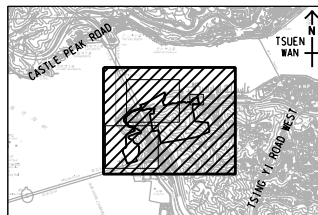
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A3 1: 5000

DIMENSION UNIT

METRES

KEY PLAN A3 1: 100000



PROJECT NO.

60733229

AGREEMENT NO.

CE 79/2023 (GE)

SHEET TITLE

PHOTOGRAPHIC RECORDS OF
SITE WALKOVER AND
DRONE SURVEY

SHEET NUMBER

60733229/B19/FIGURE 8.02

SHEET 1 OF 5

ISO A1 594mm x 841mm
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Checked:
Designer:
Project Management Initials:

826400 E

826600 E

826800 E



PHOTO 3258: STOCKPILING AREA
(DATE TAKEN: 8 APRIL 2025)



PHOTO 3251: CRUSHING AND
SCREENING FACILITIES
(DATE TAKEN: 8 APRIL 2025)



PHOTO 0318: DSD WORKS AREA
OF CONTRACT NO. DC/2020/05
RELOCATION OF SHA TIN SEWAGE
TREATMENT WORKS TO CAVERNS
- MAIN CAVERNS CONSTRUCTION
AND NATURAL HILLSIDE
(DATE TAKEN: 18 SEPTEMBER 2023)



PHOTO 5998: CHEMICAL
STORAGE AREA IN MATERIAL STORE
(DATE TAKEN: 8 APRIL 2025)

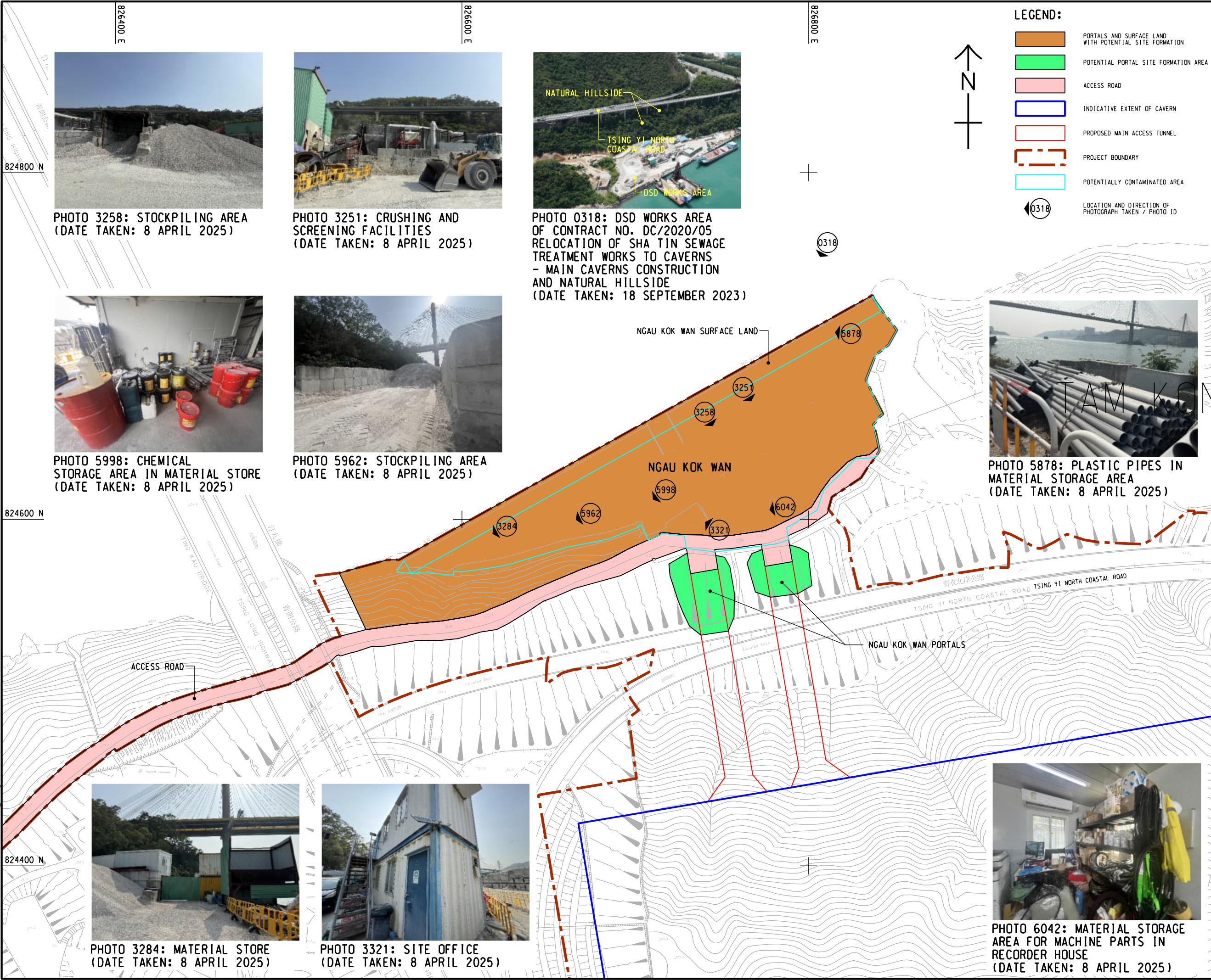


PHOTO 5962: STOCKPILING AREA
(DATE TAKEN: 8 APRIL 2025)



PHOTO 5878: PLASTIC PIPES IN
MATERIAL STORAGE AREA
(DATE TAKEN: 8 APRIL 2025)

824600 N



LEGEND:

- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
- POTENTIAL PORTAL SITE FORMATION AREA
- ACCESS ROAD
- INDICATIVE EXTENT OF CAVERN
- PROPOSED MAIN ACCESS TUNNEL
- PROJECT BOUNDARY
- POTENTIALLY CONTAMINATED AREA
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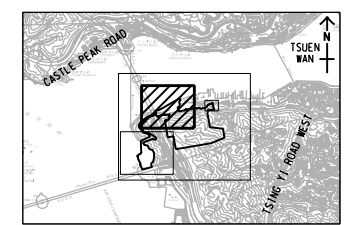
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STATUS

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KEY PLAN A3 1: 100000



PROJECT NO.
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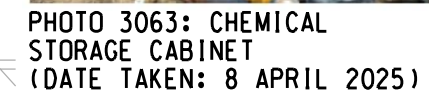
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SHEET TITLE
PHOTOGRAPHIC RECORDS OF SITE WALKOVER AND DRONE SURVEY

SHEET NUMBER
60733229/B19/FIGURE 8.03

SHEET 2 OF 5

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SHEET 3 OF 5

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LEGEND:

- ACCESS ROAD
- POTENTIAL PORTAL SITE FORMATION AREA
- PROPOSED MAIN ACCESS TUNNEL
- PROJECT BOUNDARY
- LOCATION AND DIRECTION OF PHOTOGRAPH TAKEN / PHOTO ID



PHOTO 3082: NATURAL HILLSIDE
(DATE TAKEN: 8 APRIL 2025)



PHOTO 5664: DIESEL OIL IN
CHEMICAL STORAGE CABINET
(DATE TAKEN: 8 APRIL 2025)



PHOTO 5649: LUBRICATING OIL ON
WOODEN PLANK OF AN ELEVATED
WORKING PLATFORM WITH WOODEN
SIDEBOARDS
(DATE TAKEN: 8 APRIL 2025)



PHOTO 5642: WATER PUMP
(DATE TAKEN: 8 APRIL 2025)



PHOTO 5655: MATERIAL STORAGE
AREA FOR DRILL RODS AND
ELEVATED WORKING PLATFORM
(DATE TAKEN: 8 APRIL 2025)

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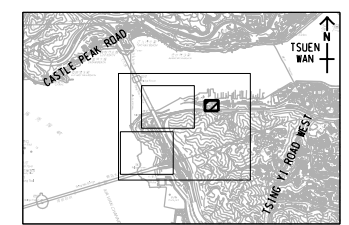
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KEY PLAN	A3 1: 100000



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SHEET TITLE
PHOTOGRAPHIC RECORDS OF
SITE WALKOVER AND
DRONE SURVEY

SHEET NUMBER
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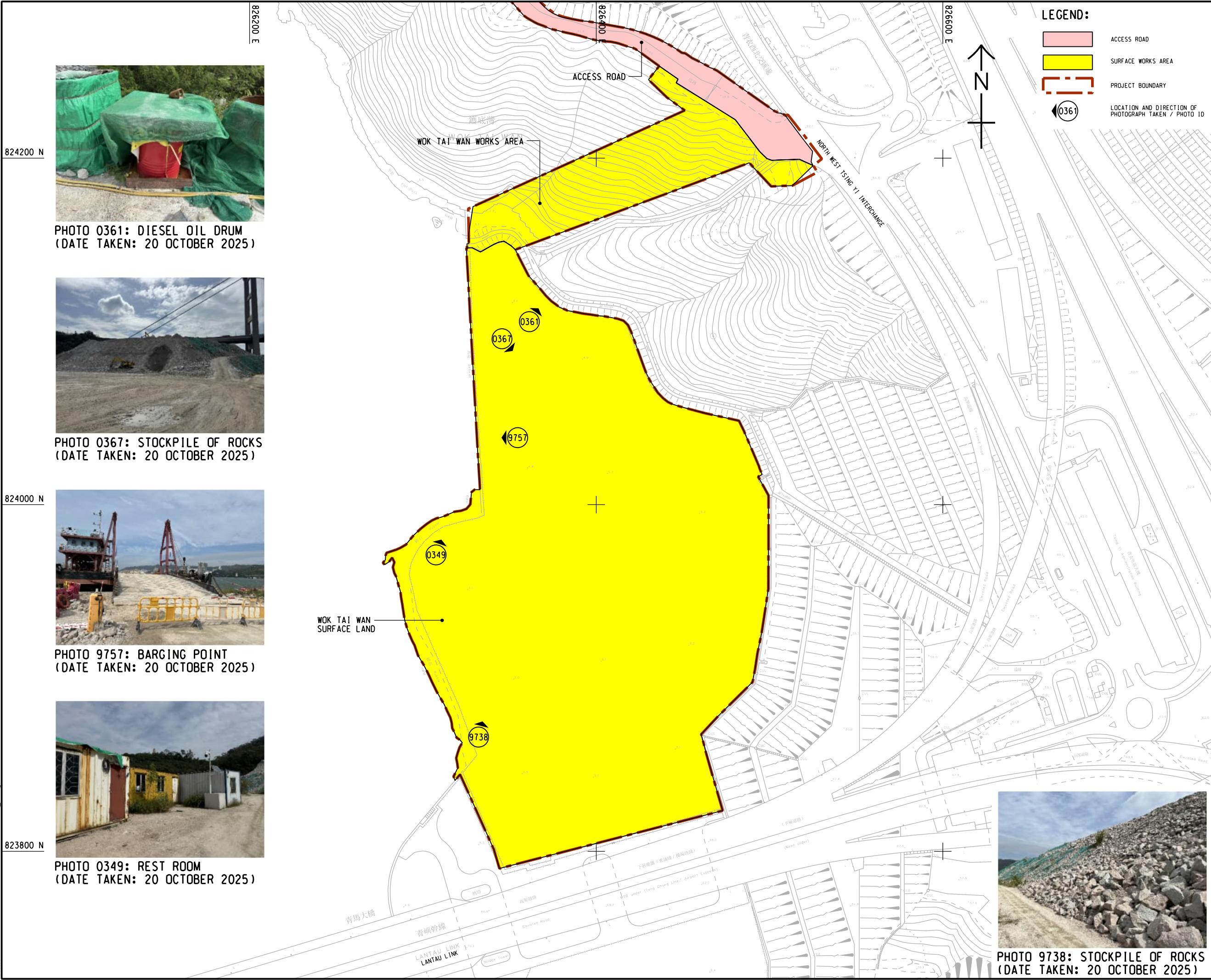


PHOTO 0361: DIESEL OIL DRUM
(DATE TAKEN: 20 OCTOBER 2025)



PHOTO 0367: STOCKPILE OF ROCKS
(DATE TAKEN: 20 OCTOBER 2025)



PHOTO 9757: BARGING POINT
(DATE TAKEN: 20 OCTOBER 2025)



PHOTO 0349: REST ROOM
(DATE TAKEN: 20 OCTOBER 2025)



PHOTO 9738: STOCKPILE OF ROCKS
(DATE TAKEN: 20 OCTOBER 2025)



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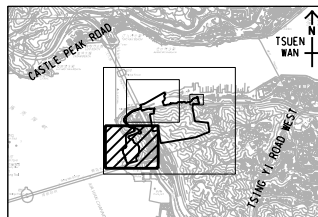
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DIMENSION UNIT
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KEY PLAN
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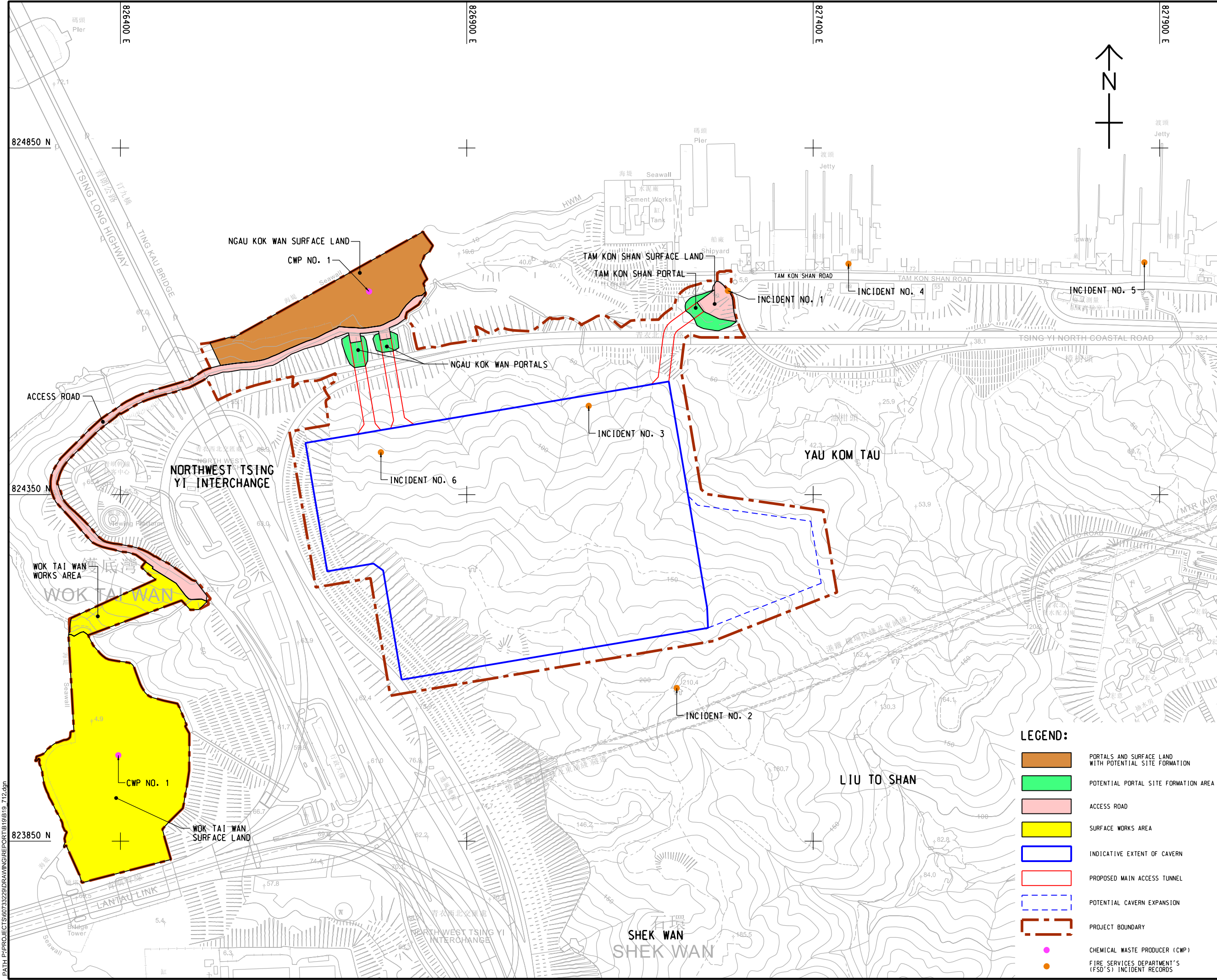


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AGREEMENT NO.
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SHEET TITLE
PHOTOGRAPHIC RECORDS OF
SITE WALKOVER AND
DRONE SURVEY

SHEET NUMBER
60733229/B19/FIGURE 8.06

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SHEET TITLE
LOCATIONS OF CHEMICAL WASTE
PRODUCER AND FIRE SERVICES
DEPARTMENT'S INCIDENT RECORDS

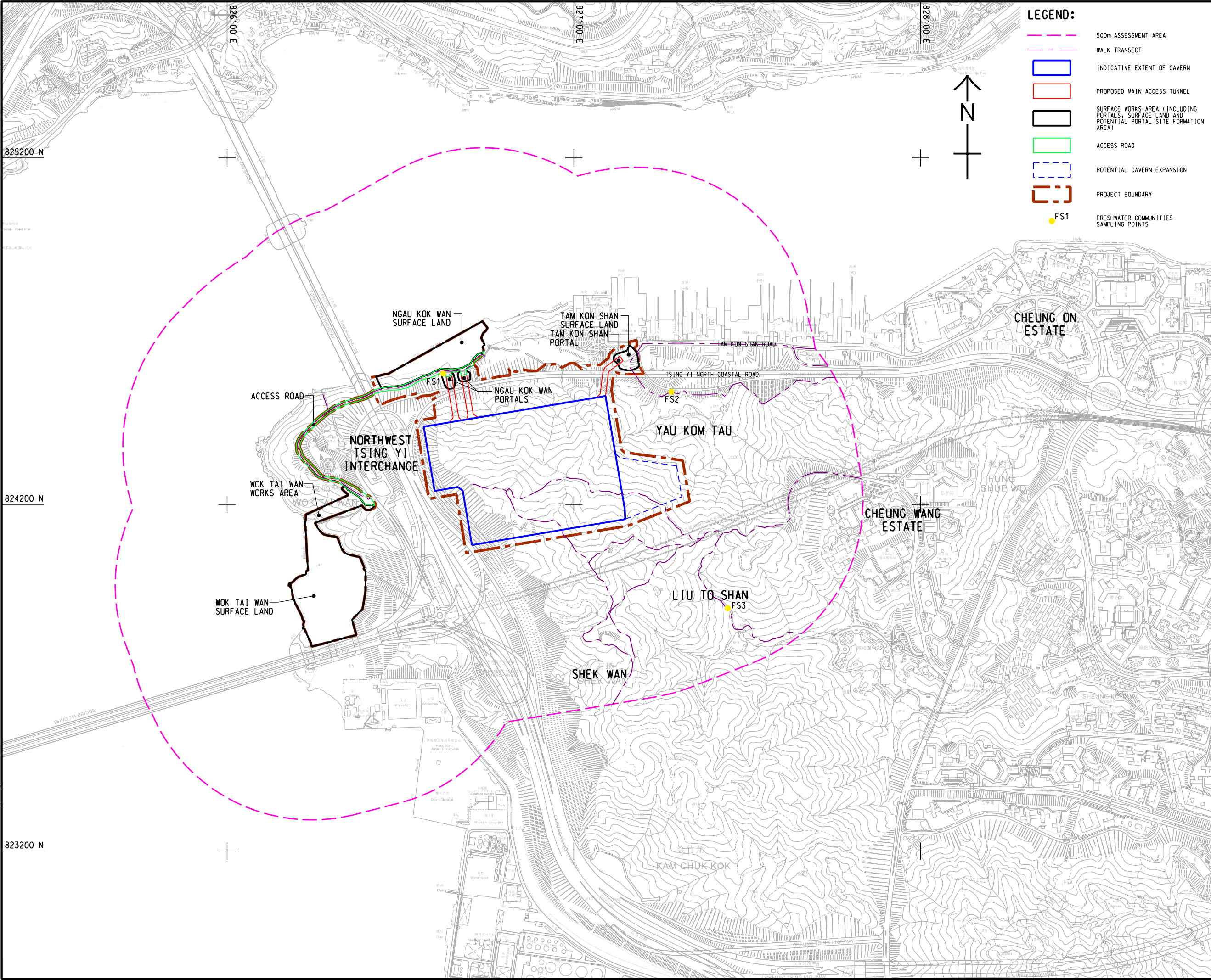
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60733229/B19/FIGURE 8.07

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- LEGEND:
- 500m ASSESSMENT AREA
 - WALK TRANSECT
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - SURFACE WORKS AREA (INCLUDING PORTAL S, SURFACE LAND AND POTENTIAL PORTAL SITE FORMATION AREA)
 - ACCESS ROAD
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - FRESHWATER COMMUNITIES SAMPLING POINTS

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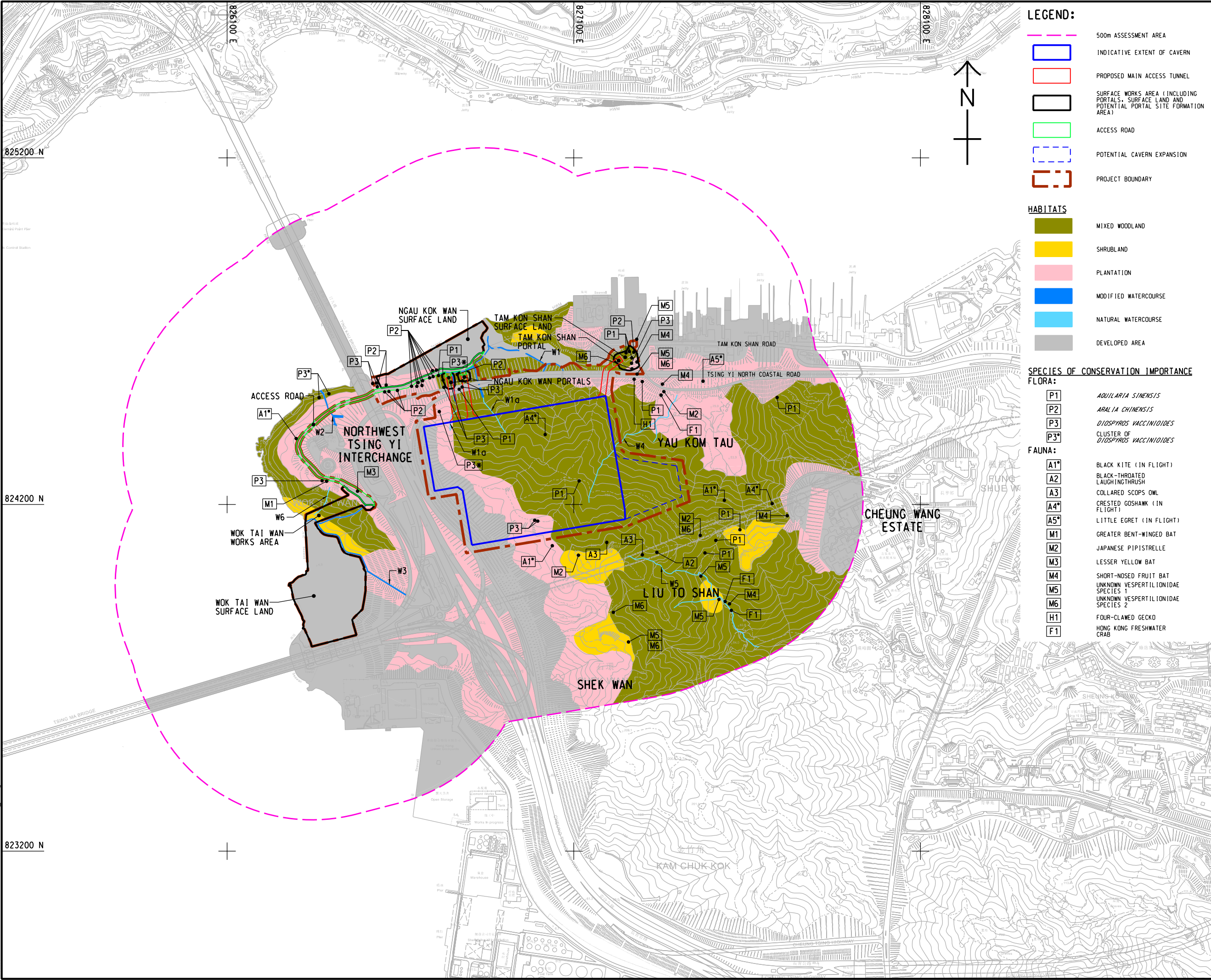
PROJECT NO. 60733229
AGREEMENT NO. CE 79/2023 (GE)

SHEET TITLE
ECOLOGICAL ASSESSMENT AREA, WALK TRANSECTS AND FRESHWATER COMMUNITIES SAMPLING POINTS

SHEET NUMBER
60733229/B19/FIGURE 9.01

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KEY PLAN

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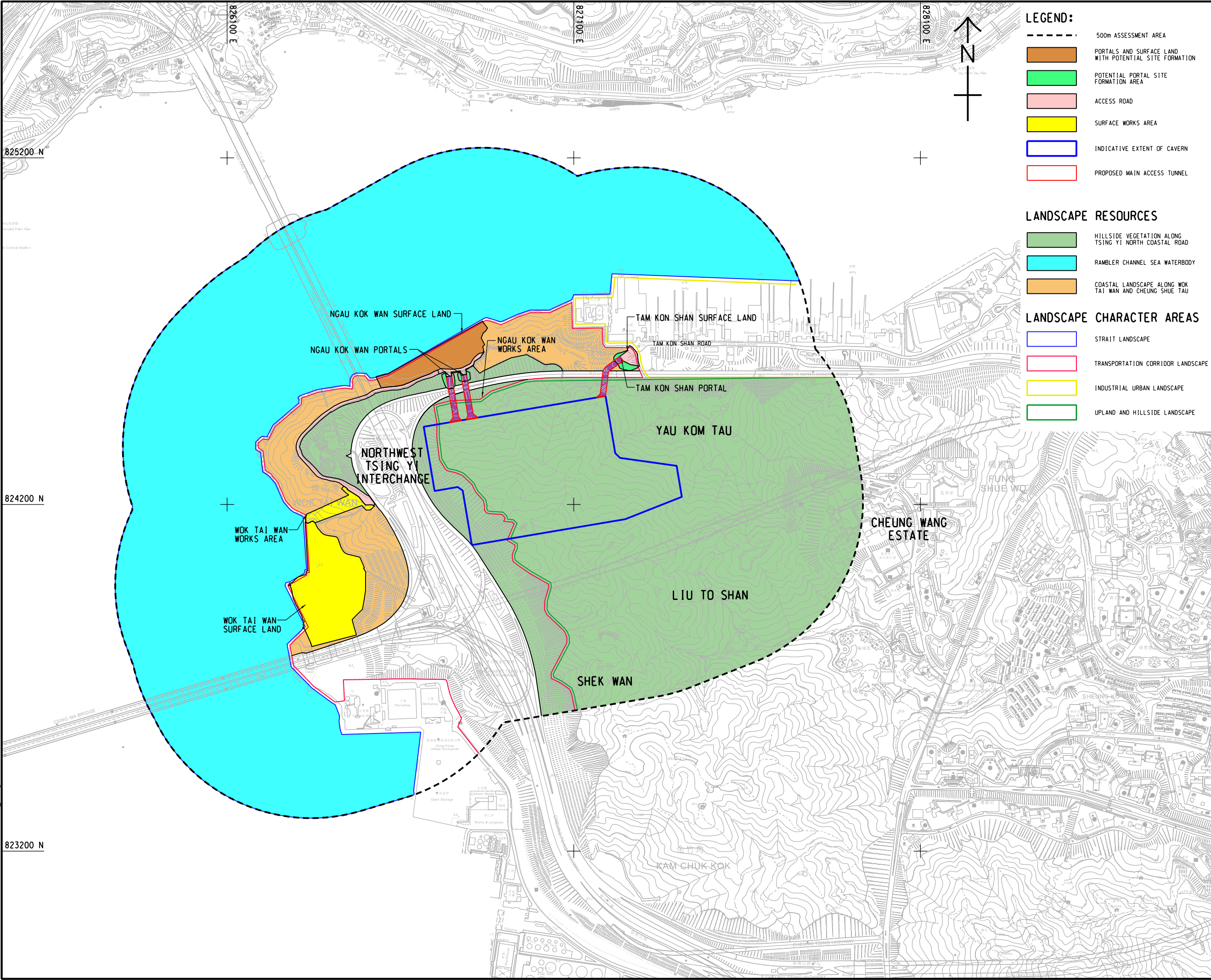
SHEET TITLE
HABITAT MAP AND LOCATION OF SPECIES OF CONSERVATION IMPORTANCE

SHEET NUMBER
60733229/B19/FIGURE 9.02

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4/2/2026



- LEGEND:**
- 500m ASSESSMENT AREA
 - PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL

- LANDSCAPE RESOURCES**
- HILLSIDE VEGETATION ALONG TSING YI NORTH COASTAL ROAD
 - RAMBLER CHANNEL SEA WATERBODY
 - COASTAL LANDSCAPE ALONG WOK TAI WAN AND CHEUNG SHUE TAU

- LANDSCAPE CHARACTER AREAS**
- STRAIT LANDSCAPE
 - TRANSPORTATION CORRIDOR LANDSCAPE
 - INDUSTRIAL URBAN LANDSCAPE
 - UPLAND AND HILLSIDE LANDSCAPE

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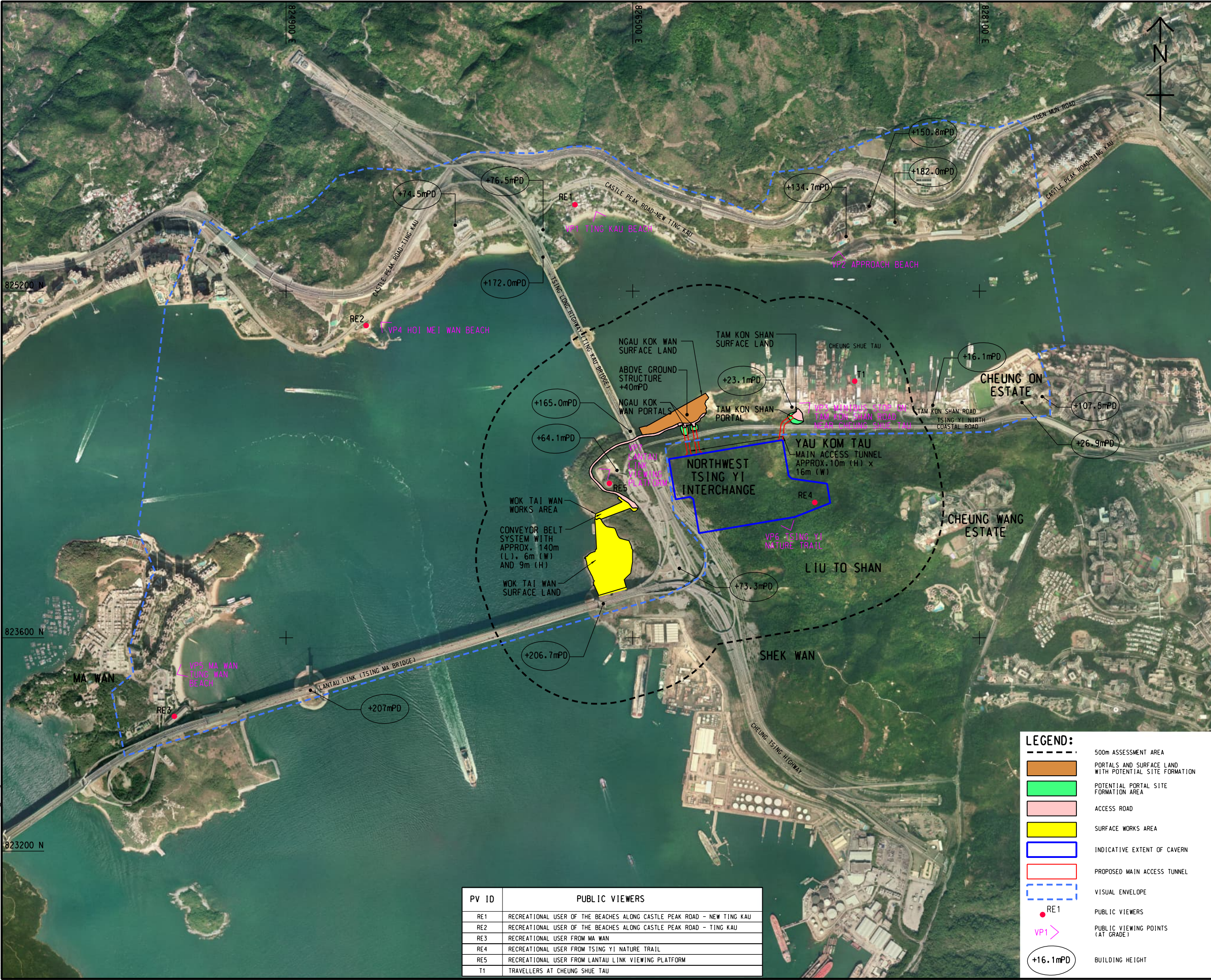
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SCALE	DIMENSION UNIT
A3 1: 10000	METRES

KEY PLAN

PROJECT NO.	AGREEMENT NO.
60733229	CE 79/2023 (GE)
SHEET TITLE	
LANDSCAPE RESOURCES & LANDSCAPE CHARACTER AREAS	
SHEET NUMBER	
60733229/B19/FIGURE 10.01	

ISO A1 594mm x 841mm
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Designer:
Project Management Initials:
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Plot File by: Wang52
4/2/2026
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PV ID	PUBLIC VIEWERS
RE1	RECREATIONAL USER OF THE BEACHES ALONG CASTLE PEAK ROAD - NEW TING KAU
RE2	RECREATIONAL USER OF THE BEACHES ALONG CASTLE PEAK ROAD - TING KAU
RE3	RECREATIONAL USER FROM MA WAN
RE4	RECREATIONAL USER FROM TSING YI NATURE TRAIL
RE5	RECREATIONAL USER FROM LANTAU LINK VIEWING PLATFORM
T1	TRAVELLERS AT CHEUNG SHUE TAU

LEGEND:

500m ASSESSMENT AREA

PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION

POTENTIAL PORTAL SITE FORMATION AREA

ACCESS ROAD

SURFACE WORKS AREA

INDICATIVE EXTENT OF CAVERN

PROPOSED MAIN ACCESS TUNNEL

VISUAL ENVELOPE

RE1

PUBLIC VIEWERS

VP1

PUBLIC VIEWING POINTS (AT GRADE)

+16.1mPD

BUILDING HEIGHT

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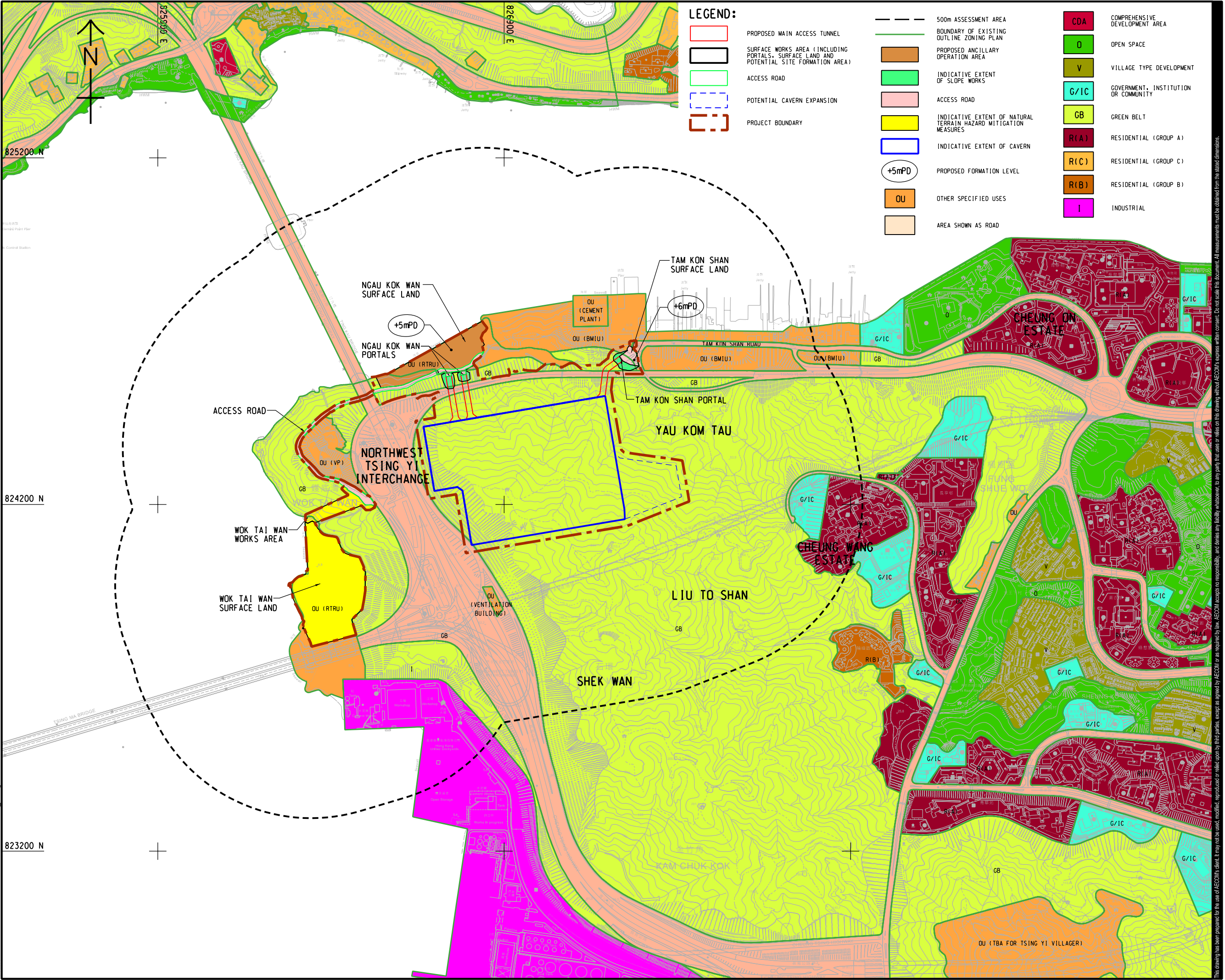
PROJECT NO. 60733229
AGREEMENT NO. CE 79/2023 (GE)

SHEET TITLE
VISUAL ENVELOPE, PUBLIC VIEWERS (PVs) AND PROPOSED PUBLIC VIEWING POINTS

SHEET NUMBER
60733229/B19/FIGURE 10.02

ISO A1 594mm x 841mm
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LEGEND:

- PROPOSED MAIN ACCESS TUNNEL
- SURFACE WORKS AREA (INCLUDING PORTALS, SURFACE LAND AND POTENTIAL SITE FORMATION AREA)
- ACCESS ROAD
- POTENTIAL CAVERN EXPANSION
- PROJECT BOUNDARY
- 500m ASSESSMENT AREA
- BOUNDARY OF EXISTING OUTLINE ZONING PLAN
- PROPOSED ANCILLARY OPERATION AREA
- INDICATIVE EXTENT OF SLOPE WORKS
- ACCESS ROAD
- INDICATIVE EXTENT OF NATURAL TERRAIN HAZARD MITIGATION MEASURES
- INDICATIVE EXTENT OF CAVERN
- PROPOSED FORMATION LEVEL
- OTHER SPECIFIED USES
- AREA SHOWN AS ROAD

- CDA COMPREHENSIVE DEVELOPMENT AREA
- O OPEN SPACE
- V VILLAGE TYPE DEVELOPMENT
- G/IC GOVERNMENT, INSTITUTION OR COMMUNITY
- GB GREEN BELT
- R(A) RESIDENTIAL (GROUP A)
- R(C) RESIDENTIAL (GROUP C)
- R(B) RESIDENTIAL (GROUP B)
- I INDUSTRIAL



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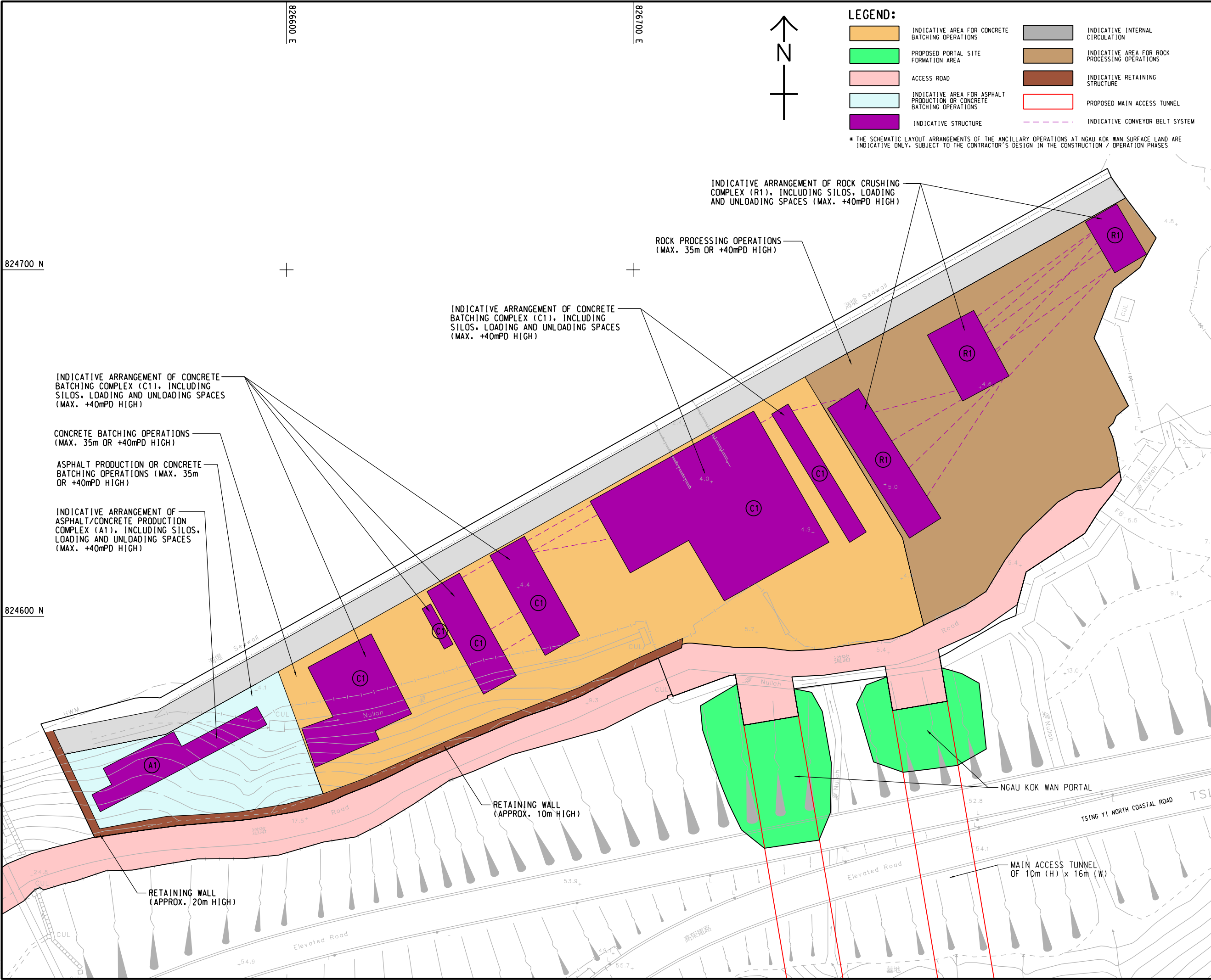
KEY PLAN

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60733229
AGREEMENT NO.
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SHEET TITLE
EXISTING OUTLINE ZONING PLAN

SHEET NUMBER
60733229/B19/FIGURE 10.03

ISO A1 594mm x 841mm
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SCALE	DIMENSION UNIT
比例	尺寸單位
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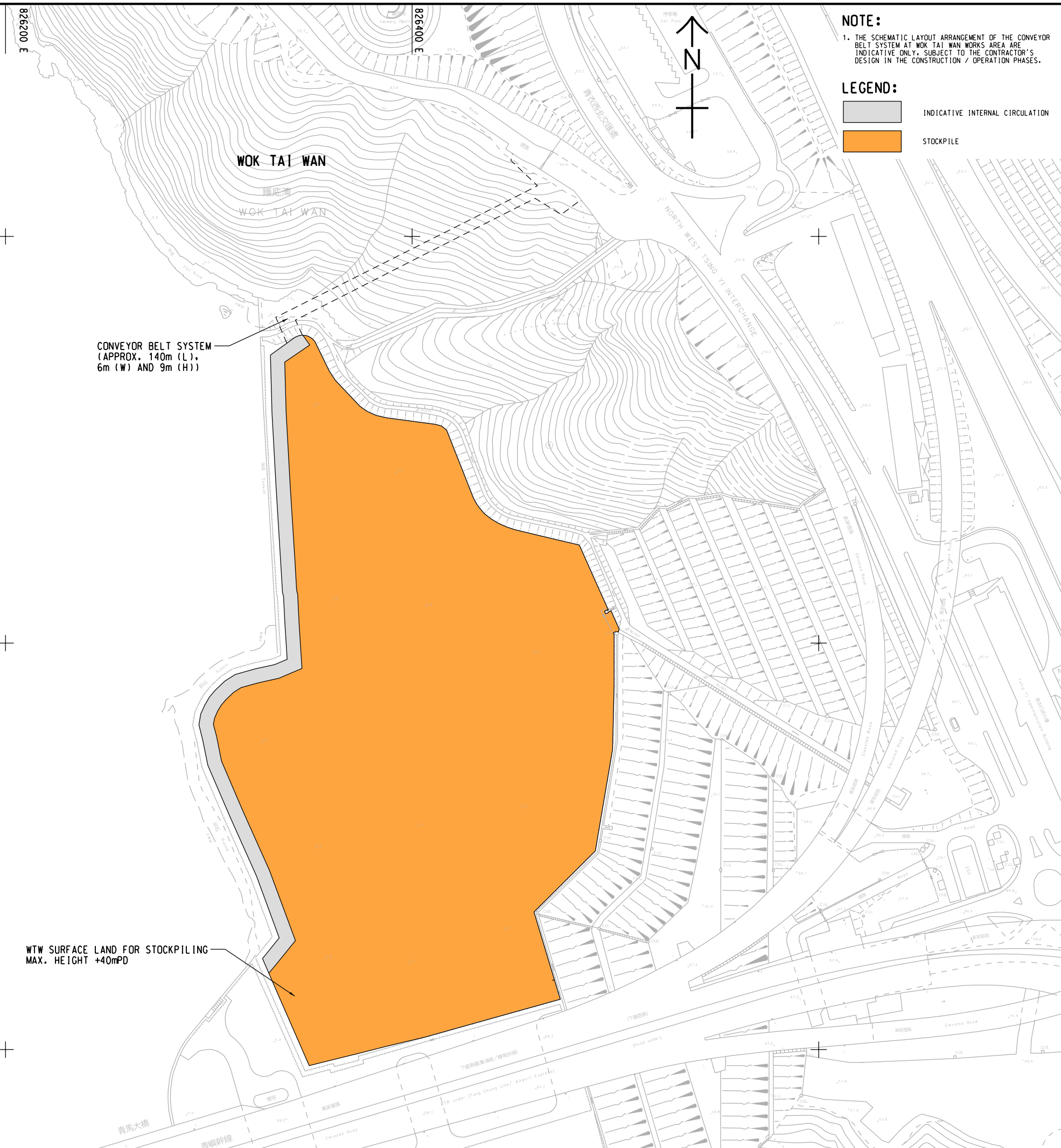
KEY PLAN	
索引圖	

PROJECT NO.	AGREEMENT NO.
60733229	CE 79/2023 (GE)

SHEET TITLE
INDICATIVE LAYOUT AT NGAU KOK WAN PORTAL

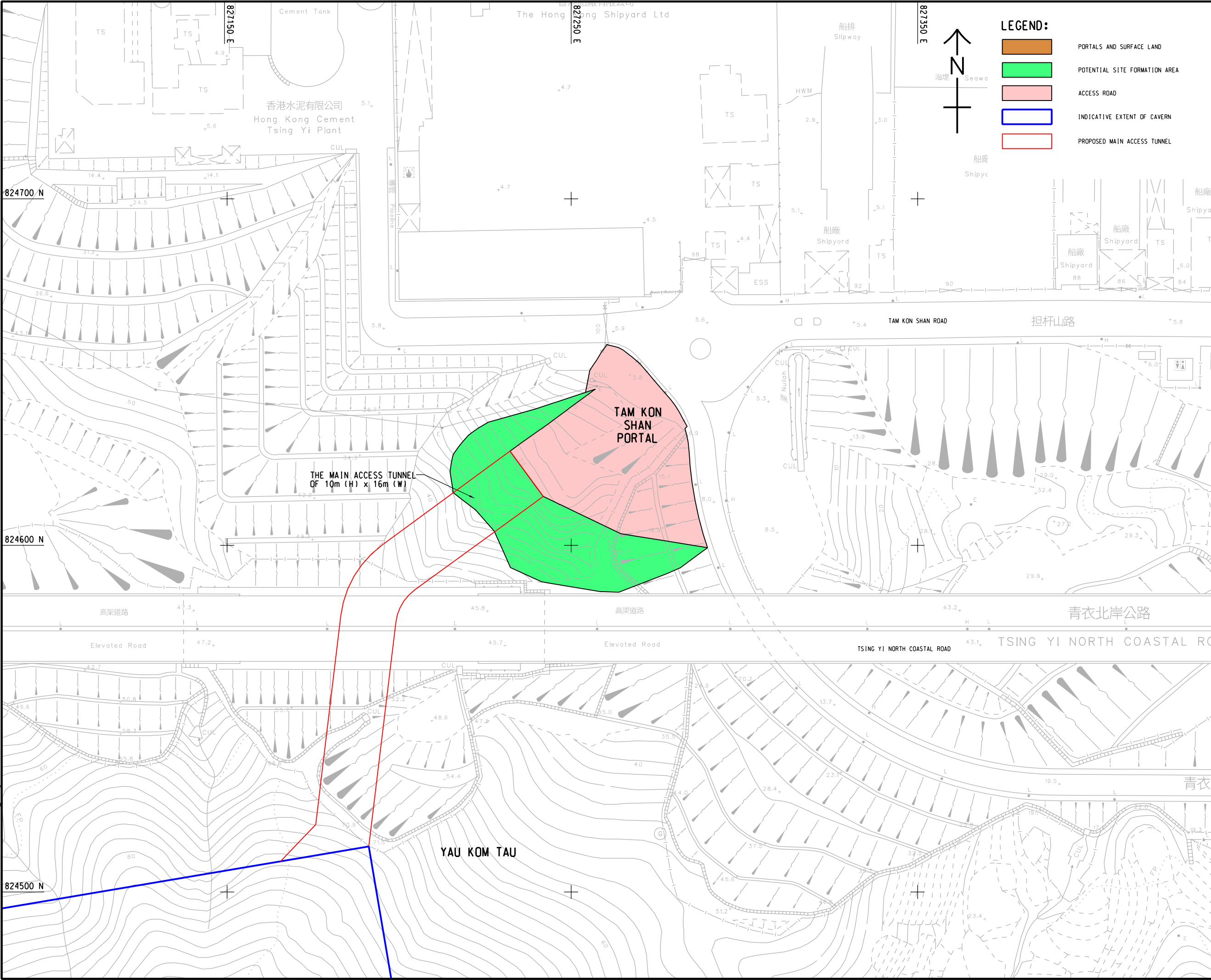
SHEET NUMBER
60733229/B19/FIGURE 10.04

823800 N



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A3 1: 1000

DIMENSION UNIT
METRES

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SHEET TITLE

INDICATIVE LAYOUT
AT TAM KON SHAN PORTAL

SHEET NUMBER
60733229/B19/FIGURE 10.06

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4/3/2026

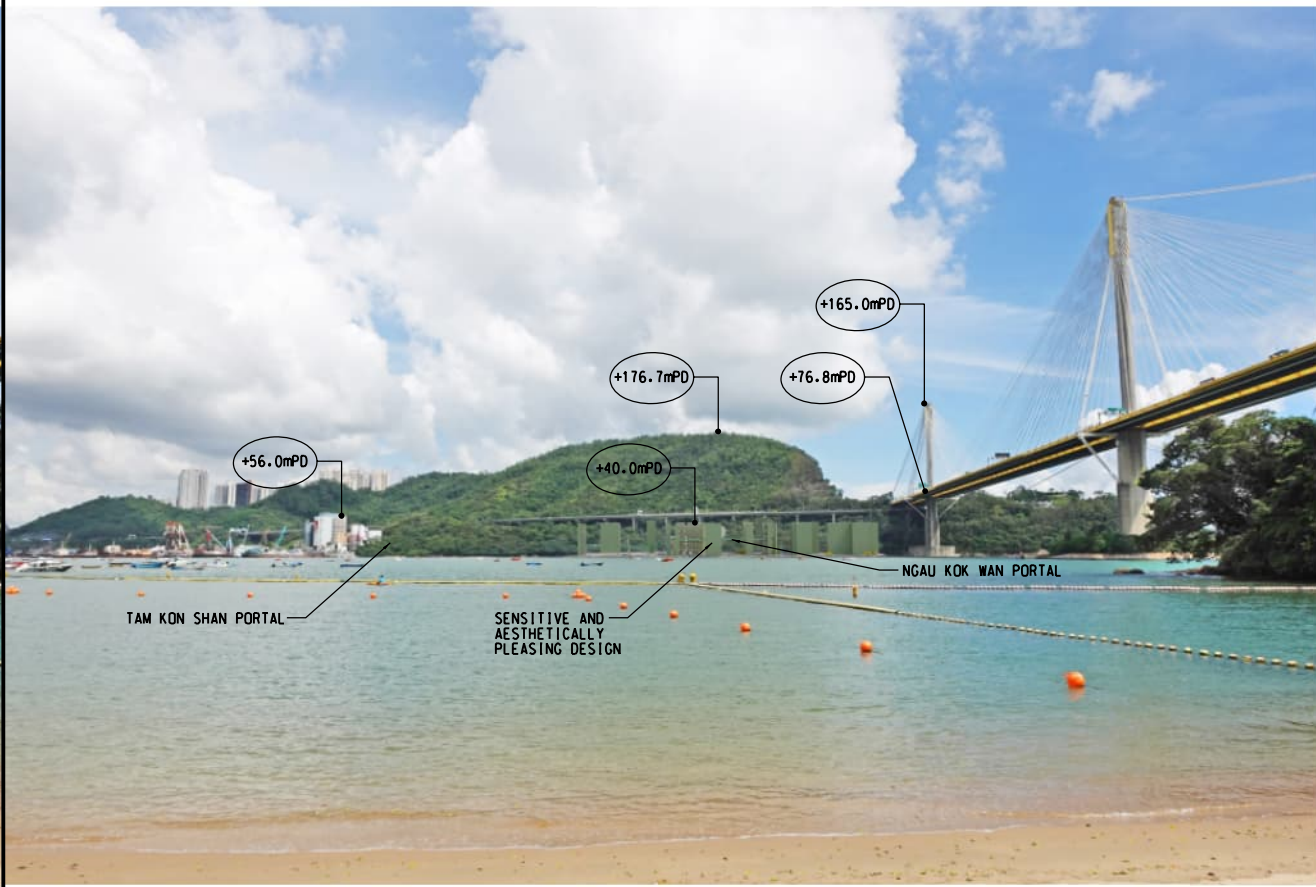
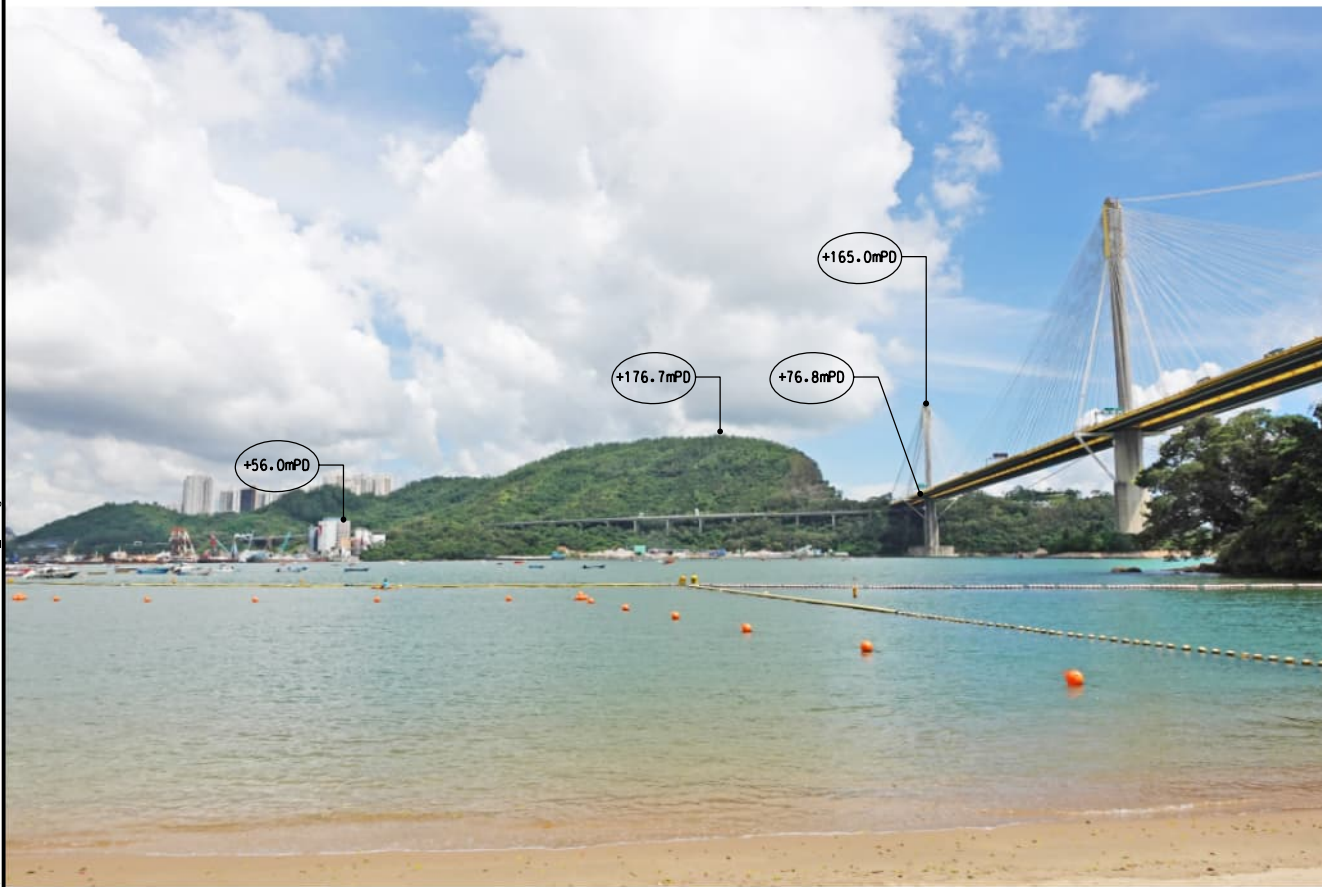
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LOCATION PLAN OF PHOTOMONTAGE VIEWPOINT



VIEWPOINT 1 - BASELINE SCENARIO

VIEWPOINT 1 - PROPOSED SCENARIO WITH MITIGATION MEASURES



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SHEET TITLE
PHOTOMONTAGE OF PROPOSED
DEVELOPMENT

SHEET NUMBER
60733229/B19/FIGURE 10.07

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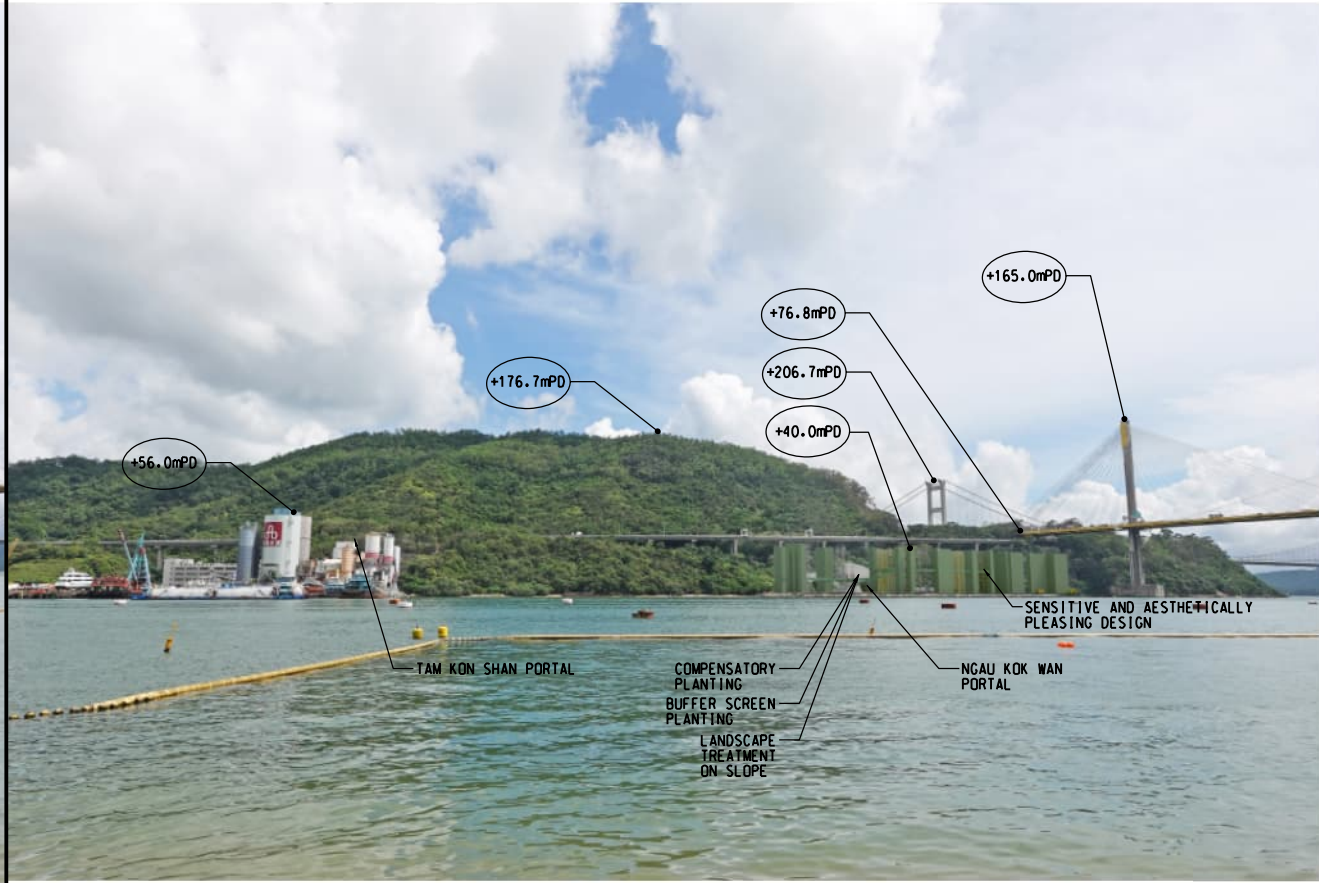
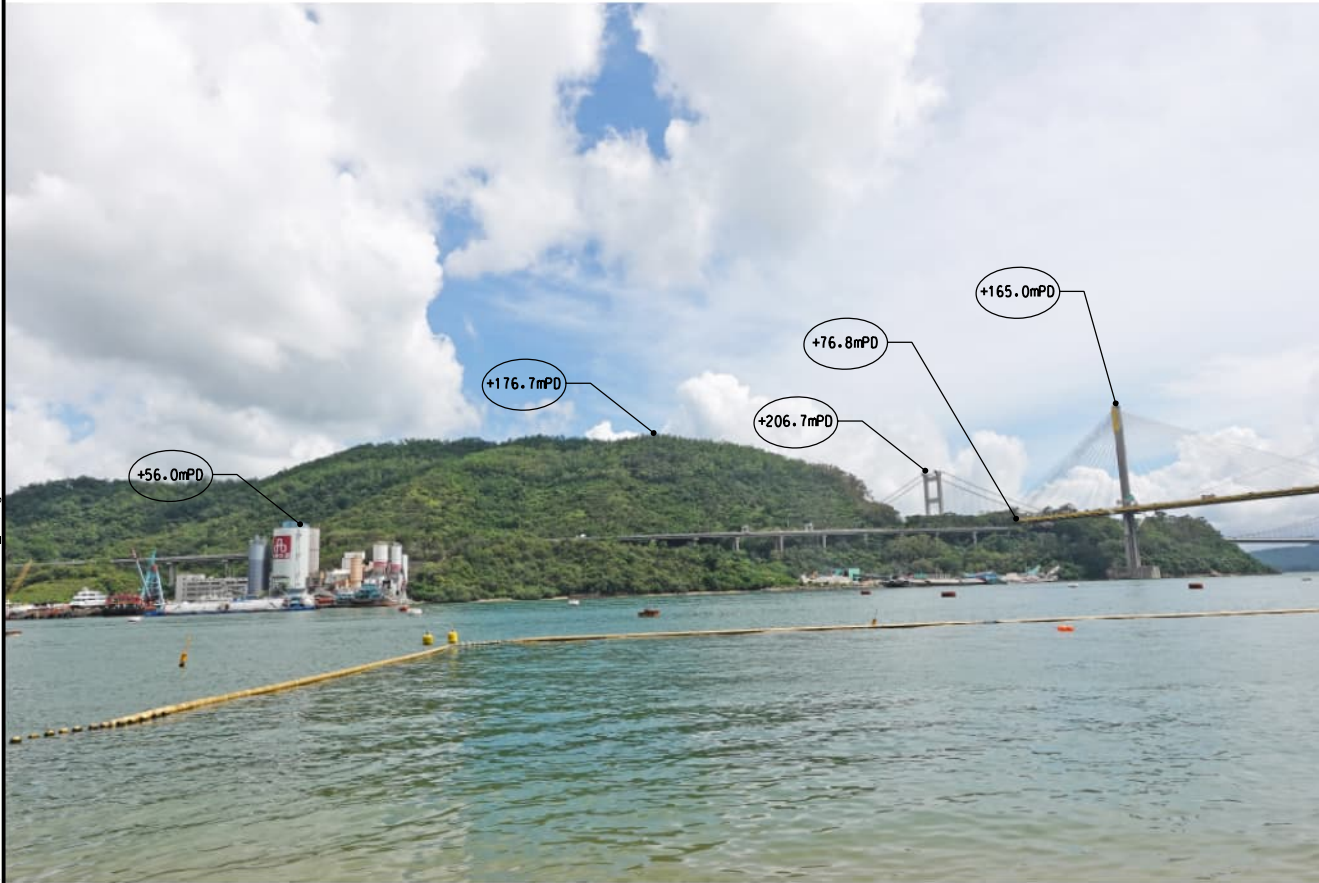
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LOCATION PLAN OF PHOTOMONTAGE VIEWPOINT



VIEWPOINT 2 - BASELINE SCENARIO

VIEWPOINT 2 - PROPOSED SCENARIO WITH MITIGATION MEASURES



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SHEET TITLE
PHOTOMONTAGE OF PROPOSED
DEVELOPMENT

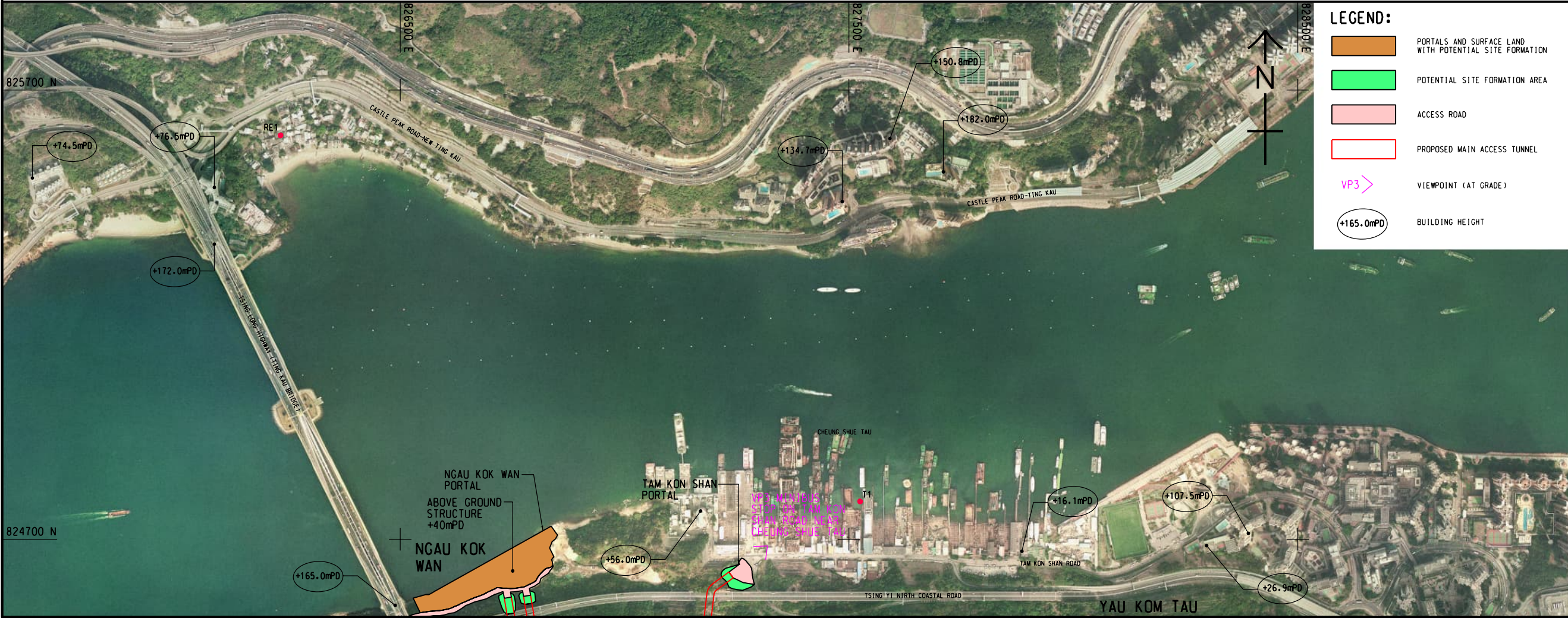
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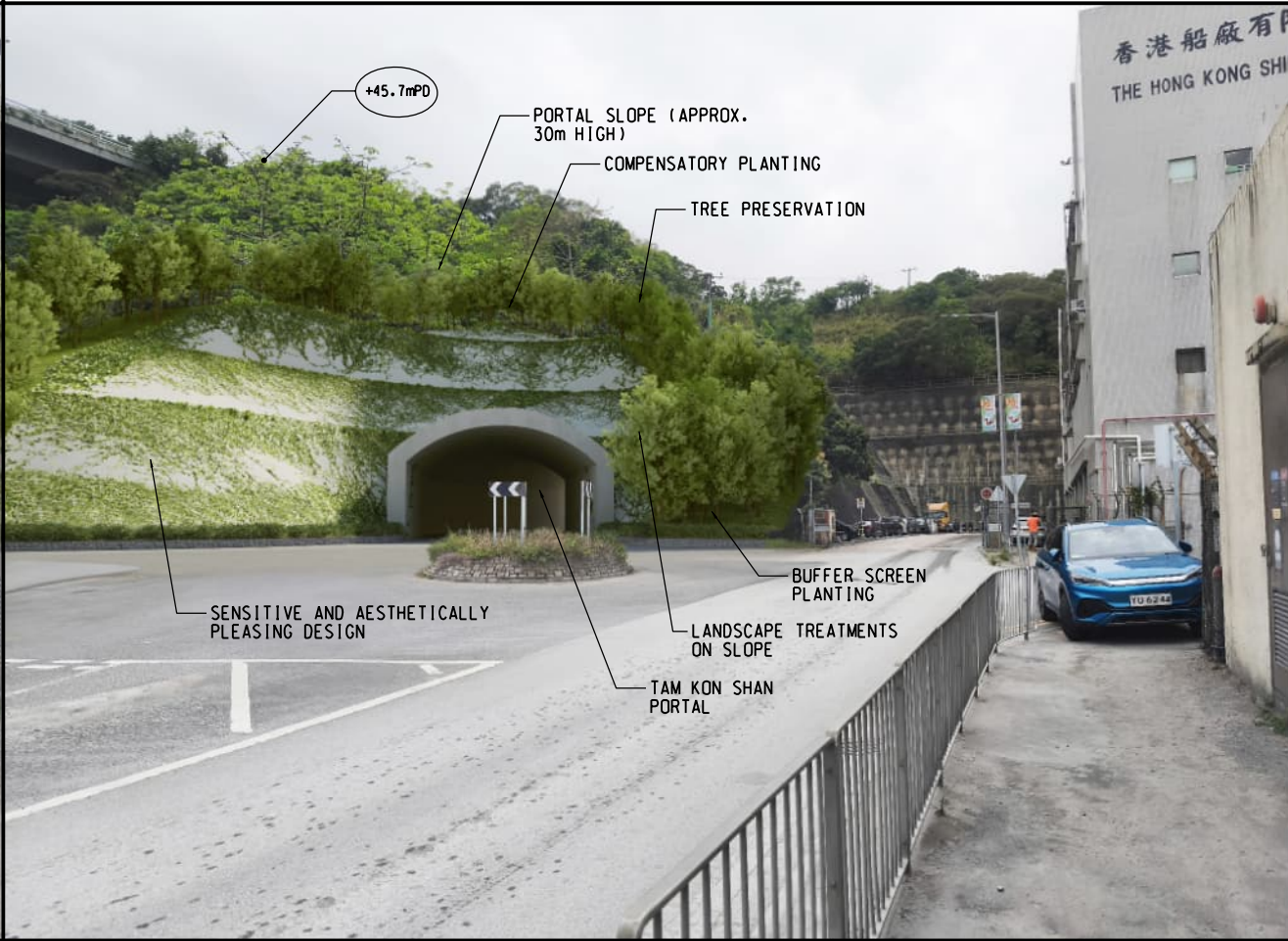
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LOCATION PLAN OF PHOTOMONTAGE VIEWPOINT



VIEWPOINT 3 - BASELINE SCENARIO

VIEWPOINT 3 - PROPOSED SCENARIO WITH MITIGATION MEASURES



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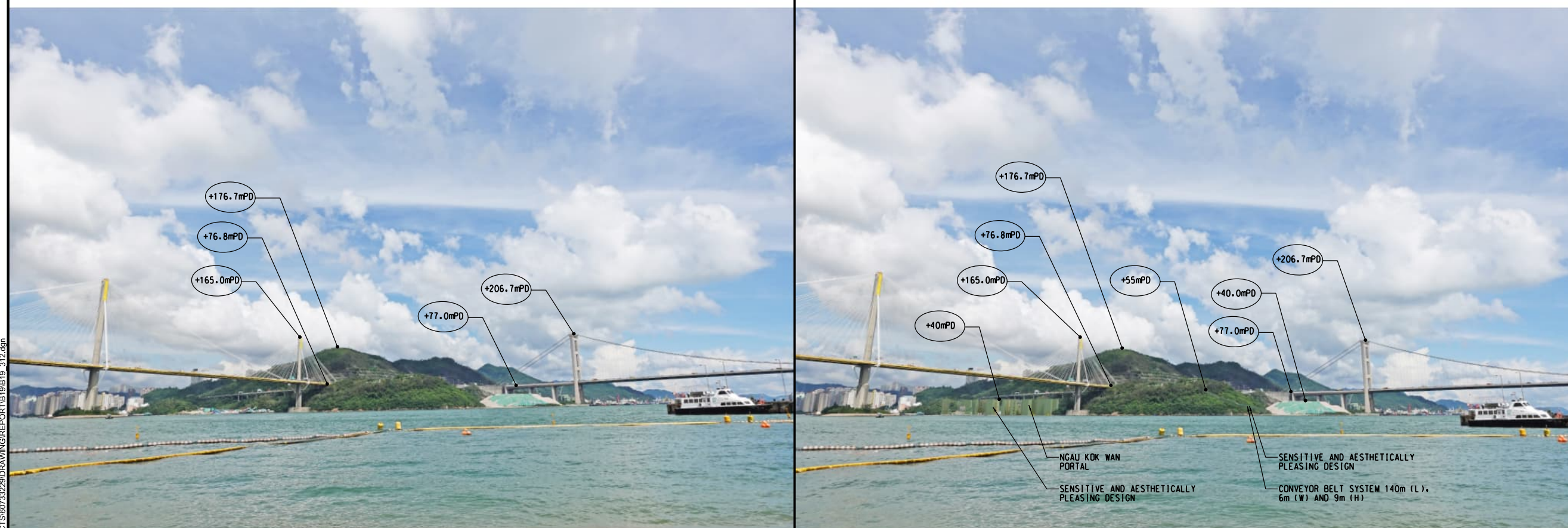
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SHEET TITLE
PHOTOMONTAGE OF PROPOSED
DEVELOPMENT
SHEET NUMBER
60733229/B19/FIGURE 10.09

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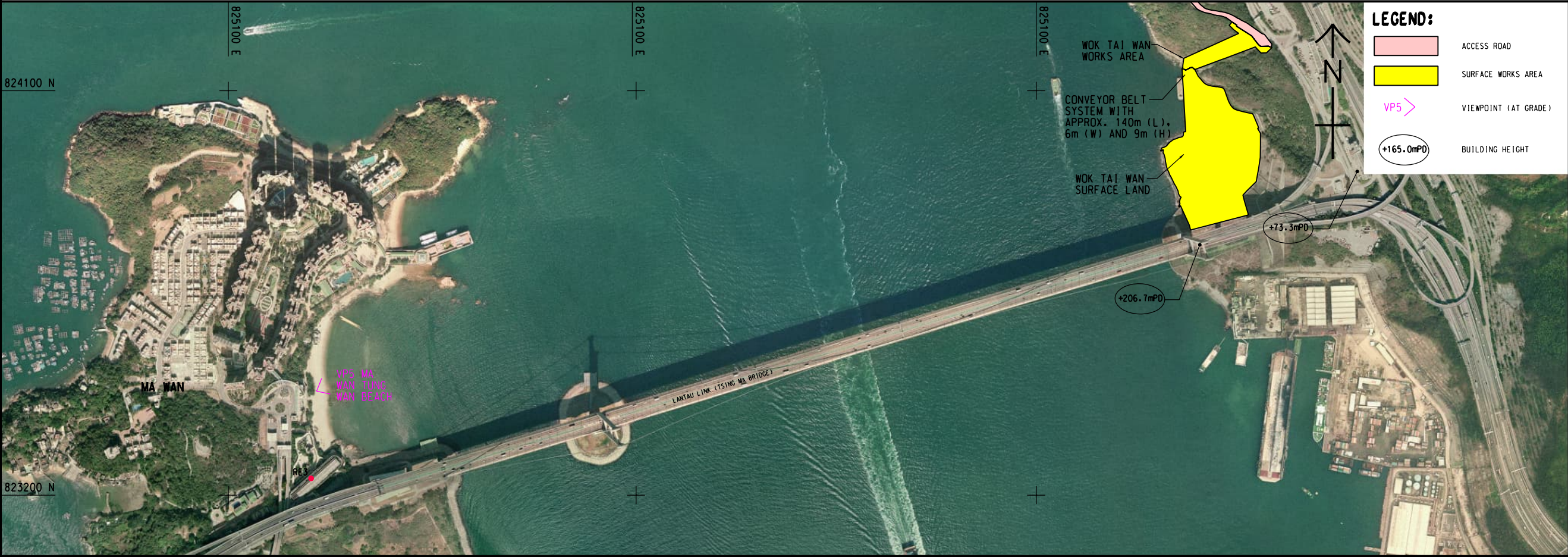
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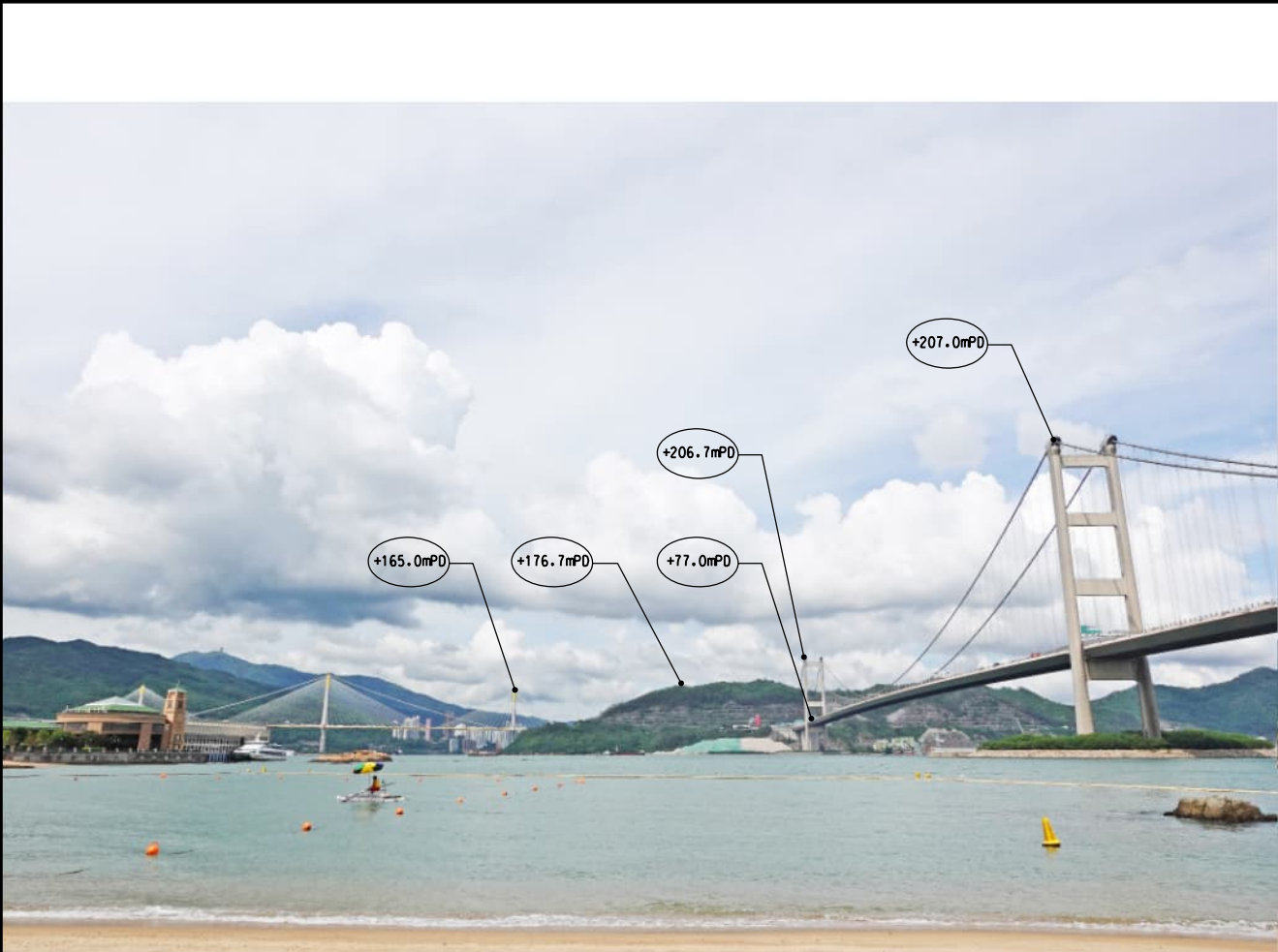
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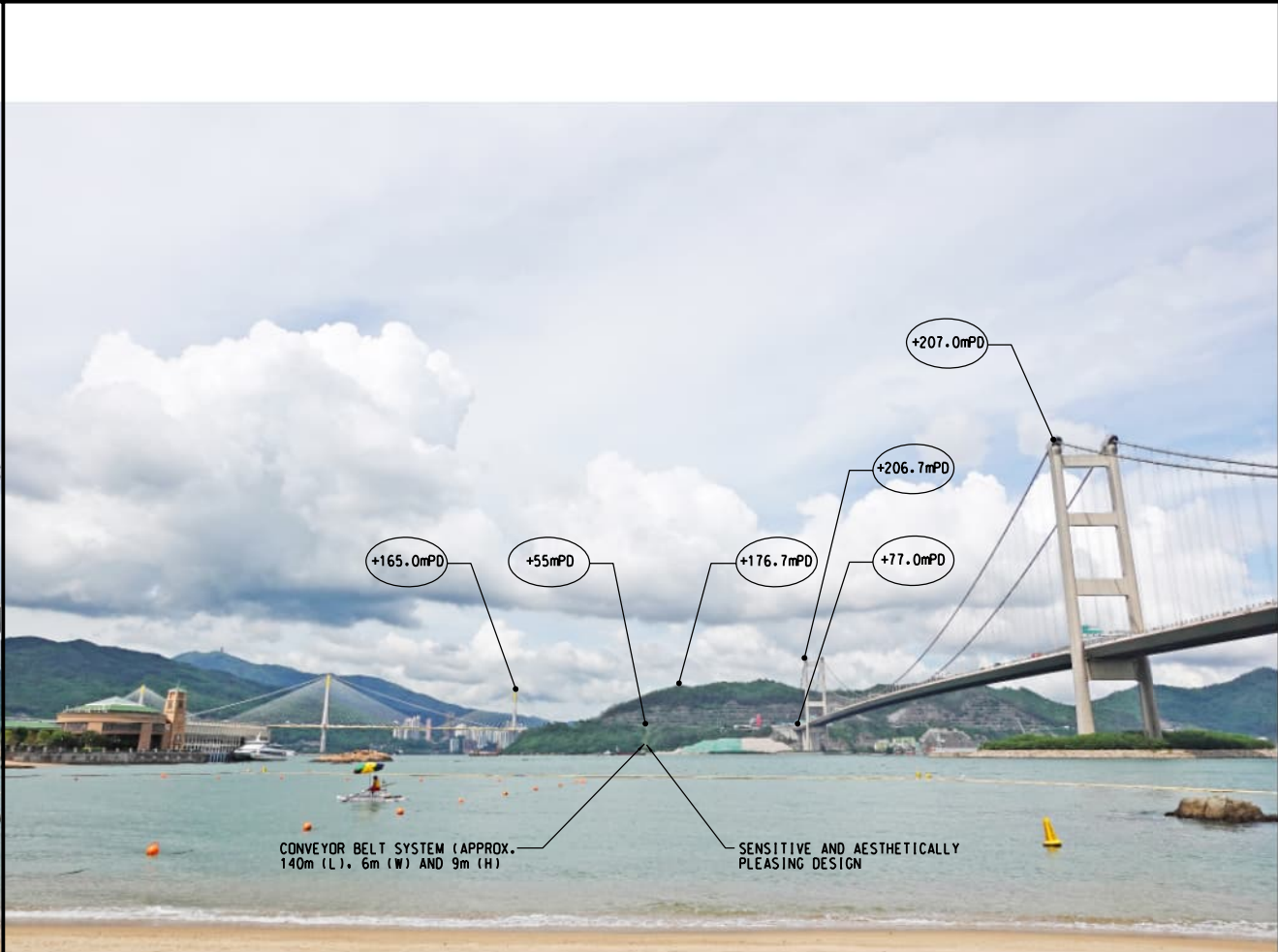
LOCATION PLAN OF PHOTOMONTAGE VIEWPOINT



VIEWPOINT 5 - BASELINE SCENARIO



VIEWPOINT 5 - PROPOSED SCENARIO WITH MITIGATION MEASURES



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SHEET TITLE

PHOTOMONTAGE OF PROPOSED
DEVELOPMENT

SHEET NUMBER

60733229/B19/FIGURE 10.11

ISO A1 594mm x 841mm
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LOCATION PLAN OF PHOTOMONTAGE VIEWPOINT



VIEWPOINT 6 - BASELINE SCENARIO

VIEWPOINT 6 - PROPOSED SCENARIO WITH MITIGATION MEASURES



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SHEET TITLE
PHOTOMONTAGE OF PROPOSED DEVELOPMENT

SHEET NUMBER
60733229/B19/FIGURE 10.12

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LOCATION PLAN OF PHOTOMONTAGE VIEWPOINT



VIEWPOINT 7 - BASELINE SCENARIO



VIEWPOINT 7 - PROPOSED SCENARIO WITH MITIGATION MEASURES



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SHEET TITLE
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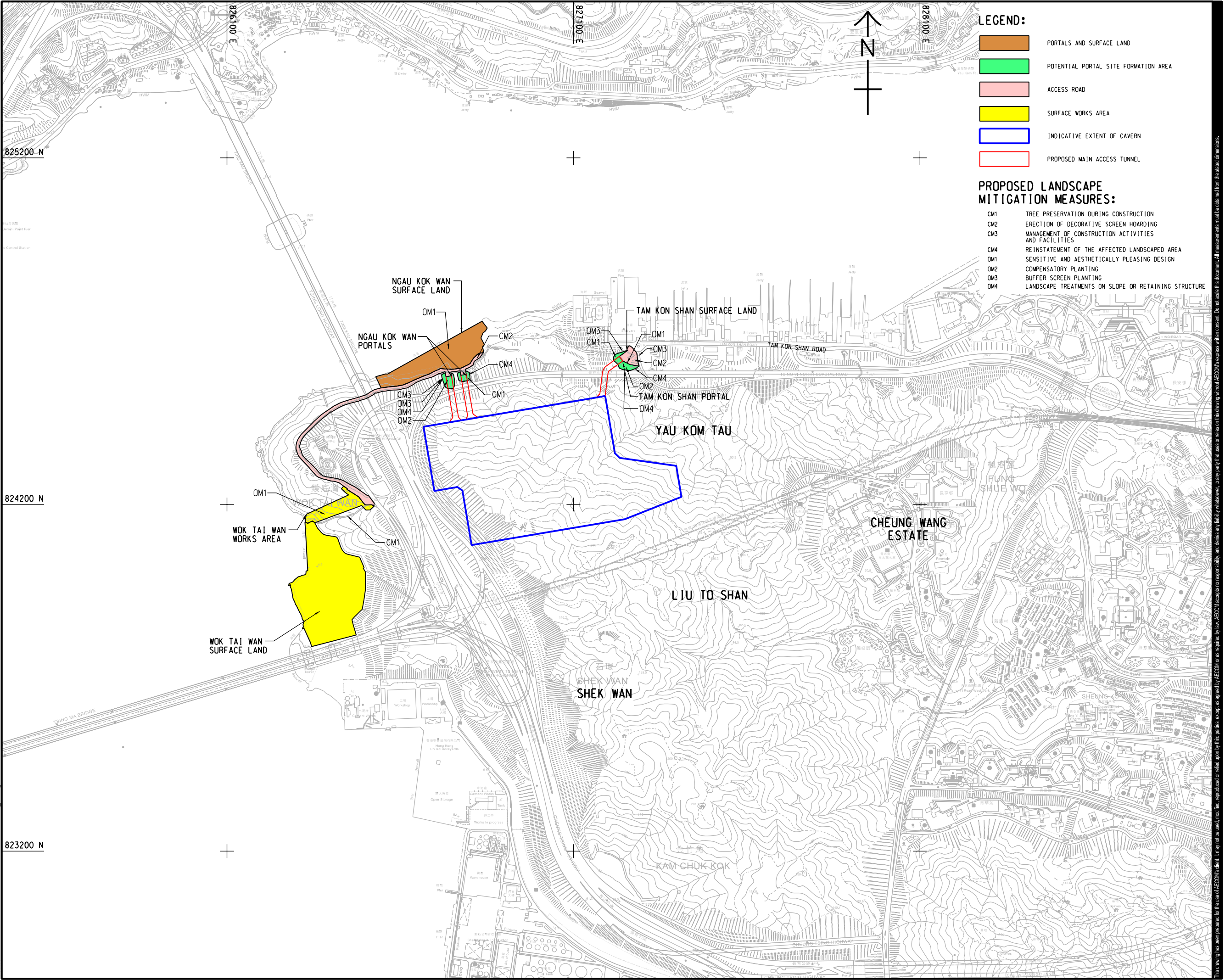
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60733229/B19/FIGURE 10.13

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A3 1 : 10000	METRES

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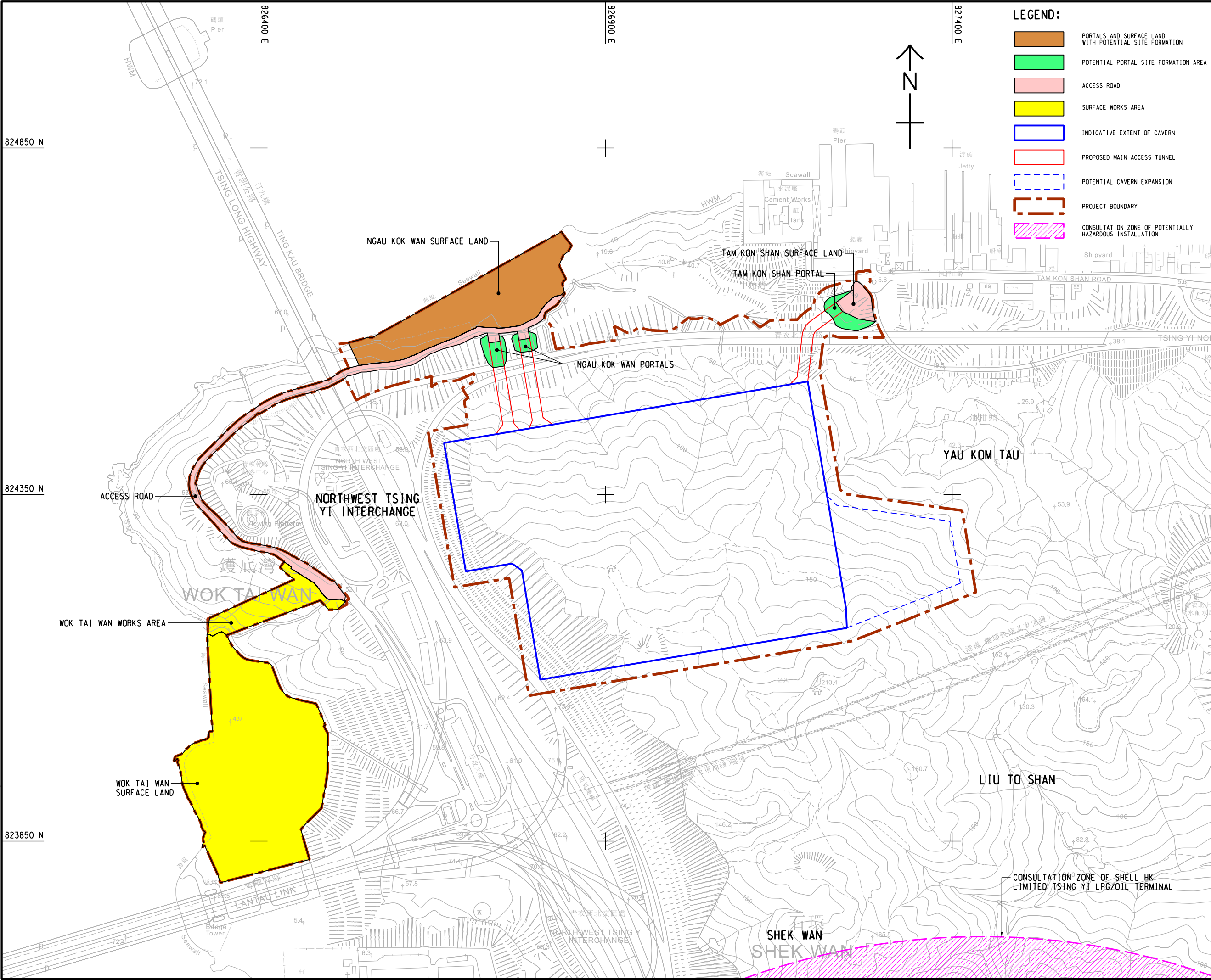
PROJECT NO.	AGREEMENT NO.
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SHEET TITLE
PROPOSED LANDSCAPE MITIGATION MEASURES

SHEET NUMBER
60733229/B19/FIGURE 10.14

ISO A1 594mm x 841mm
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- LEGEND:**
- PORTALS AND SURFACE LAND WITH POTENTIAL SITE FORMATION
 - POTENTIAL PORTAL SITE FORMATION AREA
 - ACCESS ROAD
 - SURFACE WORKS AREA
 - INDICATIVE EXTENT OF CAVERN
 - PROPOSED MAIN ACCESS TUNNEL
 - POTENTIAL CAVERN EXPANSION
 - PROJECT BOUNDARY
 - CONSULTATION ZONE OF POTENTIALLY HAZARDOUS INSTALLATION

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校核	

SCALE	DIMENSION UNIT
A3 1: 5000	METRES

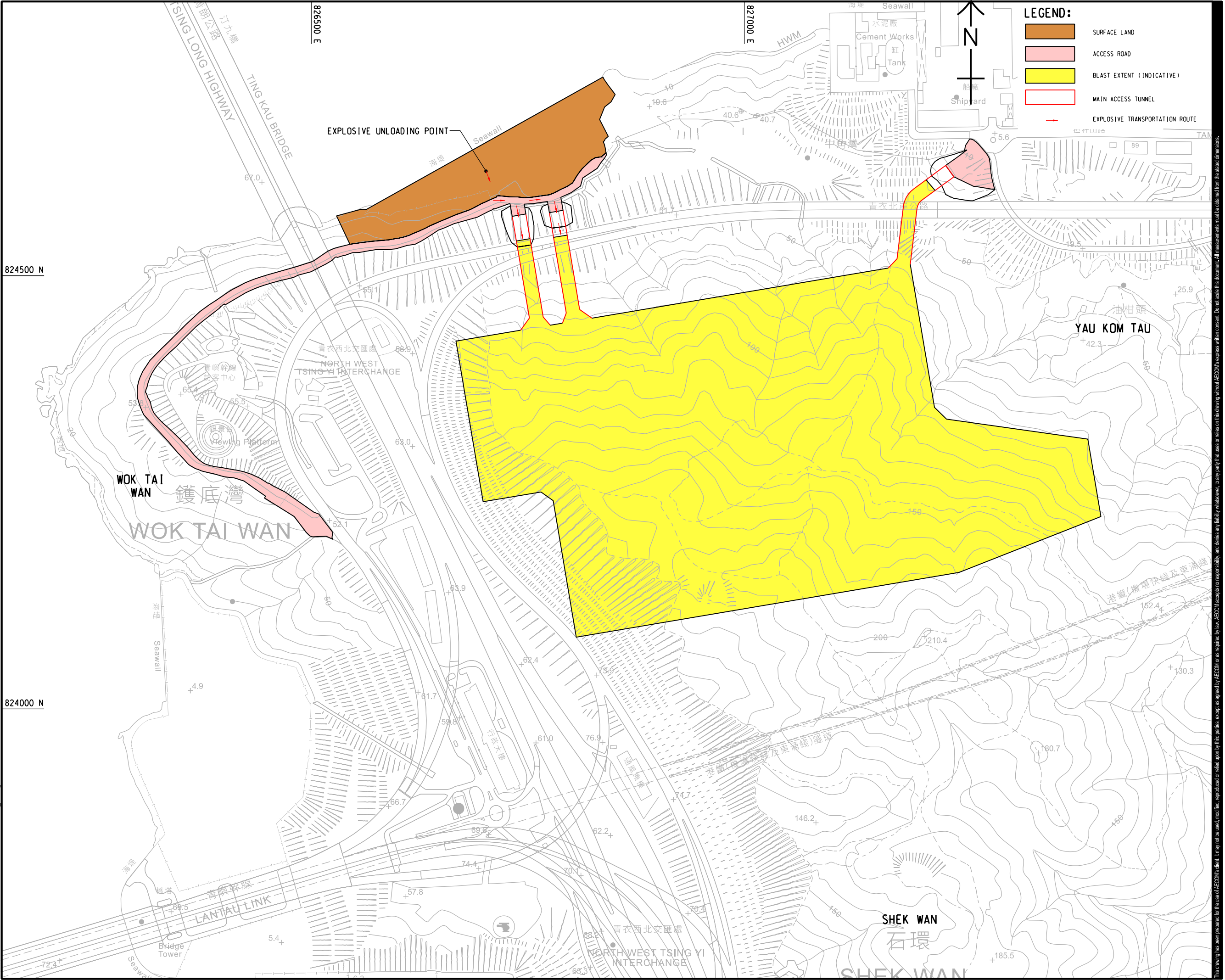
KEY PLAN	
索引圖	

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SHEET TITLE
LOCATION OF CONSULTATION ZONE OF PHI IN THE VICINITY OF THE PROJECT

SHEET NUMBER
60733229/B19/FIGURE 12.01



PROJECT
項目
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SCALE
比例
A3 1 : 4000

DIMENSION UNIT
尺寸單位
METRES

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SHEET TITLE
圖紙名稱

BLASTING EXTENT AND EXPLOSIVE ONSITE TRANSPORTATION ROUTE (INDICATIVE)

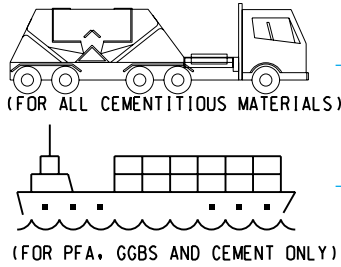
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圖紙編號
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Appendix 4.1

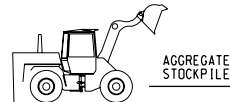




CEMENTITIOUS MATERIALS

HIGH LEVEL SENSOR
CONNECTED TO ALARM
AND CONTROL VALVE

CONTROL BOX



AGGREGATE
STOCKPILE

TP

C5

TP

C2

SHIP
UNLOADING
FEED HOPPER 2

C9

CRUSHED
AGGREGATE
BIN

C7

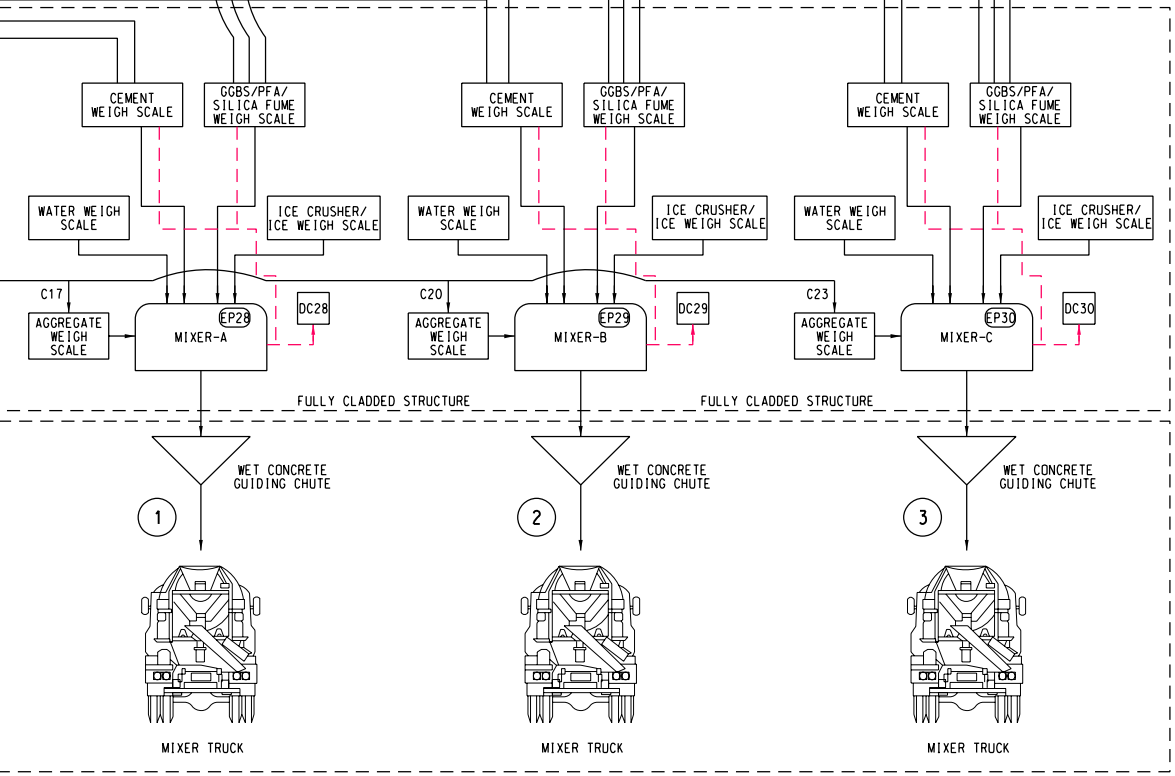
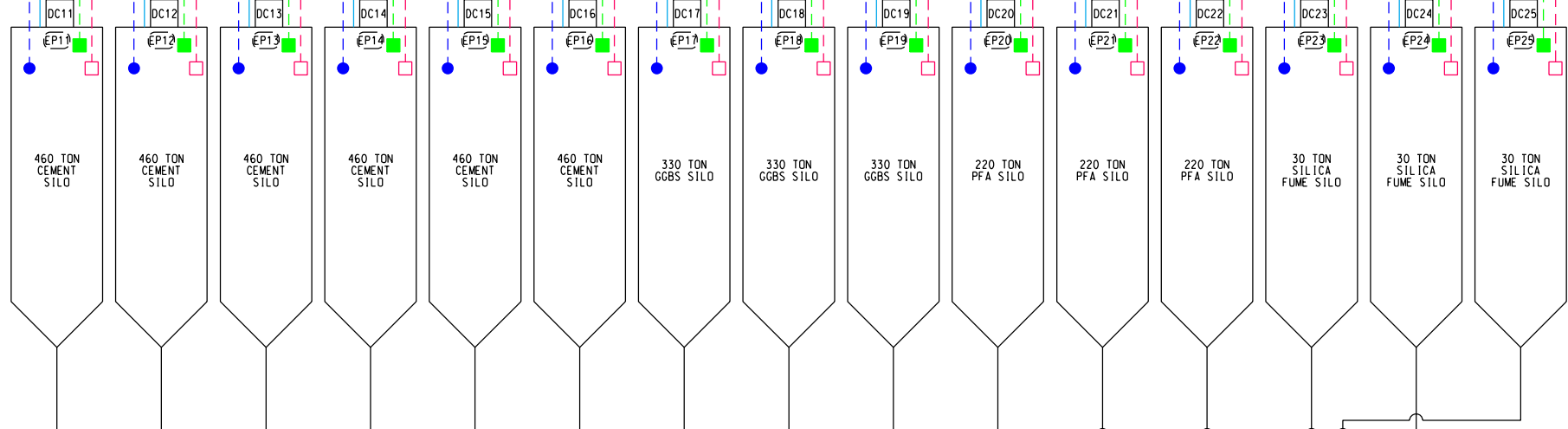
6750 TON
AGGREGATE
STORAGE BIN

10mm

20mm

S/F

C16/C18/C19/C21/C22



NOTE:

1. ALL AGGREGATE CONVEYORS WILL BE FULLY ENCLOSED.

LEGEND:

	SIGNAL CABLE		DUST COLLECTOR
	VENT PIPE		EMISSION POINT
	MATERIAL FLOW		TRANSFER POINT
	VALVE		CONVEYOR
	HIGH LEVEL SENSOR		
	LEVEL SENSOR		
	PRESSURE GAUGE		

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PROJECT

UNDERGROUND
QUARRYING AT
TSING YI NORTH –
INVESTIGATION,
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STATUS

SCALE

A3 1: 500

DIMENSION UNIT

METRES

KEY PLAN

PROJECT NO.

60733229

AGREEMENT NO.

CE 79/2023 (GE)

SHEET TITLE

SCHEMATIC DIAGRAM FOR THE
CONCRETE BATCHING OPERATION
1 TO 3

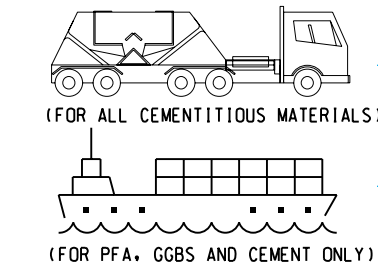
SHEET NUMBER

60733229/SK3016

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ISO A1 594mm x 841mm
Approved:
Checked:
Designer:
Project Management Initials:

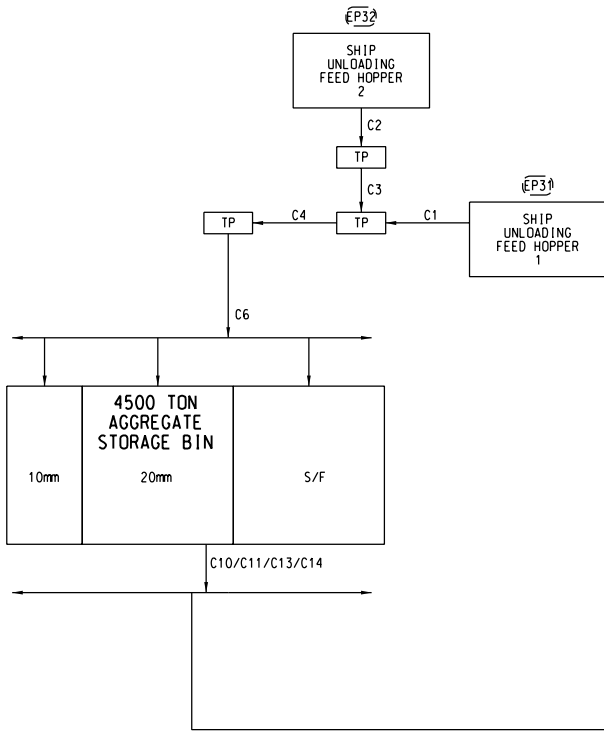
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Plot File by: WANGZP
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CEMENTITIOUS MATERIALS

HIGH LEVEL SENSOR
CONNECTED TO ALARM
AND CONTROL VALVE

CONTROL BOX

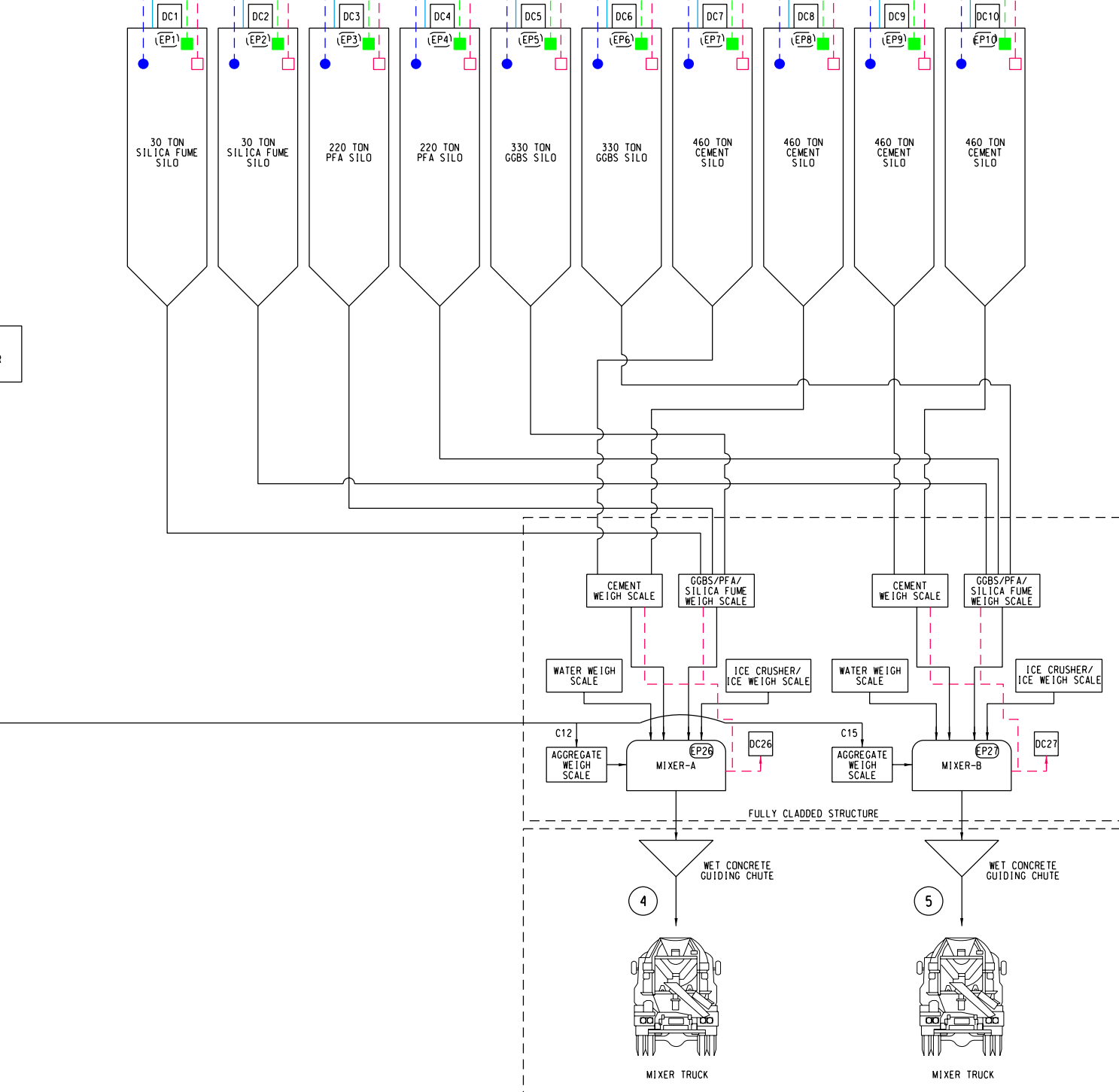


NOTE:

1. ALL AGGREGATE CONVEYORS WILL BE FULLY ENCLOSED.

LEGEND:

--- (dashed green line)	SIGNAL CABLE	DC	DUST COLLECTOR
--- (dashed red line)	VENT PIPE	(EP)	EMISSION POINT
→	MATERIAL FLOW	TP	TRANSFER POINT
⋈	VALVE	C	CONVEYOR
■ (green)	HIGH LEVEL SENSOR		
□ (pink)	LEVEL SENSOR		
● (blue)	PRESSURE GAUGE		



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SCALE

A3 1: 500

DIMENSION UNIT

METRES

KEY PLAN

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PROJECT NO.

60733229

AGREEMENT NO.

CE 79/2023 (GE)

SHEET TITLE

SCHEMATIC DIAGRAM FOR THE
CONCRETE BATCHING OPERATION
4 TO 5

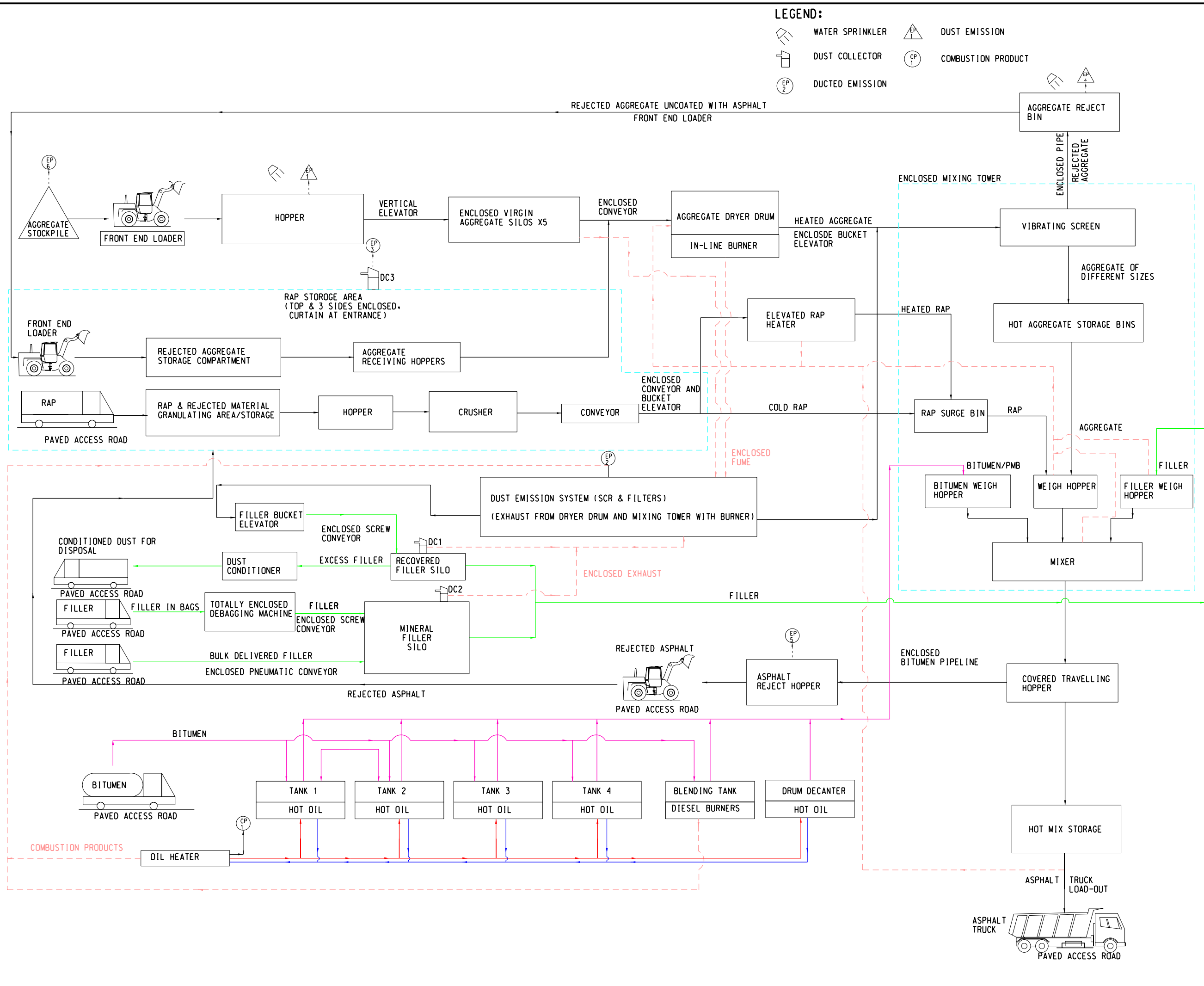
SHEET NUMBER

60733229/SK3017

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Approved:
Checked:
Designer:
Project Management Initials:

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Plot File by: XIEYZ 21/07/2026
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STATUS

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N.T.S. METRES

KEY PLAN

PROJECT NO.

60733229

AGREEMENT NO.

CE 79/2023 (GE)

SHEET TITLE

SCHEMATIC DIAGRAM FOR THE
ASPHALT PRODUCTION OPERATION

SHEET NUMBER

60733229/SK3018

Appendix 4.2

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Concrete Batching Operation							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Concrete Batching Operation	Dust Collector on Silica Fume Silo Source ID: CBP01 - 02, 23-25	Exhaust from Dust Collector (g/s)			Maximum Emission Concentration (mg/m3) Flow Rate (m3/hr)	9 2000	from design engineer from design engineer
		RSP		2.6667E-03	Ratio RSP to TSP (Controlled)	0.53	Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		1.2121E-03	Ratio FSP to RSP (Controlled)	0.45	Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo"
	Dust Collector on PFA Silo Source ID: CBP03-04, 20-22	Exhaust from Dust Collector (g/s)			Maximum Emission Concentration (mg/m3) Flow Rate (m3/hr)	9 2000	from design engineer from design engineer
		RSP		2.6667E-03	Ratio RSP to TSP (Controlled)	0.53	Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		1.2121E-03	Ratio FSP to RSP (Controlled)	0.45	Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo"
	Dust Collector on GGBS Silo Source ID: CBP05-06, 17-19	Exhaust from Dust Collector (g/s)			Maximum Emission Concentration (mg/m3) Flow Rate (m3/hr)	9 2000	from design engineer from design engineer
		RSP		2.6667E-03	Ratio RSP to TSP (Controlled)	0.53	Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		1.2121E-03	Ratio FSP to RSP (Controlled)	0.45	Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo"
	Dust Collector on Cement Silo Source ID: CBP07-16	Exhaust from Dust Collector (g/s)			Maximum Emission Concentration (mg/m3) Flow Rate (m3/hr)	9 2000	from design engineer from design engineer
		RSP		1.7000E-03	Ratio RSP to TSP (Controlled)	0.34	Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		7.7273E-04	Ratio FSP to RSP (Controlled)	0.45	Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo"
	Dust Collector on Mixers Source ID: CBP26 - 30	Exhaust from Dust Collector (g/s)			TSP emission factor (mg/m3) Flow Rate (m3/hr)	9 12000	from design engineer from design engineer
		RSP		9.1304E-03	Ratio RSP to TSP (Controlled)	0.30	Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		4.1502E-03	Ratio FSP to RSP (Controlled)	0.45	Refer to Table "Dust collector on Mixer & Weigh Hoppers"

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Concrete Batching Operation							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
	Unloading of Aggregate to Hopper 1 by Conveyor belt	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					TSP Particle size multiplier, k	0.74	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					RSP Particle size multiplier, k	0.35	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP Particle size multiplier, k	0.053	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	4	provided by design engineer
					Average wind speed, U (m/s)	2.24	mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	750	from design engineer
					Area of the storage (m ²)	25	from design engineer
					Dust Suppression Efficiency for PM (6 - 10µm)	90	for dust suppression by water sprays
					Dust Suppression Efficiency for PM (2.5 - 6µm)	65	from Table B.2.3, Appendix B.2, USEPA AP-42
					Dust Suppression Efficiency for PM (0 - 2.5µm)	40	
	Source ID: CBP31	RSP		7.0365E-04	TSP emission factor, E (kg/Mg)	4.60E-04	by formula above
					RSP emission factor, E (kg/Mg)	2.18E-04	by formula above
		FSP		1.6483E-04	FSP emission factor, E (kg/Mg)	3.30E-05	by formula above
					Mitigated PM(>10µm) emission factor (kg/Mg)	2.43E-05	
					Mitigated PM(2.5 - 10µm) emission factor (kg/Mg)	6.47E-05	
					Mitigated PM(2.5) emission factor (kg/Mg)	1.98E-05	
					Mitigated PM(>10µm) emission rate (g/s)	5.05E-03	
					Mitigated PM(2.5 - 10µm) emission rate (g/s)	1.35E-02	
					Mitigated PM(2.5) emission rate (g/s)	4.12E-03	
	Unloading of Aggregate to Hopper 2 by Conveyor belt	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					TSP Particle size multiplier, k	0.74	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					RSP Particle size multiplier, k	0.35	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP Particle size multiplier, k	0.053	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	4	provided by design engineer
					Average wind speed, U (m/s)	2.24	mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	1550	from design engineer
					Area of the storage (m ²)	25	from design engineer
					Dust Suppression Efficiency for PM (6 - 10µm)	90	for dust suppression by water sprays
					Dust Suppression Efficiency for PM (2.5 - 6µm)	65	from Table B.2.3, Appendix B.2, USEPA AP-42
					Dust Suppression Efficiency for PM (0 - 2.5µm)	40	
	Source ID: CBP32	RSP		1.4542E-03	TSP emission factor, E (kg/Mg)	4.60E-04	by formula above
					RSP emission factor, E (kg/Mg)	2.18E-04	by formula above
		FSP		3.4066E-04	FSP emission factor, E (kg/Mg)	3.30E-05	by formula above
					Mitigated PM(>10µm) emission factor (kg/Mg)	2.43E-05	
					Mitigated PM(2.5 - 10µm) emission factor (kg/Mg)	6.47E-05	
					Mitigated PM(2.5) emission factor (kg/Mg)	1.98E-05	
					Mitigated PM(>10µm) emission rate (g/s)	1.04E-02	
					Mitigated PM(2.5 - 10µm) emission rate (g/s)	2.78E-02	
					Mitigated PM(2.5) emission rate (g/s)	8.52E-03	

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD
Proposed Concrete Batching Operation

Source ID	Schematic Diagram	Emission Point	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	No. of Vertices	Exit Temperature (K)	Working Hour	RSP Emission Rate		FSP Emission Rate	
												Working hours	Non-working hours	Working hours	Non-working hours
CBP01	Concrete Batching Operation (SK3016-SK3017)	EP1	Silica Fume Silo	POINT	826663.82	824602.34	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP02		EP2	Silica Fume Silo	POINT	826668.52	824593.39	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP03		EP3	PFA Silo	POINT	826659.70	824604.22	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP04		EP4	PFA Silo	POINT	826665.23	824606.81	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP05		EP5	GGBS Silo	POINT	826662.41	824598.92	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP06		EP6	GGBS Silo	POINT	826668.17	824601.63	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP07		EP7	Cement Silo	POINT	826665.11	824593.75	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP08		EP8	Cement Silo	POINT	826670.29	824596.57	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP09		EP9	Cement Silo	POINT	826667.82	824588.92	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP10		EP10	Cement Silo	POINT	826673.11	824591.39	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP11		EP11	Cement Silo	POINT	826719.13	824609.63	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP12		EP12	Cement Silo	POINT	826721.95	824604.34	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP13		EP13	Cement Silo	POINT	826724.19	824612.10	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP14		EP14	Cement Silo	POINT	826726.89	824607.16	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP15		EP15	Cement Silo	POINT	826729.01	824614.81	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP16		EP16	Cement Silo	POINT	826731.95	824609.87	5.00	26.00	-	0	07:00 - 19:00	1.7000E-03	0.0000E+00	7.7273E-04	0.0000E+00
CBP17		EP17	GGBS Silo	POINT	826734.31	824617.52	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP18		EP18	GGBS Silo	POINT	826737.37	824612.69	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP19		EP19	GGBS Silo	POINT	826739.48	824619.75	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP20		EP20	PFA Silo	POINT	826742.31	824615.87	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP21		EP21	PFA Silo	POINT	826744.19	824622.93	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP22		EP22	PFA Silo	POINT	826747.02	824618.11	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP23		EP23	Silica Fume Silo	POINT	826722.66	824608.10	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP24		EP24	Silica Fume Silo	POINT	826733.13	824613.87	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP25		EP25	Silica Fume Silo	POINT	826743.02	824619.52	5.00	26.00	-	0	07:00 - 19:00	2.6667E-03	0.0000E+00	1.2121E-03	0.0000E+00
CBP26		EP26	Mixer	POINT	826664.17	824601.28	5.00	26.00	-	0	07:00 - 19:00	9.1304E-03	0.0000E+00	4.1502E-03	0.0000E+00
CBP27		EP27	Mixer	POINT	826667.94	824594.57	5.00	26.00	-	0	07:00 - 19:00	9.1304E-03	0.0000E+00	4.1502E-03	0.0000E+00
CBP28		EP28	Mixer	POINT	826724.01	824608.75	5.00	26.00	-	0	07:00 - 19:00	9.1304E-03	0.0000E+00	4.1502E-03	0.0000E+00
CBP29		EP29	Mixer	POINT	826734.12	824614.33	5.00	26.00	-	0	07:00 - 19:00	9.1304E-03	0.0000E+00	4.1502E-03	0.0000E+00
CBP30		EP30	Mixer	POINT	826741.95	824619.00	5.00	26.00	-	0	07:00 - 19:00	9.1304E-03	0.0000E+00	4.1502E-03	0.0000E+00
CBP31		EP31	Unloading Aggregate to Hopper	AREAPOLY	826724.81	824657.44	5.00	3.00	4	-	07:00 - 19:00	7.0365E-04	0.0000E+00	1.6483E-04	0.0000E+00
CBP32		EP32	Unloading Aggregate to Hopper	AREAPOLY	826735.22	824658.71	5.00	3.00	4	-	07:00 - 19:00	1.4542E-03	0.0000E+00	3.4066E-04	0.0000E+00

Remarks:

1. Source parameters (exit temperature, velocity, stack diameter, and release height) are obtained from engineer.

2. Emission rate for Area source (g/s/m²) = Emission rate (g/s) / Area

Location of Vertices for AREAPOLY

Source ID	Vertex 1		Vertex 2		Vertex 3		Vertex 4	
	X	Y	X	Y	X	Y	X	Y
CBP31	826724.81	824657.44	826729.93	824660.09	826731.92	824656.24	826726.80	824653.59
CBP32	826735.22	824658.71	826740.21	824661.39	826742.31	824657.47	826737.32	824654.80

Hourly Profile for CBP01-32 (daily)

Hour	CBP01-32
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Hourly Profile for CBP01-32 (annual)

Hour	CBP01-32
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	0.9000
Hour 9	0.9000
Hour 10	0.9000
Hour 11	0.9000
Hour 12	0.9000
Hour 13	0.9000
Hour 14	0.9000
Hour 15	0.9000
Hour 16	0.9000
Hour 17	0.9000
Hour 18	0.9000
Hour 19	0.9000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Rock Processing Operation							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Rock Processing Operation	Exhaust from Feeder and Jaw Crusher	Unloading of rocks into Feeder Unloading - Unfragmented Stone (g/s)			Handling rate (Mg/hr)	800	from engineer
					Area of storage (m ²)	25.4	
		RSP	1.7778E-03	1.7778E-03	RSP emission factor (kg/Mg)	8.00E-06	emission factor of RSP for "Truck Unloading - Fragmented Stone", from USEPA AP-42, Section 11.19.2, 8/04 ed,Table 11.19.2-1
		FSP	5.2288E-04	5.2288E-04	FSP emission factor (kg/Mg) % fraction of FSP	2.35E-06 2.94E-01	from USEPA AP-42, Appendix B.2, 9/90 ed., pp B.2-13
	Stone Crushing at Jaw Crusher	Primary Crushing (g/s)			Handling rate (Mg/hr)	800	from engineer
		RSP	6.0000E-02	6.0000E-02	RSP emission factor (kg/Mg)	2.70E-04	wet suppression, controlled RSP emission factor is used. RSP emission factor of the tertiary crushing (controlled) is used as there is no data for RSP arising from the primary crushing, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, note n of Table 11.19.2-1,
		FSP	1.1111E-02	1.1111E-02	FSP emission factor (kg/Mg)	5.00E-05	wet suppression, controlled FSP emission factor is used. FSP emission factor of the tertiary crushing (controlled) is used as there is no data for FSP arising from the primary crushing, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, note n of Table 11.19.2-1,
		Screening after the Primary Crushing Process (g/s)			Handling rate (Mg/hr)	792	from engineer
	Source ID: SCP02	RSP	8.1400E-02	8.1400E-02	RSP emission factor (kg/Mg)	3.70E-04	wet suppression, controlled RSP emission factor for screening is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed,Table 11.19.2-1
		FSP	5.5000E-03	5.5000E-03	FSP emission factor (kg/Mg)	2.50E-05	wet suppression, controlled FSP emission factor for screening is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1
		Subtotal (g/s)			Dust removal efficiency (%)	90.0	enclosure with dust collector, with reference to Technical Background Document on Control of Fugitive Dust at Cement Manufacturing Facilities, 3/98 ed, Section 3.3.6 (90% for conservative assumption)
		RSP FSP	1.4318E-01 1.7134E-02	1.4318E-02 1.7134E-03			
	Stone Crushing at Secondary Cone Crusher	Secondary Crushing (g/s)			Handling rate (Mg/hr)	792	from engineer
	Source ID: SCP04	RSP	5.9400E-02	5.9400E-02	RSP emission factor (kg/Mg)	2.70E-04	wet suppression, controlled RSP emission factor is used. RSP emission factor of the tertiary crushing (controlled) is used as there is no data for RSP arising from the secondary crushing, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, note n of Table 11.19.2-1,
		FSP	1.1000E-02	1.1000E-02	FSP emission factor (kg/Mg)	5.00E-05	wet suppression, controlled FSP emission factor is used. FSP emission factor of the tertiary crushing (controlled) is used as there is no data for FSP arising from the secondary crushing, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, note n of Table 11.19.2-1,

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Rock Processing Operation							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Rock Processing Operation	Screening after the Secondary Crushing Process	Screening (g/s)			Handling rate (Mg/hr)	792	from engineer
	Source ID:	RSP	8.1400E-02	8.1400E-02	RSP emission factor (kg/Mg)	3.70E-04	wet suppression, controlled RSP emission factor for screening is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1
	SCP05	FSP	5.5000E-03	5.5000E-03	FSP emission factor (kg/Mg)	2.50E-05	wet suppression, controlled FSP emission factor for screening is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1
	Stone Crushing at Tertiary Cone Crusher	Tertiary Crushing (g/s)			Handling rate (Mg/hr)	760	from engineer
	Source ID:	RSP	5.7000E-02	5.7000E-02	RSP emission factor (kg/Mg)	2.70E-04	wet suppression, controlled RSP emission factor for tertiary crushing is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1
	SCP06,SCP07	FSP	1.0556E-02	1.0556E-02	FSP emission factor (kg/Mg)	5.00E-05	wet suppression, controlled FSP emission factor for tertiary crushing is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1
	Screening after the Tertiary Crushing Process	Emission from Screening after the Tertiary Crushing Process (g/s)			Handling rate (Mg/hr)	760	from engineer
	Source ID:	RSP	7.8111E-02	7.8111E-02	RSP emission factor (kg/Mg)	3.70E-04	wet suppression, controlled RSP emission factor for screening is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1
	SCP08, SCP09	FSP	5.2778E-03	5.2778E-03	FSP emission factor (kg/Mg)	2.50E-05	wet suppression, controlled FSP emission factor for screening is used, with reference to USEPA AP-42, Section 11.19.2, 8/04 ed, Table 11.19.2-1

	Total Processing Capacity (Mg/hr)
Proposed Crusher	800

Type of Vehicles	Full load Weight (US ton)	Net Weight (US ton)
Dump truck	39.67	15.43

Maximum Throughput of Crusher		
Aggregate type	Ratio of Loading	Mass of Loading (Mg/hr)
0-6mm	45.00%	360
6-12mm	15.00%	120
12-22mm	35.00%	280
22-37mm	4.00%	32
reject aggregate	1.00%	8

Remarks
Provided by project engineer

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Proposed Rock Processing Operation

Source ID	Schematic Diagram	Emission Point	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	Working Hour	RSP Emission Rate		FSP Emission Rate	
													Working hours	Non-working hours	Working hours	Non-working hours
SCP02	Rock Processing Operation (SK3041)	EP2	Feeder, Jaw Crusher and Screening	POINT	826828.46	824659.28	5.00	15.00	0	1.00	0.50	07:00 - 19:00	1.4318E-02	0.0000E+00	1.7134E-03	0.0000E+00
SCP04		EP4	Secondary Crushing	POINT	826841.59	824702.64	5.00	12.00	0	1.00	0.50	07:00 - 19:00	5.9400E-02	0.0000E+00	1.1000E-02	0.0000E+00
SCP05		EP5	Screening	POINT	826797.29	824671.15	5.00	12.00	0	1.00	0.50	07:00 - 19:00	8.1400E-02	0.0000E+00	5.5000E-03	0.0000E+00
SCP06		EP6	Tertiary Crushing	POINT	826838.59	824708.18	5.00	10.00	0	1.00	0.50	07:00 - 19:00	5.7000E-02	0.0000E+00	1.0556E-02	0.0000E+00
SCP07		EP7	Tertiary Crushing	POINT	826835.74	824712.61	5.00	10.00	0	1.00	0.50	07:00 - 19:00	5.7000E-02	0.0000E+00	1.0556E-02	0.0000E+00
SCP08		EP8	Screening	POINT	826795.07	824676.53	5.00	10.00	0	1.00	0.50	07:00 - 19:00	7.8111E-02	0.0000E+00	5.2778E-03	0.0000E+00
SCP09		EP9	Screening	POINT	826792.86	824681.28	5.00	10.00	0	1.00	0.50	07:00 - 19:00	7.8111E-02	0.0000E+00	5.2778E-03	0.0000E+00

Remarks:

1. Source parameters (exit temperature, velocity, stack diameter, and release height) are obtained from engineer.

2. Emission rate for Area source (g/s/m²) = Emission rate (g/s) / Area

Hourly Profile for SCP02, SCP04-09

Hour	SCP02, SCP04-09
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Stockpiles							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Rock Processing Operation	Aggregate Handling and Storage of Excavated and Imported Rock	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	0.55	from AP-42, Section 11.19.2, 8/04 ed., Table 11.19.2-1, Remark b
					Average wind speed, U (m/s)	2.24	mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	800	from engineer
					Area of Storage (m ²)	660.4	water spraying with sprinklers, with reference to USEPA AP-42 Section 11.19.1, Page 11.19.1-5, 11/95 ed.
					Dust removal efficiency (%)	90.0	
		RSP	1.18E-03	1.18E-04	RSP Particle size multiplier, k RSP emission factor, E (kg/Mg)	3.50E-01 3.50E-03	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		Source ID: Stkp01	1.78E-04	1.78E-05	FSP Particle size multiplier, k	5.30E-02	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP emission factor, E (kg/Mg)	5.30E-04	
Rock Processing Operation	Material handling of Rejects	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	0.55	from AP-42, Section 11.19.2, 8/04 ed., Table 11.19.2-1, Remark b
					Average wind speed, U (m/s)	2.24	mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	8	from engineer
					Area of Storage (m ²)	33.4	water spraying with sprinklers, with reference to USEPA AP-42 Section 11.19.1, Page 11.19.1-5, 11/95 ed.
					Dust removal efficiency (%)	90.0	
		RSP	2.33E-04	2.33E-05	RSP Particle size multiplier, k RSP emission factor, E (kg/Mg)	3.50E-01 3.50E-03	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		Source ID: Stkp03	3.52E-05	3.52E-06	FSP Particle size multiplier, k	5.30E-02	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP emission factor, E (kg/Mg)	5.30E-04	
Asphalt Production	Aggregate Handling and Storage of Excavated Rock	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	0.55	from AP-42, Section 11.19.2, 8/04 ed., Table 11.19.2-1, Remark b
					Average wind speed, U (m/s)	2.24	mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	440	from engineer
					Area of Storage (m ²)	619.7	water spraying with sprinklers, with reference to USEPA AP-42 Section 11.19.1, Page 11.19.1-5, 11/95 ed.
					Dust removal efficiency (%)	90.0	
		RSP	6.91E-04	6.91E-05	RSP Particle size multiplier, k RSP emission factor, E (kg/Mg)	3.50E-01 3.50E-03	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		Source ID: Stkp02	1.05E-04	1.05E-05	FSP Particle size multiplier, k	5.30E-02	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP emission factor, E (kg/Mg)	5.30E-04	

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Stockpiles							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Wok Tai Wan	Aggregate handling and storage at Stockpiles for Production	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	0.55	from AP-42, Section 11.19.2, 8/04 ed., Table 11.19.2-1, Remark b
					Average wind speed, U (m/s)	2.27	mean wind speed extracted from WRF (Grid 31,37)
					Loading rate of materials (Mg/hr)	600	from engineer
					Area of Storage (m ²)	400.0	
					Dust removal efficiency (%)	90.0	water spraying with sprinklers, with reference to USEPA AP-42 Section 11.19.1, Page 11.19.1-5, 11/95 ed.
		RSP	1.48E-03	1.48E-04	RSP Particle size multiplier, k RSP emission factor, E (kg/Mg)	3.50E-01 3.56E-03	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		Source ID: Stkp06	2.25E-04	2.25E-05	FSP Particle size multiplier, k	5.30E-02	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP emission factor, E (kg/Mg)	5.39E-04	
Wok Tai Wan	Aggregate handling and storage at Stockpiles for Production	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	0.55	from AP-42, Section 11.19.2, 8/04 ed., Table 11.19.2-1, Remark b
					Average wind speed, U (m/s)	2.27	mean wind speed extracted from WRF (Grid 31,37)
					Loading rate of materials (Mg/hr)	132	from engineer
					Area of Storage (m ²)	400	
					Dust removal efficiency (%)	90.0	water spraying with sprinklers, with reference to USEPA AP-42 Section 11.19.1, Page 11.19.1-5, 11/95 ed.
		RSP	3.26E-04	3.26E-05	RSP Particle size multiplier, k RSP emission factor, E (kg/Mg)	3.50E-01 3.56E-03	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		Source ID: Stkp07	4.94E-05	4.94E-06	FSP Particle size multiplier, k	5.30E-02	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP emission factor, E (kg/Mg)	5.39E-04	
Wok Tai Wan	Aggregate handling and storage at Stockpiles for Production	Spoil handling (g/s·m ²)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	0.55	from AP-42, Section 11.19.2, 8/04 ed., Table 11.19.2-1, Remark b
					Average wind speed, U (m/s)	2.27	mean wind speed extracted from WRF (Grid 31,37)
					Loading rate of materials (Mg/hr)	132	from engineer
					Area of Storage (m ²)	400	
					Dust removal efficiency (%)	90.0	water spraying with sprinklers, with reference to USEPA AP-42 Section 11.19.1, Page 11.19.1-5, 11/95 ed.
		RSP	3.26E-04	3.26E-05	RSP Particle size multiplier, k RSP emission factor, E (kg/Mg)	3.50E-01 3.56E-03	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		Source ID: Stkp08	4.94E-05	4.94E-06	FSP Particle size multiplier, k	5.30E-02	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP emission factor, E (kg/Mg)	5.39E-04	

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Stockpiles

Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Stockpiles	Wind Erosion	Wind Erosion (g/s·m ²)	1.275E-06		Emission Rate = Emission Factor*10^6/(10000*365*24*60*60)*(Percentage Active/100)		AP-42, 5th ed., Table 11.9.4
					TSP emission factor (Mg/hectare/yr)	0.85	
					Percentage area actively operating (%)	100	
					Emission height (m)	0.5	
		RSP			RSP emission factor (Mg/hectare/yr)	0.4021	
					% fraction of TSP	0.47	
	Source ID: Stkp01-05	FSP	1.941E-07		FSP emission factor (Mg/hectare/yr)	0.0612	from USEPA AP-42, 5th ed. 11/06 ed. S13.2.4
					% fraction of TSP	0.07	

Type of Vehicles	Full load Weight (ton)	Net Weight (ton)
Dump truck	36	14

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Stockpiles

Source ID	Schematic Diagram	Emission Point	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	No. of Vertices	Working Hour	RSP Emission Rate		FSP Emission Rate	
											Working hours	Non-working hours	Working hours	Non-working hours
Stkp01	Rock Processing Operation (SK3041)	EP1	Aggregate Stockpile	AREAPOLY	826756.97	824673.42	5.00	0.00	6	07:00 - 19:00	1.1910E-04	0.0000E+00	1.8037E-05	0.0000E+00
Stkp02			Aggregate Stockpile	AREAPOLY	826546.85	824547.64	5.00	0.00	6	00:00 - 24:00	7.0335E-05	0.0000E+00	1.0652E-05	0.0000E+00
Stkp03	Rock Processing Operation (SK3041)	EP3	Aggregate Stockpile	AREAPOLY	826824.66	824665.61	5.00	0.00	4	07:00 - 19:00	2.4552E-05	0.0000E+00	3.7189E-06	0.0000E+00
Stkp04			Aggregate Stockpile	AREAPOLY	826366.23	824088.74	6.00	0.00	6	00:00 - 24:00	1.2749E-06	0.0000E+00	1.9406E-07	0.0000E+00
Stkp05			Aggregate Stockpile	AREAPOLY	826325.27	824146.38	6.00	0.00	6	00:00 - 24:00	1.2749E-06	0.0000E+00	1.9406E-07	0.0000E+00
Stkp06			Aggregate Stockpile	AREAPOLY	826382.87	824112.60	6.00	0.00	4	07:00 - 19:00	1.4837E-04	0.0000E+00	2.2468E-05	0.0000E+00
Stkp07			Aggregate Stockpile	AREAPOLY	826430.11	824074.10	6.00	0.00	4	07:00 - 19:00	3.2642E-05	0.0000E+00	4.9429E-06	0.0000E+00
Stkp08			Aggregate Stockpile	AREAPOLY	826490.82	824012.72	6.00	0.00	4	07:00 - 19:00	3.2642E-05	0.0000E+00	4.9429E-06	0.0000E+00

Remarks:

1. Source parameters (exit temperature, velocity, stack diameter, and release height) are obtained from engineer.

2. Emission rate for Area source (g/s/m²) = Emission rate (g/s) / Area

Location of Vertices for AREAPOLY

Source ID	Vertex 1		Vertex 2		Vertex 3		Vertex 4		Vertex 5		Vertex 6	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
Stkp01	826756.97	824673.42	826762.99	824676.69	826770.05	824664.53	826787.83	824666.76	826795.68	824649.76	826783.78	824632.76
Stkp02	826546.85	824547.64	826561.37	824555.36	826565.29	824548.03	826591.96	824561.37	826597.32	824544.37	826549.99	824537.57
Stkp03	826824.66	824665.61	826823.99	824672.77	826828.62	824673.21	826829.29	824666.05				
Stkp04	826366.23	824088.74	826422.51	824093.67	826438.68	824061.41	826484.28	824044.68	826501.18	823963.79	826374.07	823958.96
Stkp05	826325.27	824146.38	826350.63	824149.58	826378.71	824114.07	826418.13	824103.80	826422.18	824093.81	826327.89	824085.66
Stkp06	826382.87	824112.60	826407.43	824106.43	826403.62	824091.27	826378.97	824097.12				
Stkp07	826430.11	824074.10	826443.39	824052.53	826430.08	824044.33	826416.52	824065.72				
Stkp08	826490.82	824012.72	826495.63	823987.85	826480.28	823984.89	826475.15	824009.69				

Hourly Profile for Stkp01, Stkp03

Hour	
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Hourly Profile for Stkp02

Hour	daily	annual
Hour 1	1.0000	0.4000
Hour 2	1.0000	0.4000
Hour 3	1.0000	0.4000
Hour 4	1.0000	0.4000
Hour 5	1.0000	0.4000
Hour 6	1.0000	0.4000
Hour 7	1.0000	0.4000
Hour 8	1.0000	0.4000
Hour 9	1.0000	0.4000
Hour 10	1.0000	0.4000
Hour 11	1.0000	0.4000
Hour 12	1.0000	0.4000
Hour 13	1.0000	0.4000
Hour 14	1.0000	0.4000
Hour 15	1.0000	0.4000
Hour 16	1.0000	0.4000
Hour 17	1.0000	0.4000
Hour 18	1.0000	0.4000
Hour 19	1.0000	0.4000
Hour 20	1.0000	0.4000
Hour 21	1.0000	0.4000
Hour 22	1.0000	0.4000
Hour 23	1.0000	0.4000
Hour 24	1.0000	0.4000

Hourly Profile for Stkp04-05

Hour	
Hour 1	1.0000
Hour 2	1.0000
Hour 3	1.0000
Hour 4	1.0000
Hour 5	1.0000
Hour 6	1.0000
Hour 7	1.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	1.0000
Hour 21	1.0000
Hour 22	1.0000
Hour 23	1.0000
Hour 24	1.0000

Hourly Profile for Stkp06-08

Hour	
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Daily estimation)						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
Ngau Kok Wan	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Width of the road (m) Dust removal efficiency (%)	 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	0700-1900				Average truck weight, W (tons) Number of trips per hour (trips/hr)	25 average of unladen and laden vehicles 258 incoming and outgoing vehicles
		RSP	1.4321E-03	1.1886E-04	RSP emission factor, E (g/VKT)	1.60E+02 by formula above
		FSP	3.4647E-04	2.8757E-05	FSP emission factor, E (g/VKT)	3.87E+01 by formula above
	0000-0700,1900-0000 ¹				Average truck weight, W (tons) Number of trips per hour (trips/hr)	13 average of unladen and laden vehicles for asphalt production 126 incoming and outgoing vehicles for asphalt production
		RSP	3.5598E-04	2.9546E-05	RSP emission factor, E (g/VKT)	8.14E+01 by formula above
	Source ID: HR01	FSP	8.6123E-05	7.14822E-06	FSP emission factor, E (g/VKT)	1.97E+01 by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)	 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 23 average of unladen and laden mixer trucks and PFA tanker 61 incoming and outgoing mixer trucks and PFA tanker to/from concrete batching operation 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	Source ID: HR02	RSP	3.0619E-04	2.5413E-05	RSP emission factor, E (g/VKT)	1.44E+02 by formula above
		FSP	7.4077E-05	6.1484E-06	FSP emission factor, E (g/VKT)	3.49E+01 by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)	 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 23 average of unladen and laden mixer trucks and PFA tanker 41 incoming and outgoing mixer trucks and PFA tanker to/from concrete batching operation 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	2.0412E-04	1.6942E-05	RSP emission factor, E (g/VKT)	1.44E+02 by formula above
	Source ID: HR03	FSP	4.9385E-05	4.0989E-06	FSP emission factor, E (g/VKT)	3.49E+01 by formula above

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Daily estimation)							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed.
	0700-1900				Average truck weight, W (tons) Number of trips per hour (trips/hr)	26 166	average of unladen and laden vehicles incoming and outgoing vehicles
		RSP	9.4360E-04	7.8319E-05	RSP emission factor, E (g/VKT)	1.64E+02	by formula above
		FSP	2.2829E-04	1.8948E-05	FSP emission factor, E (g/VKT)	3.96E+01	by formula above
	0000-0700,1900-0000 ¹				Average truck weight, W (tons) Number of trips per hour (trips/hr)	20 126	average of unladen and laden vehicles for asphalt production incoming and outgoing vehicles for asphalt production
	Source ID: HR04, HR15	RSP	5.5816E-04	4.6328E-05	RSP emission factor, E (g/VKT)	1.28E+02	by formula above
		FSP	1.3504E-04	1.1208E-05	FSP emission factor, E (g/VKT)	3.09E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed.
	0700-1900				Average truck weight, W (tons) Number of trips per hour (trips/hr)	28 70	average of unladen and laden dump trucks incoming and outgoing dump trucks
		RSP	4.2567E-04	3.5331E-05	RSP emission factor, E (g/VKT)	1.75E+02	by formula above
		FSP	1.0299E-04	8.5478E-06	FSP emission factor, E (g/VKT)	4.24E+01	by formula above
	0000-0700,1900-0000 ¹				Average truck weight, W (tons) Number of trips per hour (trips/hr)	16 40	average of unladen and laden vehicles for asphalt production incoming and outgoing vehicles for asphalt production
	Source ID: HR05-08	RSP	1.3745E-04	1.1408E-05	RSP emission factor, E (g/VKT)	9.90E+01	by formula above
		FSP	3.3254E-05	2.7601E-06	FSP emission factor, E (g/VKT)	2.39E+01	by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Daily estimation)										
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks			
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					RSP Particle size multiplier, k (g/VKT)	0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					FSP Particle size multiplier, k (g/VKT)	0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					Road surface silt loading, sL (g/m2)	12	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					Average truck weight, W (tons)	27	average of unladen and laden vehicles to/from asphalt production			
					Number of trips per hour (trips/hr)	126	incoming and outgoing vehicles to/from asphalt production			
					Width of the road (m)	8	from engineer			
					Dust removal efficiency (%)	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.			
					RSP	7.3943E-04	6.1372E-05	RSP emission factor, E (g/VKT)	1.69E+02	by formula above
					FSP	1.7889E-04	1.4848E-05	FSP emission factor, E (g/VKT)	4.09E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					RSP Particle size multiplier, k (g/VKT)	0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					FSP Particle size multiplier, k (g/VKT)	0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					Road surface silt loading, sL (g/m2)	12	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					Average truck weight, W (tons)	18	average of unladen and laden vehicles to/from ASP			
					Number of trips per hour (trips/hr)	86	incoming and outgoing vehicles to/from ASP			
					Width of the road (m)	8	from engineer			
					Dust removal efficiency (%)	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.			
					RSP	3.3609E-04	2.7896E-05	RSP emission factor, E (g/VKT)	1.13E+02	by formula above
					FSP	8.1312E-05	6.7489E-06	FSP emission factor, E (g/VKT)	2.72E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					RSP Particle size multiplier, k (g/VKT)	0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					FSP Particle size multiplier, k (g/VKT)	0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					Road surface silt loading, sL (g/m2)	12	from USEPA AP-42, Section 13.2.1, 01/11 ed.			
					Average truck weight, W (tons)	18	average of unladen and laden vehicles to/from asphalt production			
					Number of trips per hour (trips/hr)	86	incoming and outgoing vehicles to/from asphalt production			
					Width of the road (m)	8	from engineer			
					Dust removal efficiency (%)	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.			
					RSP	3.3609E-04	2.7896E-05	RSP emission factor, E (g/VKT)	1.13E+02	by formula above
					FSP	8.1312E-05	6.7489E-06	FSP emission factor, E (g/VKT)	2.72E+01	by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Daily estimation)							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed.
		RSP	3.3609E-04	2.7896E-05	RSP emission factor, E (g/VKT)	1.13E+02	0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 18 average of unladen and laden vehicles to/from asphalt production 86 incoming and outgoing vehicles to/from asphalt production 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		FSP	8.1312E-05	6.7489E-06	FSP emission factor, E (g/VKT)	2.72E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed.
		RSP	5.4542E-04	4.5270E-05	RSP emission factor, E (g/VKT)	1.38E+02	0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 22 average of unladen and laden vehicles to/from asphalt production 114 incoming and outgoing vehicles to/from asphalt production 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		FSP	1.3196E-04	1.0952E-05	FSP emission factor, E (g/VKT)	3.33E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed.
		RSP	2.0102E-03	1.6685E-04	RSP emission factor, E (g/VKT)	1.11E+02	0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 18 average of laden and unladen loader in rock processing operation 228 loaders in rock processing operation 3.5 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		FSP	4.8634E-04	4.0366E-05	FSP emission factor, E (g/VKT)	2.69E+01	by formula above
	Source ID: HR13						
	Source ID: HR14						
	Source ID: HR21						

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Daily estimation)

Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks	
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02		from USEPA AP-42, Section 13.2.1, 01/11 ed.	
	Aggregate Loaders in asphalt production				RSP Particle size multiplier, k (g/VKT)		0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.
					FSP Particle size multiplier, k (g/VKT)		0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.
					Road surface silt loading, sL (g/m2)		12	from USEPA AP-42, Section 13.2.1, 01/11 ed.
					Average truck weight, W (tons)		18	average of laden and unladen aggregate loaders in asphalt production
					Number of trips per hour (trips/hr)		168	aggregate loaders in asphalt production
					Width of the road (m)		3.5	from engineer
					Dust removal efficiency (%)		91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	Source ID: HR23	RSP	1.4812E-03	1.2294E-04	RSP emission factor, E (g/VKT)	1.11E+02	by formula above	
		FSP	3.5835E-04	2.9743E-05	FSP emission factor, E (g/VKT)	2.69E+01	by formula above	
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02		from USEPA AP-42, Section 13.2.1, 01/11 ed.	
					RSP Particle size multiplier, k (g/VKT)		0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.
					FSP Particle size multiplier, k (g/VKT)		0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.
					Road surface silt loading, sL (g/m2)		12	from USEPA AP-42, Section 13.2.1, 01/11 ed.
					Average truck weight, W (tons)		28	average of unladen and laden dump trucks to/from asphalt production
					Number of trips per hour (trips/hr)		40	incoming and outgoing dump trucks to/from asphalt production
					Width of the road (m)		20	from engineer
					Dust removal efficiency (%)		91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	Source ID: HR22	RSP	9.7297E-05	8.0756E-06	RSP emission factor, E (g/VKT)	1.75E+02	by formula above	
		FSP	2.3540E-05	1.9538E-06	FSP emission factor, E (g/VKT)	4.24E+01	by formula above	

Notes:
1- Traffic on HR01, HR04-08 and HR15 during 0000-0700 and 1900-0000 is due to vehicle movement for asphalt production, which has a 24-hour operation period.

Vehicle Movement for Rock Processing Operation

Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Loader	114	22.0	13.2

Vehicle Movement for Concrete Batching Operation

Type of Vehicles	No. of Vehicle per Hour	Full load Weight (US ton)	Net Weight (US ton)
Cement/PFA tanker	1	46.3	15.4
Mixer Truck	50	33.1	12.1

Vehicle Movement for Asphalt Production

Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Asphalt Truck	16	39.7	15.4
Bitumen Tanker	6	22.0	13.2
RAP Truck	21	39.7	15.4
Aggregate Loader	84	22.0	13.2
Filler Loader	2	22.0	13.2
RAP Loader	8	22.0	13.2
Foul Batch Loader	4	22.0	13.2
Dump truck	20	39.7	15.4

Vehicle movement from Quarry

Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Dump truck	15	39.7	15.4

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Daily Estimation)

Source ID	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	No. of Vertices	Szinit	Working Hour	RSP Emission Rate		FSP Emission Rate	
										Working hours	Non-working hours	Working hours	Non-working hours
HR01	paved haul road	AREAPOLY	826711.00	824588.93	5.00	3.31	4	3.07581	00:00 - 24:00	1.1886E-04	0.0000E+00	2.8757E-05	0.0000E+00
HR02	paved haul road	AREAPOLY	826743.10	824624.02	5.00	3.31	4	3.07581	07:00 - 19:00	2.5413E-05	0.0000E+00	6.1484E-06	0.0000E+00
HR03	paved haul road	AREAPOLY	826657.40	824605.22	5.00	3.31	4	3.07581	07:00 - 19:00	1.6942E-05	0.0000E+00	4.0989E-06	0.0000E+00
HR04	paved haul road	AREAPOLY	826700.88	824596.97	5.00	3.31	4	3.07581	00:00 - 24:00	7.8319E-05	0.0000E+00	1.8948E-05	0.0000E+00
HR05	paved haul road	AREAPOLY	826711.47	824597.88	5.00	3.31	4	3.07581	00:00 - 24:00	3.5331E-05	0.0000E+00	8.5478E-06	0.0000E+00
HR06	paved haul road	AREAPOLY	826755.63	824597.70	5.00	3.31	4	3.07581	00:00 - 24:00	3.5331E-05	0.0000E+00	8.5478E-06	0.0000E+00
HR07	paved haul road	AREAPOLY	826774.39	824623.21	5.00	3.31	4	3.07581	00:00 - 24:00	3.5331E-05	0.0000E+00	8.5478E-06	0.0000E+00
HR08	paved haul road	AREAPOLY	826764.86	824620.14	5.00	3.31	4	3.07581	00:00 - 24:00	3.5331E-05	0.0000E+00	8.5478E-06	0.0000E+00
HR12	paved haul road	AREAPOLY	826617.83	824606.29	5.00	3.31	4	3.07581	00:00 - 24:00	2.7896E-05	0.0000E+00	6.7489E-06	0.0000E+00
HR13	paved haul road	AREAPOLY	826605.78	824599.46	5.00	3.31	4	3.07581	00:00 - 24:00	2.7896E-05	0.0000E+00	6.7489E-06	0.0000E+00
HR14	paved haul road	AREAPOLY	826543.81	824564.28	5.00	3.31	4	3.07581	00:00 - 24:00	4.5270E-05	0.0000E+00	1.0952E-05	0.0000E+00
HR15	paved haul road	AREAPOLY	826675.72	824588.17	5.00	3.31	4	3.07581	00:00 - 24:00	7.8319E-05	0.0000E+00	1.8948E-05	0.0000E+00
HR16	paved haul road	AREAPOLY	826666.81	824585.05	5.00	3.31	4	3.07581	00:00 - 24:00	6.1372E-05	0.0000E+00	1.4848E-05	0.0000E+00
HR17	paved haul road	AREAPOLY	826634.49	824573.75	5.00	3.31	4	3.07581	00:00 - 24:00	6.1372E-05	0.0000E+00	1.4848E-05	0.0000E+00
HR18	paved haul road	AREAPOLY	826634.17	824574.09	5.00	3.31	4	3.07581	00:00 - 24:00	2.7896E-05	0.0000E+00	6.7489E-06	0.0000E+00
HR21	paved haul road	AREAPOLY	826791.46	824645.35	5.00	3.31	4	3.07581	07:00 - 19:00	1.6685E-04	0.0000E+00	4.0366E-05	0.0000E+00
HR22	paved haul road	AREAPOLY	826627.47	824566.90	5.00	3.31	4	3.07581	00:00 - 24:00	8.0756E-06	0.0000E+00	1.9538E-06	0.0000E+00
HR23	paved haul road	AREAPOLY	826584.91	824558.61	5.00	3.31	4	3.07581	00:00 - 24:00	1.2294E-04	0.0000E+00	2.9743E-05	0.0000E+00

Remarks:

1. release height = weighted average vehicle height *1.7 /2; initial vertical dimation = weighted avergae vehicle height *1.7/2.15

2. Emission rate for Area source (g/s/m²) = Emission rate (g/s) / Area

Location of Vertices for AREAPOLY

Source ID	Vertex 1		Vertex 2		Vertex 3		Vertex 4	
	X	Y	X	Y	X	Y	X	Y
HR01	826711.00	824588.93	826701.59	824589.38	826702.04	824598.04	826711.40	824597.46
HR02	826743.10	824624.02	826747.42	824616.40	826707.37	824593.67	826703.05	824601.29
HR03	826657.40	824605.22	826664.82	824609.06	826675.72	824588.17	826668.19	824584.37
HR04	826700.88	824596.97	826703.70	824588.92	826678.54	824580.12	826675.72	824588.17
HR05	826711.47	824597.88	826757.48	824595.72	826757.06	824586.97	826711.06	824589.13
HR06	826755.63	824597.70	826778.43	824601.64	826779.96	824592.76	826757.17	824588.82
HR07	826774.39	824623.21	826781.36	824601.15	826772.77	824598.43	826765.80	824620.49
HR08	826764.86	824620.14	826738.45	824667.18	826746.64	824671.78	826773.06	824624.74
HR12	826617.83	824606.29	826622.77	824597.59	826610.72	824590.76	826605.78	824599.46
HR13	826605.78	824599.46	826610.76	824590.68	826548.79	824555.51	826543.81	824564.28
HR14	826543.81	824564.28	826548.66	824555.74	826530.98	824545.70	826526.13	824554.25
HR15	826675.72	824588.17	826678.55	824580.07	826669.64	824576.95	826666.81	824585.05
HR16	826666.81	824585.05	826669.60	824577.07	826637.29	824565.76	826634.49	824573.75
HR17	826634.49	824573.75	826637.42	824565.40	826628.82	824562.39	826625.90	824570.75
HR18	826634.17	824574.09	826625.43	824570.33	826614.92	824594.73	826623.66	824598.50
HR21	826791.46	824645.35	826816.91	824660.52	826821.48	824652.86	826796.03	824637.69
HR22	826627.47	824566.90	826630.58	824559.63	826598.36	824545.87	826595.26	824553.13
HR23	826584.91	824558.61	826579.14	824573.66	826586.81	824576.50	826592.61	824561.33

Hourly Profile	no vehicles of asphalt production
Hour	HR02-HR03, HR21
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Hourly Profile	vehicles of asphalt production
Hour	HR12-HR14, HR16-HR18,HR22-HR23
Hour 1	1.0000
Hour 2	1.0000
Hour 3	1.0000
Hour 4	1.0000
Hour 5	1.0000
Hour 6	1.0000
Hour 7	1.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	1.0000
Hour 21	1.0000
Hour 22	1.0000
Hour 23	1.0000
Hour 24	1.0000

Hourly Profile	vehicles of all ancillary operations
Hour	HR01
Hour 1	0.2486
Hour 2	0.2486
Hour 3	0.2486
Hour 4	0.2486
Hour 5	0.2486
Hour 6	0.2486
Hour 7	0.2486
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.2486
Hour 21	0.2486
Hour 22	0.2486
Hour 23	0.2486
Hour 24	0.2486

Appendix 4.2 Calculation of Emission Rates from Project

Hourly Profile	vehicles of all ancillary operations
Hour	HR04&HR15
Hour 1	0.5915
Hour 2	0.5915
Hour 3	0.5915
Hour 4	0.5915
Hour 5	0.5915
Hour 6	0.5915
Hour 7	0.5915
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.5915
Hour 21	0.5915
Hour 22	0.5915
Hour 23	0.5915
Hour 24	0.5915

Hourly Profile	vehicles of all ancillary operations
Hour	HR05-HR08
Hour 1	0.3229
Hour 2	0.3229
Hour 3	0.3229
Hour 4	0.3229
Hour 5	0.3229
Hour 6	0.3229
Hour 7	0.3229
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.3229
Hour 21	0.3229
Hour 22	0.3229
Hour 23	0.3229
Hour 24	0.3229

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Annual Estimation)							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Ngau Kok Wan	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	0700-1900				Average truck weight, W (tons) Number of trips per hour (trips/hr)	25 172	average of unladen and laden vehicles incoming and outgoing vehicles
		RSP	9.3741E-04	7.7805E-05	RSP emission factor, E (g/VKT)	1.57E+02	by formula above
		FSP	2.2679E-04	1.8824E-05	FSP emission factor, E (g/VKT)	3.79E+01	by formula above
	0000-0700,1900-0000 ¹				Average truck weight, W (tons) Number of trips per hour (trips/hr)	8 50	average of unladen and laden vehicles for asphalt production incoming and outgoing vehicles for asphalt production
		RSP	8.4466E-05	7.01064E-06	RSP emission factor, E (g/VKT)	4.83E+01	by formula above
	Source ID: HR01	FSP	2.0435E-05	1.69612E-06	FSP emission factor, E (g/VKT)	1.17E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 23 average of unladen and laden mixer trucks and PFA tanker 55 incoming and outgoing mixer trucks and PFA tanker to/from concrete batching operation 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	2.7557E-04	2.2872E-05	RSP emission factor, E (g/VKT)	1.44E+02	by formula above
	Source ID: HR02	FSP	6.6670E-05	5.5336E-06	FSP emission factor, E (g/VKT)	3.49E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)		from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 23 average of unladen and laden mixer trucks and PFA tanker 37 incoming and outgoing mixer trucks and PFA tanker to/from concrete batching operation 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	1.8371E-04	1.5248E-05	RSP emission factor, E (g/VKT)	1.44E+02	by formula above
	Source ID: HR03	FSP	4.4446E-05	3.6891E-06	FSP emission factor, E (g/VKT)	3.49E+01	by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Annual Estimation)						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Width of the road (m) Dust removal efficiency (%)	from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	0700-1900				Average truck weight, W (tons) Number of trips per hour (trips/hr)	25 average of unladen and laden vehicles 86 incoming and outgoing vehicles
		RSP	4.7953E-04	3.9801E-05	RSP emission factor, E (g/VKT)	1.60E+02 by formula above
		FSP	1.1602E-04	9.6293E-06	FSP emission factor, E (g/VKT)	3.87E+01 by formula above
	0000-0700,1900-0000 ¹				Average truck weight, W (tons) Number of trips per hour (trips/hr)	16 average of unladen and laden vehicles for asphalt production 50 incoming and outgoing vehicles for asphalt production
	Source ID: HR04, HR15	RSP	1.7068E-04	1.4167E-05	RSP emission factor, E (g/VKT)	9.75E+01 by formula above
		FSP	4.1294E-05	3.4274E-06	FSP emission factor, E (g/VKT)	2.36E+01 by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Width of the road (m) Dust removal efficiency (%)	from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
	0700-1900				Average truck weight, W (tons) Number of trips per hour (trips/hr)	28 average of unladen and laden dump trucks 46 incoming and outgoing dump trucks
		RSP	2.7973E-04	2.3217E-05	RSP emission factor, E (g/VKT)	1.75E+02 by formula above
		FSP	6.7676E-05	5.6171E-06	FSP emission factor, E (g/VKT)	4.24E+01 by formula above
	0000-0700,1900-0000 ¹				Average truck weight, W (tons) Number of trips per hour (trips/hr)	10 average of unladen and laden vehicles for asphalt production 16 incoming and outgoing vehicles for asphalt production
	Source ID: HR05-08	RSP	3.3135E-05	2.7502E-06	RSP emission factor, E (g/VKT)	5.96E+01 by formula above
		FSP	8.0165E-06	6.6537E-07	FSP emission factor, E (g/VKT)	1.44E+01 by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Annual Estimation)											
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks				
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					RSP Particle size multiplier, k (g/VKT)	0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					FSP Particle size multiplier, k (g/VKT)	0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					Road surface silt loading, sL (g/m2)	12	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					Average truck weight, W (tons)	27	average of unladen and laden vehicles to/from asphalt production				
					Number of trips per hour (trips/hr)	50	incoming and outgoing vehicles to/from asphalt production				
					Width of the road (m)	8	from engineer				
					Dust removal efficiency (%)	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.				
					Source ID: HR16-17	RSP	2.9577E-04	2.4549E-05	RSP emission factor, E (g/VKT)	1.69E+02	by formula above
						FSP	7.1557E-05	5.9393E-06	FSP emission factor, E (g/VKT)	4.09E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					RSP Particle size multiplier, k (g/VKT)	0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					FSP Particle size multiplier, k (g/VKT)	0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					Road surface silt loading, sL (g/m2)	12	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					Average truck weight, W (tons)	18	average of unladen and laden vehicles to/from ASP				
					Number of trips per hour (trips/hr)	34	incoming and outgoing vehicles to/from ASP				
					Width of the road (m)	8	from engineer				
					Dust removal efficiency (%)	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.				
					Source ID: HR18	RSP	1.3444E-04	1.1158E-05	RSP emission factor, E (g/VKT)	1.13E+02	by formula above
						FSP	3.2525E-05	2.6996E-06	FSP emission factor, E (g/VKT)	2.72E+01	by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					RSP Particle size multiplier, k (g/VKT)	0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					FSP Particle size multiplier, k (g/VKT)	0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					Road surface silt loading, sL (g/m2)	12	from USEPA AP-42, Section 13.2.1, 01/11 ed.				
					Average truck weight, W (tons)	18	average of unladen and laden vehicles to/from asphalt production				
					Number of trips per hour (trips/hr)	34	incoming and outgoing vehicles to/from asphalt production				
					Width of the road (m)	8	from engineer				
					Dust removal efficiency (%)	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.				
					Source ID: HR12	RSP	1.3444E-04	1.1158E-05	RSP emission factor, E (g/VKT)	1.13E+02	by formula above
						FSP	3.2525E-05	2.6996E-06	FSP emission factor, E (g/VKT)	2.72E+01	by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Annual Estimation)						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)	from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 18 average of unladen and laden vehicles to/from asphalt production 34 incoming and outgoing vehicles to/from asphalt production 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	1.3444E-04	1.1158E-05	RSP emission factor, E (g/VKT)	1.13E+02 by formula above
		FSP	3.2525E-05	2.6996E-06	FSP emission factor, E (g/VKT)	2.72E+01 by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)	from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 22 average of unladen and laden vehicles to/from asphalt production 46 incoming and outgoing vehicles to/from asphalt production 8 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	2.1817E-04	1.8108E-05	RSP emission factor, E (g/VKT)	1.38E+02 by formula above
		FSP	5.2782E-05	4.3809E-06	FSP emission factor, E (g/VKT)	3.33E+01 by formula above
	Paved Haul Road	Paved Haul Road (g/s·m ²)			Emission factor (g/VKT) = k*(sL)^0.91*(W)^1.02 RSP Particle size multiplier, k (g/VKT) FSP Particle size multiplier, k (g/VKT) Road surface silt loading, sL (g/m2) Average truck weight, W (tons) Number of trips per hour (trips/hr) Width of the road (m) Dust removal efficiency (%)	from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.62 from USEPA AP-42, Section 13.2.1, 01/11 ed. 0.15 from USEPA AP-42, Section 13.2.1, 01/11 ed. 12 from USEPA AP-42, Section 13.2.1, 01/11 ed. 18 average of laden and unladen loader in rock processing operation 228 loaders in rock processing operation 3.5 from engineer 91.7 watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	2.0102E-03	1.6685E-04	RSP emission factor, E (g/VKT)	1.11E+02 by formula above
		FSP	4.8634E-04	4.0366E-05	FSP emission factor, E (g/VKT)	2.69E+01 by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Annual Estimation)										
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks			
	Paved Haul Road	Paved Haul Road			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.			
	Aggregate Loaders in asphalt production	(g/s·m ²)			RSP Particle size multiplier, k (g/VKT)		0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.		
					FSP Particle size multiplier, k (g/VKT)		0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.		
					Road surface silt loading, sL (g/m2)		12	from USEPA AP-42, Section 13.2.1, 01/11 ed.		
					Average truck weight, W (tons)		18	average of laden and unladen aggregate loaders in asphalt production		
					Number of trips per hour (trips/hr)		67	aggregate loaders in asphalt production		
					Width of the road (m)		3.5	from engineer		
					Dust removal efficiency (%)		91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.		
	Source ID: HR23	RSP	5.9248E-04	4.9176E-05	RSP emission factor, E (g/VKT)	1.11E+02	by formula above			
		FSP	1.4334E-04	1.1897E-05	FSP emission factor, E (g/VKT)	2.69E+01	by formula above			
	Paved Haul Road	Paved Haul Road			Emission factor (g/VKT) = $k \cdot (sL)^{0.91} \cdot (W)^{1.02}$		from USEPA AP-42, Section 13.2.1, 01/11 ed.			
		(g/s·m ²)			RSP Particle size multiplier, k (g/VKT)		0.62	from USEPA AP-42, Section 13.2.1, 01/11 ed.		
					FSP Particle size multiplier, k (g/VKT)		0.15	from USEPA AP-42, Section 13.2.1, 01/11 ed.		
					Road surface silt loading, sL (g/m2)		12	from USEPA AP-42, Section 13.2.1, 01/11 ed.		
					Average truck weight, W (tons)		28	average of unladen and laden dump trucks to/from asphalt production		
					Number of trips per hour (trips/hr)		16	incoming and outgoing dump trucks to/from asphalt production		
					Width of the road (m)		20	from engineer		
					Dust removal efficiency (%)		91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.		
	Source ID: HR22	RSP	3.8919E-05	3.2303E-06	RSP emission factor, E (g/VKT)	1.75E+02	by formula above			
		FSP	9.4158E-06	7.8151E-07	FSP emission factor, E (g/VKT)	4.24E+01	by formula above			

Notes:
1- Traffic on HR01, HR04-08 and HR15 during 0000-0700 and 1900-0000 is due to vehicle movement for asphalt production, which has a 24-hour operation period.

Vehicle Movement for Rock Processing Operation			
Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Loader	114	22.0	13.2

Vehicle Movement for Concrete Batching Operation			
Type of Vehicles	No. of Vehicle per Hour	Full load Weight (US ton)	Net Weight (US ton)
Cement/PFA tanker	0.9	46.3	15.4
Mixer Truck	45	33.1	12.1

Vehicle Movement for Asphalt Production			
Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Asphalt Truck	6.4	39.7	15.4
Bitumen Tanker	2.4	22.0	13.2
RAP Truck	8.4	39.7	15.4
Aggregate Loader	33.6	22.0	13.2
Filler Loader	0.8	22.0	13.2
RAP Loader	3.2	22.0	13.2
Foul Batch Loader	1.6	22.0	13.2
Dump truck	8	39.7	15.4

Vehicle movement from Quarry			
Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Dump truck	15	39.7	15.4

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Proposed Paved Surface Haul Roads assessing Ancillary Operations (Annual estimation)

Source ID	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	No. of Vertices	Szinit	Working Hour	RSP Emission Rate		FSP Emission Rate	
										Working hours	Non-working hours	Working hours	Non-working hours
HR01	paved haul road	AREAPOLY	826711.00	824588.93	5.00	3.31	4	3.07581	00:00 - 24:00	7.7805E-05	0.0000E+00	1.8824E-05	0.0000E+00
HR02	paved haul road	AREAPOLY	826743.10	824624.02	5.00	3.31	4	3.07581	07:00 - 19:00	2.2872E-05	0.0000E+00	5.5336E-06	0.0000E+00
HR03	paved haul road	AREAPOLY	826657.40	824605.22	5.00	3.31	4	3.07581	07:00 - 19:00	1.5248E-05	0.0000E+00	3.6891E-06	0.0000E+00
HR04	paved haul road	AREAPOLY	826700.88	824596.97	5.00	3.31	4	3.07581	00:00 - 24:00	3.9801E-05	0.0000E+00	9.6293E-06	0.0000E+00
HR05	paved haul road	AREAPOLY	826711.47	824597.88	5.00	3.31	4	3.07581	00:00 - 24:00	2.3217E-05	0.0000E+00	5.6171E-06	0.0000E+00
HR06	paved haul road	AREAPOLY	826755.63	824597.70	5.00	3.31	4	3.07581	00:00 - 24:00	2.3217E-05	0.0000E+00	5.6171E-06	0.0000E+00
HR07	paved haul road	AREAPOLY	826774.39	824623.21	5.00	3.31	4	3.07581	00:00 - 24:00	2.3217E-05	0.0000E+00	5.6171E-06	0.0000E+00
HR08	paved haul road	AREAPOLY	826764.86	824620.14	5.00	3.31	4	3.07581	00:00 - 24:00	2.3217E-05	0.0000E+00	5.6171E-06	0.0000E+00
HR12	paved haul road	AREAPOLY	826617.83	824606.29	5.00	3.31	4	3.07581	00:00 - 24:00	1.1158E-05	0.0000E+00	2.6996E-06	0.0000E+00
HR13	paved haul road	AREAPOLY	826605.78	824599.46	5.00	3.31	4	3.07581	00:00 - 24:00	1.1158E-05	0.0000E+00	2.6996E-06	0.0000E+00
HR14	paved haul road	AREAPOLY	826543.81	824564.28	5.00	3.31	4	3.07581	00:00 - 24:00	1.8108E-05	0.0000E+00	4.3809E-06	0.0000E+00
HR15	paved haul road	AREAPOLY	826675.72	824588.17	5.00	3.31	4	3.07581	00:00 - 24:00	3.9801E-05	0.0000E+00	9.6293E-06	0.0000E+00
HR16	paved haul road	AREAPOLY	826666.81	824585.05	5.00	3.31	4	3.07581	00:00 - 24:00	2.4549E-05	0.0000E+00	5.9393E-06	0.0000E+00
HR17	paved haul road	AREAPOLY	826634.49	824573.75	5.00	3.31	4	3.07581	00:00 - 24:00	2.4549E-05	0.0000E+00	5.9393E-06	0.0000E+00
HR18	paved haul road	AREAPOLY	826634.17	824574.09	5.00	3.31	4	3.07581	00:00 - 24:00	1.1158E-05	0.0000E+00	2.6996E-06	0.0000E+00
HR21	paved haul road	AREAPOLY	826791.46	824645.35	5.00	3.31	4	3.07581	07:00 - 19:00	1.6685E-04	0.0000E+00	4.0366E-05	0.0000E+00
HR22	paved haul road	AREAPOLY	826627.47	824566.90	5.00	3.31	4	3.07581	00:00 - 24:00	3.2303E-06	0.0000E+00	7.8151E-07	0.0000E+00
HR23	paved haul road	AREAPOLY	826584.91	824558.61	5.00	3.31	4	3.07581	00:00 - 24:00	4.9176E-05	0.0000E+00	1.1897E-05	0.0000E+00

Remarks:

1. release height = weighted average vehicle height *1.7 /2; initial vertical dimation = weighted avergae vehicle height *1.7/2.15

2. Emission rate for Area source (g/s/m²) = Emission rate (g/s) / Area

Location of Vertices for AREAPOLY

Source ID	Vertex 1		Vertex 2		Vertex 3		Vertex 4	
	X	Y	X	Y	X	Y	X	Y
HR01	826711.00	824588.93	826701.59	824589.38	826702.04	824598.04	826711.40	824597.46
HR02	826743.10	824624.02	826747.42	824616.40	826707.37	824593.67	826703.05	824601.29
HR03	826657.40	824605.22	826664.82	824609.06	826675.72	824588.17	826668.19	824584.37
HR04	826700.88	824596.97	826703.70	824588.92	826678.54	824580.12	826675.72	824588.17
HR05	826711.47	824597.88	826757.48	824595.72	826757.06	824586.97	826711.06	824589.13
HR06	826755.63	824597.70	826778.43	824601.64	826779.96	824592.76	826757.17	824588.82
HR07	826774.39	824623.21	826781.36	824601.15	826772.77	824598.43	826765.80	824620.49
HR08	826764.86	824620.14	826738.45	824667.18	826746.64	824671.78	826773.06	824624.74
HR12	826617.83	824606.29	826622.77	824597.59	826610.72	824590.76	826605.78	824599.46
HR13	826605.78	824599.46	826610.76	824590.68	826548.79	824555.51	826543.81	824564.28
HR14	826543.81	824564.28	826548.66	824555.74	826530.98	824545.70	826526.13	824554.25
HR15	826675.72	824588.17	826678.55	824580.07	826669.64	824576.95	826666.81	824585.05
HR16	826666.81	824585.05	826669.60	824577.07	826637.29	824565.76	826634.49	824573.75
HR17	826634.49	824573.75	826637.42	824565.40	826628.82	824562.39	826625.90	824570.75
HR18	826634.17	824574.09	826625.43	824570.33	826614.92	824594.73	826623.66	824598.50
HR21	826791.46	824645.35	826816.91	824660.52	826821.48	824652.86	826796.03	824637.69
HR22	826627.47	824566.90	826630.58	824559.63	826598.36	824545.87	826595.26	824553.13
HR23	826584.91	824558.61	826579.14	824573.66	826586.81	824576.50	826592.61	824561.33

Hourly Profile	no vehicles of asphalt production
Hour	HR02-HR03, HR21
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Hourly Profile	vehicles of asphalt production
Hour	HR12-HR14, HR16-HR18,HR22-HR23
Hour 1	1.0000
Hour 2	1.0000
Hour 3	1.0000
Hour 4	1.0000
Hour 5	1.0000
Hour 6	1.0000
Hour 7	1.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	1.0000
Hour 21	1.0000
Hour 22	1.0000
Hour 23	1.0000
Hour 24	1.0000

Hourly Profile	vehicles of all ancillary operations
Hour	HR01
Hour 1	0.0901
Hour 2	0.0901
Hour 3	0.0901
Hour 4	0.0901
Hour 5	0.0901
Hour 6	0.0901
Hour 7	0.0901
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0901
Hour 21	0.0901
Hour 22	0.0901
Hour 23	0.0901
Hour 24	0.0901

Appendix 4.2 Calculation of Emission Rates from Project

Hourly Profile	vehicles of all ancillary operations
Hour	HR04&HR15
Hour 1	0.3559
Hour 2	0.3559
Hour 3	0.3559
Hour 4	0.3559
Hour 5	0.3559
Hour 6	0.3559
Hour 7	0.3559
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.3559
Hour 21	0.3559
Hour 22	0.3559
Hour 23	0.3559
Hour 24	0.3559

Hourly Profile	vehicles of all ancillary operations
Hour	HR05-HR08
Hour 1	0.1185
Hour 2	0.1185
Hour 3	0.1185
Hour 4	0.1185
Hour 5	0.1185
Hour 6	0.1185
Hour 7	0.1185
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.1185
Hour 21	0.1185
Hour 22	0.1185
Hour 23	0.1185
Hour 24	0.1185

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Quarry							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Quarry	Quarrying	Blasting (g/s)			Emission Rate (kg/blast) = 0.00022 (Horizontal Area)^1.5		from USEPA AP-42, 10/98 ed., Section 11.9
					Blasting Face Area (m ²)	200	from Engineer
					Blast per day	1	from Engineer
					Blast in 1 hour	1	Maximum number of blast in 1 hour
					Blasting period of the day	12:00-15:00	12:00 - 15:00 from Engineer. 12:00 - 13:00 is assumed as conservative case
					% of dust suppression	91.7	by watering
					TSP emission factor (kg/blast)	6.22E-01	by formula above
		RSP	8.988E-02	7.460E-03	% fraction of RSP	0.52	from USEPA AP-42, 10/98 ed., Section 11.9, Table 11.9-2
		FSP	5.185E-03	4.304E-04	% fraction of FSP	0.03	from USEPA AP-42, 10/98 ed., Section 11.9, Table 11.9-2
		Spoil Handling (g/s)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4		from USEPA AP-42, 11/06ed., Section 13.2.4
					Particle size mutiplier for TSP, k	0.74	from USEPA AP-42, 11/06 ed., Section 13.2.4
					Particle size mutiplier for RSP, k	0.35	from USEPA AP-42, 11/06 ed., Section 13.2.4
					Particle size mutiplier for FSP, k	0.053	from USEPA AP-42, 11/06 ed., Section 13.2.4
					Material moisture content, M (%)	0.7	for crushed limestone from USEPA AP-42, 11/06 ed., Table 13.2.4-1
					Average wind speed, U (m/s)	0.1	Assume minimum wind speed inside the tunnel
					Maximum Spoil Handling Rate (Mg/hr)	260	from engineer
					% of dust suppression	91.7	by watering
		RSP	3.162E-03	2.625E-04	RSP emission factor (kg/Mg)	4.38E-05	by formula above
		FSP	4.789E-04	3.975E-05	FSP emission factor (kg/Mg)	6.63E-06	by formula above
		Unpaved Haul Road inside Cavern (g/s)			Emission factor (g/VKT) = k*(s/12)^a*(W/3)^b*281.9		from USEPA AP-42, 11/06ed., Section 13.2.2
		Dump Truck			Surface Material Silt Content, s (%)	10	for plant road of Stone quarrying, from Table 13.2.2-1, AP-42, 11/06 ed.
					Mean Vehicle Weight, W (US ton)	27.6	Average value of full load weight and net weight of truck provided by Engineer
					Number of Vehicle per hour	15	from engineer
					Travelling Distance (m) per vehicle	2600	round-trip from portal to blasting area
					% of dust suppression	91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.
		RSP	1.054E+01	8.752E-01	Particle Size Multiplier for RSP, k	1.5	from USEPA AP-42, 11/06 ed., Table 13.2.2-2
					a	0.9	
					b	0.45	
					RSP emission factor (g/vehicle-meter-travelled)	0.973	by formula above
		FSP	1.054E+00	8.752E-02	Particle Size Multiplier for FSP, k	0.15	from USEPA AP-42, 11/06 ed., Table 13.2.2-2
					a	0.9	
					b	0.45	
					FSP emission factor (g/vehicle-meter-travelled)	0.097	by formula above

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Quarry	Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks				
Quarry		Unpaved Haul Road inside cavern (g/s) Other vehicles to Ngau Kok Wan from Tam Kon Shan				Emission factor (g/VKT) = $k \cdot (s/12)^a \cdot (W/3)^b \cdot 281.9$		from USEPA AP-42, 11/06ed., Section 13.2.2				
						Surface Material Silt Content, s (%)		10	for plant road of Stone quarrying, from Table 13.2.2-1, AP-42, 11/06 ed.			
						Mean Vehicle Weight, W (US ton)		19.8	Average value of incoming vehicles			
						Number of Vehicle per hour		94	from engineer			
						Travelling Distance (m) per vehicle		734	from Tam Kon Shan portal to Ngau Kok Wan Portal			
						% of dust suppression		91.7	watering every hour, the removal efficiency estimated based on USEPA Control of Open Fugitive dust sources (EPA-450/3-88-008), 9/92 ed, in recent EIA studies are 91.7%.			
						RSP		1.609E+01	1.336E+00	Particle Size Multiplier for RSP, k	1.5	from USEPA AP-42, 11/06 ed., Table 13.2.2-2
									a	0.9		
									b	0.45		
									RSP emission factor (g/vehicle-meter-travelled)	0.840	by formula above	
						FSP		1.609E+00	1.336E-01	Particle Size Multiplier for FSP, k	0.15	from USEPA AP-42, 11/06 ed., Table 13.2.2-2
		a	0.9									
		b	0.45									
		FSP emission factor (g/vehicle-meter-travelled)	0.084	by formula above								
Quarry	Exhaust from Portal	Source ID: BP01, BP02	Subtotal (g/s)			% of dust suppression		85	to be treated by dust filter at exhaust			
			During Blasting ¹									
			RSP			4.415E-01		6.622E-02		from 12:00 to 13:00		
			FSP			4.400E-02		6.599E-03		from 12:00 to 13:00		
			Non-Blasting ²									
			RSP			1.106E+00		1.658E-01		Working hours other than blasting hour		
			FSP			1.106E-01		1.658E-02		Working hours other than blasting hour		

Notes:
1- Emisisons during blasting hour include emisissions from blasting, spoil handling and emisissions from dump trucks on unpaved haul road inside cavern. The emissions are equally distributed to the two portals.
2- Emisissions during non-blasting hour include emisissions from spoil handling and emisissions from dump trucks, and other vehicles to Ngau Kok Wan from Tam Kon Shan, on unpaved haul road inside cavern. The emissions are equally distributed to the two portals.

Vehicles in Quarry			
Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Dump truck	15	39.67	15.43

Vehicle for Concrete Batching Operation			
Type of Vehicles	No. of Vehicle per Hour	Full load Weight (US ton)	Net Weight (US ton)
Cement/PFA tanker	1	46.3	15.4
Mixer Truck	50	33.1	12.1

Vehicles for Asphalt Production			
Type of Vehicles	No. of Trips per Hour	Full load Weight (US ton)	Net Weight (US ton)
Asphalt Truck	16	39.7	15.4
Bitumen Tanker	6	22.0	13.2
RAP Truck	21	39.7	15.4

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Proposed Quarry

Portal Exhaust

Source ID	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	Syinit	Szinit	Working Hour	RSP Emission Rate (g/s)		FSP Emission Rate (g/s)	
										Working hours	Non-working hours	Working hours	Non-working hours
BP01	Portal Exhaust	VOLUME	826740.38	824570.05	5.00	5.00	3.72	4.65	07:00 - 19:00	1.6583E-01	0.0000E+00	1.6584E-02	0.0000E+00
BP02	Portal Exhaust	VOLUME	826782.15	824574.10	5.00	5.00	3.72	4.65	07:00 - 19:00	1.6583E-01	0.0000E+00	1.6584E-02	0.0000E+00

Remarks:

- Source parameters (exit temperature, velocity, stack diameter, and release height) are obtained from engineer.

Hourly Profile for BP01-BP02

Hour	RSP	FSP
Hour 1	0.0000	0.0000
Hour 2	0.0000	0.0000
Hour 3	0.0000	0.0000
Hour 4	0.0000	0.0000
Hour 5	0.0000	0.0000
Hour 6	0.0000	0.0000
Hour 7	0.0000	0.0000
Hour 8	1.0000	1.0000
Hour 9	1.0000	1.0000
Hour 10	1.0000	1.0000
Hour 11	1.0000	1.0000
Hour 12	1.0000	1.0000
Hour 13	0.3993	0.3979
Hour 14	1.0000	1.0000
Hour 15	1.0000	1.0000
Hour 16	1.0000	1.0000
Hour 17	1.0000	1.0000
Hour 18	1.0000	1.0000
Hour 19	1.0000	1.0000
Hour 20	0.0000	0.0000
Hour 21	0.0000	0.0000
Hour 22	0.0000	0.0000
Hour 23	0.0000	0.0000
Hour 24	0.0000	0.0000

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Quarry
Vehicular emisison from cavern haul road (portal emission)

Description	No. of Portal Sources	No. of Volume Sources	Hour	Total Emission Rate				Emission Rate (1st - 3rd Volume Sources)				Emission Rate (the 4th Volume Source)				Emission Rate (the 5th - 7th Volume Sources)			
				NO	NO2	RSP	FSP	NO	NO2	RSP	FSP	NO	NO2	RSP	FSP	NO	NO2	RSP	FSP
				(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)
Vehicular Emission on Cavern Haul Road	2	7 for each of the 2 portal sources	0000-0100	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0100-0200	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0200-0300	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0300-0400	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0400-0500	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0500-0600	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0600-0700	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0700-0800	1.8815E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			0800-0900	1.8815E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			0900-1000	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1000-1100	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1100-1200	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6978E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1200-1300	6.9988E-02	1.5974E-02	2.6159E-03	2.4067E-03	6.6655E-03	1.5214E-03	2.4913E-04	2.2921E-04	4.9991E-03	1.1410E-03	1.8685E-04	1.7191E-04	3.3327E-03	7.6068E-04	1.2457E-04	1.1461E-04
			1300-1400	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1400-1500	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1500-1600	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1600-1700	1.8815E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7919E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9597E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1700-1800	1.8816E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1800-1900	1.8815E-01	4.2945E-02	7.0326E-03	6.4703E-03	1.7920E-02	4.0900E-03	6.6977E-04	6.1622E-04	1.3440E-02	3.0675E-03	5.0233E-04	4.6216E-04	8.9598E-03	2.0450E-03	3.3489E-04	3.0811E-04
			1900-2000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			2000-2100	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			2100-2200	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			2200-2300	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			2300-0000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Remark
1. 2/3 of the total emission from the portal is distributed to the sources at the first 50m and 1/3 of the total emission is distributed to the source at the second 50m. The middle volume source (the 4th volume source) wouldhave an average emission rate of a volume source in the first half of the portal source length and the second half of the portal source length

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Proposed Quarry

Vehicular emissison from cavern haul road (portal emission)

										RSP Emission Rate (g/s)		FSP Emission Rate (g/s)		NO Emission Rate (g/s)		NO2 Emission Rate (g/s)	
Source ID	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	Syinit	Szinit	Working Hour	Working hours	Non-working hours	Working hours	Non-working hours	Working hours	Non-working hours	Working hours	Non-working hours
V101	Portal Emission	VOLUME	826739.22	824577.69	5.00	5.00	7.44	4.65	07:00 - 19:00	6.6977E-04	0.0000E+00	6.1622E-04	0.0000E+00	1.7920E-02	0.0000E+00	4.0900E-03	0.0000E+00
V102	Portal Emission	VOLUME	826736.44	824593.24	5.00	5.00	7.44	4.65	07:00 - 19:00	6.6977E-04	0.0000E+00	6.1622E-04	0.0000E+00	1.7920E-02	0.0000E+00	4.0900E-03	0.0000E+00
V103	Portal Emission	VOLUME	826733.99	824608.95	5.00	5.00	7.44	4.65	07:00 - 19:00	6.6977E-04	0.0000E+00	6.1622E-04	0.0000E+00	1.7920E-02	0.0000E+00	4.0900E-03	0.0000E+00
V104	Portal Emission	VOLUME	826731.42	824624.79	5.00	5.00	7.44	4.65	07:00 - 19:00	5.0233E-04	0.0000E+00	4.6216E-04	0.0000E+00	1.3440E-02	0.0000E+00	3.0675E-03	0.0000E+00
V105	Portal Emission	VOLUME	826728.60	824640.36	5.00	5.00	7.44	4.65	07:00 - 19:00	3.3489E-04	0.0000E+00	3.0811E-04	0.0000E+00	8.9598E-03	0.0000E+00	2.0450E-03	0.0000E+00
V106	Portal Emission	VOLUME	826725.75	824655.68	5.00	5.00	7.44	4.65	07:00 - 19:00	3.3489E-04	0.0000E+00	3.0811E-04	0.0000E+00	8.9598E-03	0.0000E+00	2.0450E-03	0.0000E+00
V107	Portal Emission	VOLUME	826722.67	824671.21	5.00	5.00	7.44	4.65	07:00 - 19:00	3.3489E-04	0.0000E+00	3.0811E-04	0.0000E+00	8.9598E-03	0.0000E+00	2.0450E-03	0.0000E+00
V201	Portal Emission	VOLUME	826780.97	824582.31	5.00	5.00	7.44	4.65	07:00 - 19:00	6.6977E-04	0.0000E+00	6.1622E-04	0.0000E+00	1.7920E-02	0.0000E+00	4.0900E-03	0.0000E+00
V202	Portal Emission	VOLUME	826778.17	824598.16	5.00	5.00	7.44	4.65	07:00 - 19:00	6.6977E-04	0.0000E+00	6.1622E-04	0.0000E+00	1.7920E-02	0.0000E+00	4.0900E-03	0.0000E+00
V203	Portal Emission	VOLUME	826775.49	824613.98	5.00	5.00	7.44	4.65	07:00 - 19:00	6.6977E-04	0.0000E+00	6.1622E-04	0.0000E+00	1.7920E-02	0.0000E+00	4.0900E-03	0.0000E+00
V204	Portal Emission	VOLUME	826772.86	824629.36	5.00	5.00	7.44	4.65	07:00 - 19:00	5.0233E-04	0.0000E+00	4.6216E-04	0.0000E+00	1.3440E-02	0.0000E+00	3.0675E-03	0.0000E+00
V205	Portal Emission	VOLUME	826770.22	824645.22	5.00	5.00	7.44	4.65	07:00 - 19:00	3.3489E-04	0.0000E+00	3.0811E-04	0.0000E+00	8.9598E-03	0.0000E+00	2.0450E-03	0.0000E+00
V206	Portal Emission	VOLUME	826767.65	824660.89	5.00	5.00	7.44	4.65	07:00 - 19:00	3.3489E-04	0.0000E+00	3.0811E-04	0.0000E+00	8.9598E-03	0.0000E+00	2.0450E-03	0.0000E+00
V207	Portal Emission	VOLUME	826765.15	824676.61	5.00	5.00	7.44	4.65	07:00 - 19:00	3.3489E-04	0.0000E+00	3.0811E-04	0.0000E+00	8.9598E-03	0.0000E+00	2.0450E-03	0.0000E+00

Remarks:

1. Dimension of portals are obtained from engineer.

Hourly Profile

Hour	
Hour 1	0.0000
Hour 2	0.0000
Hour 3	0.0000
Hour 4	0.0000
Hour 5	0.0000
Hour 6	0.0000
Hour 7	0.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	0.3720
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	0.0000
Hour 21	0.0000
Hour 22	0.0000
Hour 23	0.0000
Hour 24	0.0000

Appendix 4.2
Calculation of Emission Rates from Project

Tsing Yi North Underground Quarry
Summary of Cavern Haul Road Segments

Road Name	Road ID	X coordinate of endpoint 1	Y coordinate of endpoint 1	X coordinate of endpoint 2	Y coordinate of endpoint 2	Grid (I,J)	Vehicle height	Release height	Szinit	Width	Elevation
		(m)	(m)	(m)	(m)		(m)	(mAG)	(m)	(m)	(m)
Cavern Haul Road 1	C101	827249.16	824629.04	827196.51	824585.45	31,38	3.9	3.3	3.1	22.0	34.0
Cavern Haul Road 1	C102	827196.51	824585.45	827178.43	824494.92	31,38	3.9	3.3	3.1	22.0	61.0
Cavern Haul Road 1	C103	827178.43	824494.92	826808.49	824435.08	31,38	3.9	3.3	3.1	22.0	90.0
Cavern Haul Road 2	C201	826808.49	824435.08	826782.15	824574.10	31,38	3.9	3.3	3.1	22.0	44.0
Cavern Haul Road 3	C301	826808.49	824435.08	826764.56	824426.77	31,38	3.9	3.3	3.1	22.0	82.0
Cavern Haul Road 4	C401	826764.56	824426.77	826740.38	824570.05	31,38	3.9	3.3	3.1	22.0	49.0
Cavern Haul Road 5	C501	826764.56	824426.77	826678.02	824414.40	31,38 31,37	3.9	3.3	3.1	22.0	93.0
Cavern Haul Road 5	C502	826678.02	824414.40	826704.48	824250.61	31,37	3.9	3.3	3.1	22.0	114.0
Cavern Haul Road 5	C503	826704.48	824250.61	826783.67	824262.88	31,37	3.9	3.3	3.1	22.0	130.0
Cavern Haul Road 5	C504	826783.67	824262.88	826811.56	824095.57	31,37	3.9	3.3	3.1	22.0	133.0
Cavern Haul Road 5	C505	826811.56	824095.57	827247.67	824169.19	31,37	3.9	3.3	3.1	22.0	193.0
Cavern Haul Road 5	C506	827247.67	824169.19	827405.69	824225.91	32,37	3.9	3.3	3.1	22.0	159.0
Cavern Haul Road 5	C507	827405.69	824225.91	827399.01	824268.06	32,37	3.9	3.3	3.1	22.0	106.0

Appendix 4.2 Calculation of Emission Rates from Project

Tsing Yi North Underground Quarry
Summary of Meteorological Data

Grid (I,J)	Hour	Annual Minimum		Month Minimum																							
		Temperature	RH	January		February		March		April		May		June		July		August		September		October		November		December	
				Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH
Custom	0000-0100	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0100-0200	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0200-0300	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0300-0400	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0400-0500	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0500-0600	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0600-0700	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0700-0800	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0800-0900	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	0900-1000	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1000-1100	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1100-1200	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1200-1300	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1300-1400	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1400-1500	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1500-1600	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1600-1700	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1700-1800	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1800-1900	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	1900-2000	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	2000-2100	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	2100-2200	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	2200-2300	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16
Custom	2300-0000	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16	9	16

Appendix 4.2 Calculation of Emission Rates from Project

Tsing Yi North Underground Quarry
Summary of Meteorological Data

Grid (I,J)	Hour	Month Average																							
		January		February		March		April		May		June		July		August		September		October		November		December	
		Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH	Temperature	RH
Custom	0000-0100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0100-0200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0200-0300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0300-0400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0400-0500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0500-0600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0600-0700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0700-0800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0800-0900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	0900-1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1000-1100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1100-1200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1200-1300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1300-1400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1400-1500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1500-1600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1600-1700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1700-1800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1800-1900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	1900-2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	2000-2100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	2100-2200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	2200-2300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Custom	2300-0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 4.2 Calculation of Emission Rates from Project

Traffic Data / Modeling Parameters For AERMOD (Cavern Haul Roads, Year 2028)

Road Name	Road ID	Speed Limit (km/hr)	Average Speed (km/hr)	Start Emission Estimated by Broad Brush Approach (Y/N)	Hour	Total Vehicles (Veh/hr)	01 - Private Cars	02 - Taxi	03 - Light Goods Vehicles <=2.5t	04 - Light Goods Vehicles 2.5-3.5t	05 - Light Goods Vehicles > 3.5t	06 - Medium Goods Vehicles <=15t	07 - Medium Goods Vehicles 15-24t	08 - Public Light Buses	09 - Private Light Bus <=3.5t	10 - Private Light Bus >3.5t	11 - Non-franchised Bus <=6.4t	12 - Non-franchised Bus 6.4-15t	13 - Non-franchised Bus 15-24t	14 - Franchise d Bus Single Deck	15 - Franchise d Bus Double Deck	16 - Motorcycl es	17 - Heavy Goods Vehicles > 24t	18 - Non-franchised Bus >24t	Total
							PC	TAXI	LGV3	LGV4	LGV6	HGV7	HGV8	PLB	PV4	PV5	NFB6	NFB7	NFB8	FBSD	FBDD	MC	HGV9	NFB9	
Cavern Haul Road 1	C1	8	8.0	N	0000-0100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0100-0200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0200-0300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0300-0400	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0400-0500	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0500-0600	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0600-0700	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0700-0800	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0800-0900	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	0900-1000	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1000-1100	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1100-1200	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1200-1300	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1300-1400	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1400-1500	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1500-1600	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1600-1700	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1700-1800	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1800-1900	94	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	1900-2000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	2000-2100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	2100-2200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	2200-2300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 1	C1	8	8.0	N	2300-0000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0000-0100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0100-0200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0200-0300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0300-0400	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0400-0500	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0500-0600	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0600-0700	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0700-0800	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0800-0900	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	0900-1000	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1000-1100	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1100-1200	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1200-1300	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1300-1400	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1400-1500	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1500-1600	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1600-1700	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1700-1800	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1800-1900	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	1900-2000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	2000-2100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	2100-2200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	2200-2300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 2	C2	8	8.0	N	2300-0000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%

Appendix 4.2 Calculation of Emission Rates from Project

Traffic Data / Modeling Parameters For AERMOD (Cavern Haul Roads, Year 2028)

Road Name	Road ID	Speed Limit (km/hr)	Average Speed (km/hr)	Start Emission Estimated by Broad Brush Approach (Y/N)	Hour	Total Vehicles (Veh/hr)	01 - Private Cars	02 - Taxi	03 - Light Goods Vehicles <=2.5t	04 - Light Goods Vehicles 2.5-3.5t	05 - Light Goods Vehicles> 3.5t	06 - Medium Goods Vehicles< =15t	07 - Medium Goods Vehicles1 5-24t	08 - Public Light Buses	09 - Private Light Bus <=3.5t	10 - Private Light Bus >3.5t	11 - Non-franchised Bus<=6.4t	12 - Non-franchised Bus 6.4-15t	13 - Non-franchised Bus 15-24t	14 - Franchise d Bus Single Deck	15 - Franchise d Bus Double Deck	16 - Motorcycl es	17 - Heavy Goods Vehicles> 24t	18 - Non-franchised Bus >24t	Total
							PC	TAXI	LGV3	LGV4	LGV6	HGV7	HGV8	PLB	PV4	PV5	NFB6	NFB7	NFB8	FBSD	FBDD	MC	HGV9	NFB9	
Cavern Haul Road 3	C3	8	8.0	N	0000-0100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0100-0200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0200-0300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0300-0400	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0400-0500	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0500-0600	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0600-0700	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0700-0800	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0800-0900	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	0900-1000	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1000-1100	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1100-1200	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1200-1300	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1300-1400	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1400-1500	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1500-1600	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1600-1700	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1700-1800	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1800-1900	47	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	1900-2000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	2000-2100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	2100-2200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	2200-2300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 3	C3	8	8.0	N	2300-0000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0000-0100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0100-0200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0200-0300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0300-0400	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0400-0500	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0500-0600	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0600-0700	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0700-0800	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0800-0900	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	0900-1000	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1000-1100	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1100-1200	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1200-1300	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1300-1400	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1400-1500	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1500-1600	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1600-1700	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1700-1800	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1800-1900	77	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	1900-2000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	2000-2100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	2100-2200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	2200-2300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 4	C4	8	8.0	N	2300-0000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%

Appendix 4.2 Calculation of Emission Rates from Project

Traffic Data / Modeling Parameters For AERMOD (Cavern Haul Roads, Year 2028)

Road Name	Road ID	Speed Limit (km/hr)	Average Speed (km/hr)	Start Emission Estimated by Broad Brush Approach (Y/N)	Hour	Total Vehicles (Veh/hr)	01 - Private Cars	02 - Taxi	03 - Light Goods Vehicles <=2.5t	04 - Light Goods Vehicles 2.5-3.5t	05 - Light Goods Vehicles> 3.5t	06 - Medium Goods Vehicles< =15t	07 - Medium Goods Vehicles1 5-24t	08 - Public Light Buses	09 - Private Light Bus <=3.5t	10 - Private Light Bus >3.5t	11 - Non-franchised Bus<=6.4t	12 - Non-franchised Bus 6.4-15t	13 - Non-franchised Bus 15-24t	14 - Franchise d Bus Single Deck	15 - Franchise d Bus Double Deck	16 - Motorcycl es	17 - Heavy Goods Vehicles> 24t	18 - Non-franchised Bus >24t	Total
							PC	TAXI	LGV3	LGV4	LGV6	HGV7	HGV8	PLB	PV4	PV5	NFB6	NFB7	NFB8	FBSD	FBDD	MC	HGV9	NFB9	
Cavern Haul Road 5	C5	8	8.0	N	0000-0100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0100-0200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0200-0300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0300-0400	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0400-0500	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0500-0600	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0600-0700	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0700-0800	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0800-0900	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	0900-1000	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1000-1100	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1100-1200	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1200-1300	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1300-1400	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1400-1500	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1500-1600	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1600-1700	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1700-1800	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1800-1900	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	1900-2000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	2000-2100	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	2100-2200	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	2200-2300	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Cavern Haul Road 5	C5	8	8.0	N	2300-0000	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%

Appendix 4.2 Calculation of Emission Rates from Project

Particle Size Distribution of Process

Aggregate Handling, Storage Pile and Quarrying		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 2.5	1.25	7%	15%	100%
2.5 - 5.0	3.75	20%	42%	-
5.0 - 10.0	7.50	20%	43%	-
10.0 - 15.0	12.50	18%	-	-
15.0 - 30.0	22.50	35%	-	-

Remark: Dervied from aerodynamic particle size multiplier (k) of Section 13.2.4, 11/06 ed., AP-42, USEPA

Unloading Aggregate to Hopper (Controlled by Water Spray)		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 2.5	1.25	18%	23%	100%
2.5 - 10.0	6.25	59%	77%	-
10.0 - 30.0	20.00	22%	-	-

Remark: Derived from the emission factors estimated from Section 13.2.4, 11/06 ed., AP-42, USEPA

RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)

Source	Uncontrolled Emission Factor (kg/Mg)		Controlled Emission Factor (kg/Mg)		Uncontrolled RSP-to-TSP Ratio	Controlled RSP-to-TSP Ratio
	TSP	RSP	TSP	RSP		
Cement unloading to elevated storage silo (pneumatic)	0.36	0.24	0.00050	0.00017	0.6667	0.3400
Cement supplement unloading to elevated storage silo (pneumatic)	1.57	0.65	0.0045	0.0024	0.4140	0.5333
Weigh hopper loading	0.0026	0.0013	-	-	0.5000	-
Mixer loading (central mix)	0.286	0.078	0.0092	0.0028	0.2727	0.3043

Remark:

(a) Reference from Table 11.12-1 Emission Factors for Concrete Batching, Chapter 11.12 Concrete Batching, AP-42, USEPA (Version 01/12)

Particle Size Distribution of General Concrete Batching Process (Controlled by Fabric Filter)

Particale Size Range ^a	Average Partical Size ^a	% before Removal ^a	Removal Efficiency % ^b	% after Removal	Normalised Fraction ^c	Normalised Fraction for PM10 ^{c, d}
≤ 1.0	0.50	4	99.0%	0.04	7%	12%
1.0 - 2.0	1.50	7	99.0%	0.07	12%	21%
2.0 - 2.5	2.25	4	99.0%	0.04	7%	12%
2.5 - 3.0	2.75	3	99.5%	0.015	3%	5%
3.0 - 4.0	3.50	7	99.5%	0.035	6%	11%
4.0 - 5.0	4.50	5	99.5%	0.025	4%	8%
5.0 - 6.0	5.50	4	99.5%	0.02	3%	6%
6.0 - 10	8.00	17	99.5%	0.085	15%	26%
10 - 30	20.00	49	99.5%	0.245	43%	-

Remark:

(a) Derived from Table B.2.2 "Description of Particle Size Categories" for Category 3 "Mechanically Generated Aggregate, Unprocessed Ores", Page B.2-13 of Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95) (see below)

(b) Control efficiency of fabric filter on different size of particle refers to Table B.2-3 Typical Collection Efficiencies of Various Particulate Control Device, Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95) (see below)

(c) Normalised Fraction = % after normal of each particale size range / sum of % after removal of all particle size ranges

(d) Sum of normalissed fraction maintains 100% in air dispersion model by applying percentage in 6 decimal places.

Appendix 4.2 Calculation of Emission Rates from Project
Particle Size Distribution of Process

<u>Dust collector on Cement Silo / Cement Supplement Silo</u>		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 1.0	0.50	N/A	12%	27%
1.0 - 2.0	1.50	N/A	21%	47%
2.0 - 2.5	2.25	N/A	12%	27%
2.5 - 3.0	2.75	N/A	5%	-
3.0 - 4.0	3.50	N/A	11%	-
4.0 - 5.0	4.50	N/A	8%	-
5.0 - 6.0	5.50	N/A	6%	-
6.0 - 10	8.00	N/A	26%	-
10.0 - 30.0	20.00	N/A	-	-

Remark:

(a) Size distribution for RSP refers to Normalised Fraction for PM10 of Table "Particle Size Distribution of General Concrete Batching Process (Controlled by Fabric Filter)"

<u>Dust collector on Mixer & Weigh Hoppers</u>		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 1.0	0.50	N/A	12%	27%
1.0 - 2.0	1.50	N/A	21%	47%
2.0 - 2.5	2.25	N/A	12%	27%
2.5 - 3.0	2.75	N/A	5%	-
3.0 - 4.0	3.50	N/A	11%	-
4.0 - 5.0	4.50	N/A	8%	-
5.0 - 6.0	5.50	N/A	6%	-
6.0 - 10	8.00	N/A	26%	-
10.0 - 30.0	20.00	N/A	-	-

Remark:

(a) Size distribution for RSP refers to Normalised Fraction for PM10 of Table "Particle Size Distribution of General Concrete Batching Process (Controlled by Fabric Filter)"

<u>Unloading of Unfragmented Stone</u>		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 1.0	0.50	4%	8%	27%
1.0 - 2.0	1.50	7%	14%	47%
2.0 - 2.5	2.25	4%	8%	27%
2.5 - 3.0	2.75	3%	6%	-
3.0 - 4.0	3.50	7%	14%	-
4.0 - 5.0	4.50	5%	10%	-
5.0 - 6.0	5.50	4%	8%	-
6.0 - 10	8.00	17%	33%	-
10 - 30	20.00	49%	-	-

Remark:

(a) Reference from Table B.2.2 "Description of Particle Size Categories" for Category 3 "Mechanically Generated Aggregate, Unprocessed Ores", Page B.2-13 of Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95)

Appendix 4.2 Calculation of Emission Rates from Project

Particle Size Distribution of Process

Crushing (Primary, Secondary, Tertiary)		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 2.5	1.25	N/A	19%	100%
2.5 - 10	6.25	N/A	81%	-
10 - 30	20	N/A	-	-

Remark:
(a) Derived from Table 11.19.2-1, Section 11.19, 8/04 ed., AP-42, USEPA
(b) With reference to the note n of above Table 11.19.2-1 AP-42, emission factor for tertiary crusher is used as an upper limit for primary and secondary crushing

Screening (Primary, Secondary, Tertiary)		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 2.5	1.25	N/A	7%	100%
2.5 - 10	6.25	N/A	93%	-
10 - 30	20	N/A	-	-

Remark:
(a) Derived from Table 11.19.2-1, Section 11.19, 8/04 ed., AP-42, USEPA
(b) With reference to the note n of above Table 11.19.2-1 AP-42, emission factor for tertiary crusher is used as an upper limit for primary and secondary crushing

Batch Mix Dryer, Hot Screen and mixer (Fabric Filter)		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 1	0.5	N/A	76.9%	91%
1 - 2.5	1.75	N/A	7.7%	9%
2.5 - 5	3.75	N/A	7.7%	-
5 - 10	7.5	N/A	7.7%	-
10 - 15	12.5	N/A	-	-

Remark: Derived from Table 11.1-2, Section 11.1, 3/04 ed., AP-42, USEPA

Appendix 4.2 Calculation of Emission Rates from Project
Particle Size Distribution of Process

Industial Boiler FIRING DISTILLATE OIL (Uncontrolled)		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 0.625	0.3125	N/A	4%	17%
0.625 - 1	0.8125	N/A	12%	50%
1 - 1.25	1.125	N/A	2%	8%
1.25 - 2.5	1.875	N/A	6%	25%
2.5 - 6	4.25	N/A	36%	-
6 - 10	8	N/A	40%	-
10 - 15	12.5	N/A	-	-

Remark: Derived from Table 1.3-6, Section 1.3, 5/10 ed., AP-42, USEPA

Paved Haul Road		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 2.5	1.25	N/A	24%	100%
2.5 - 10	6.25	N/A	76%	-
10 - 15	12.5	N/A	-	-
15 - 30	22.5	N/A	-	-

Remark: Derived from Table 13.2.1-1, Section 13.2.1, 1/11 ed., AP-42, USEPA

Unpaved Haul Road		for TSP	for RSP	for FSP
Particale Size Range	Average Partical Size	Percentage	Percentage	Percentage
≤ 2.5	1.25	N/A	10%	100%
2.5 - 10	6.25	N/A	90%	-
10 - 30	30	N/A	-	-

Remark: Derived from Page 13.2.2-4, Section 13.2.2, 11/06 ed., AP-42, USEPA

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Asphalt Production						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
Asphalt Production	Loading of Aggregate to Cold Aggregate Hopper	Spoil handling (g/s.m2)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					RSP Particle size multiplier, k	0.35 from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP Particle size multiplier, k	0.05 from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	6 from design engineer with reference to typical asphalt production
					Average wind speed, U (m/s)	2.24 mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	90 from design engineer
					Area of storage (m ²)	39.1
					Dust Suppression Efficiency for PM (6 - 10µm)	90
					Dust Suppression Efficiency for PM (2.5 - 6µm)	65
					Dust Suppression Efficiency for PM (0 - 2.5µm)	40
		RSP		3.0668E-05	RSP emission factor, E (kg/Mg)	1.23E-04 by formula above
		FSP		7.1842E-06	FSP emission factor, E (kg/Mg)	1.87E-05 by formula above
					Mitigated PM(2.5 - 10µm) emission factor (kg/Mg)	3.67E-05
					Mitigated PM(2.5) emission factor (kg/Mg)	1.12E-05
	Source ID: AP01				Mitigated PM(2.5 - 10µm) emission rate (g/s)	9.18E-04
					Mitigated PM(2.5) emission rate (g/s)	2.81E-04
Asphalt Production	Dust Emission System	Spoil handling at 5 enclosed virgin aggregate silos (g/s)			Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4	from USEPA AP-42 Section 13.2.4, 11/06 ed.
					RSP Particle size multiplier, k	0.35 from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP Particle size multiplier, k	0.05 from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	6 from design engineer with reference to typical asphalt production
					Average wind speed, U (m/s)	2.24 mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	90 from design engineer
					Dust Suppression Efficiency for PM (6 - 10µm)	90
					Dust Suppression Efficiency for PM (2.5 - 6µm)	65
					Dust Suppression Efficiency for PM (0 - 2.5µm)	40
		RSP		1.1984E-03	RSP emission factor, E (kg/Mg)	1.23E-04 by formula above
		FSP		2.8073E-04	FSP emission factor, E (kg/Mg)	1.87E-05 by formula above
					Mitigated PM(2.5 - 10µm) emission factor (kg/Mg)	3.67E-05
					Mitigated PM(2.5) emission factor (kg/Mg)	1.12E-05
					Mitigated PM(2.5 - 10µm) emission rate (g/s)	9.18E-04
					Mitigated PM(2.5) emission rate (g/s)	2.81E-04
	Source ID: AP02	Dust Collector 1 on Recovered Filler Silo			TSP emission factor (mg/m3)	9 from design engineer
		Exhaust from Dust Collector (g/s)			Flow Rate (m3/hr)	14000 from design engineer
						The process is fully enclosed, thus exhaust emission is the only emission
		RSP		1.8667E-02	Ratio RSP to TSP (Controlled)	0.53 Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		8.4848E-03	Ratio FSP to RSP (Controlled)	0.45 Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo"

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Asphalt Production							
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters		Remarks
Asphalt Production	Dust Emission System Source ID: AP02	Dust Collector 2 on Mineral Filler Silo Exhaust from Dust Collector (g/s)			TSP emission factor (mg/m3)	9	from design engineer
					Flow Rate (m3/hr)	14000	from design engineer
							The process is fully enclosed, thus exhaust emission is the only emission
		RSP		1.8667E-02	Ratio RSP to TSP (Controlled)	0.53	Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)"
		FSP		8.4848E-03	Ratio FSP to RSP (Controlled)	0.45	Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo"
	Exhaust from Dryer Drum and Mixing Tower - Connected Dryer, Hot Screens and Mixer (g/s)				Processing Capacity (Mg/hr)	208	from design engineer
		RSP		7.8000E-01	RSP emission factor (kg/Mg)	1.35E-02	Total PM-10 emission factor for Fabric Filter is used because the exhaust from dryer drum and mixing tower is connected to baghouse, with reference to USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-1.
		FSP		7.3378E-01	FSP emission factor (kg/Mg)	1.27E-02	Total PM-2.5 is the sum of filterable PM-2.5 (USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-2), condensable inorganic PM and condensable organic PM (USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-1). Figures for Fabric Filter are used because the exhaust from dryer drum and mixing tower is connected to baghouse
	Fuel Oil Combustion in Dryer, Hot Screens and Mixer (g/s)				Sulphur content by weight (%)	1.00E-03	Ultra-low-sulfur diesel (ULSD) is used in industrial and its fuel sulphur content is at ≤ 0.001% w/w, with reference to EPD
					Maximum fuel consumption rate (L/hr)	1867	from design engineer
		RSP	6.2227E-02	6.2227E-02	RSP emission factor (g/L)	1.20E-01	from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-6
		FSP	1.5557E-02	1.5557E-02	FSP emission factor (g/L)	3.00E-02	from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-6
		SO ₂		8.8362E-03	SO ₂ emission factor (g/L)	1.70E-02	from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-1
		NO _x	1.2445E+00	1.2445E+00	NO _x emission factor (g/L)	2.40E+00	from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-1

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Asphalt Production						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
Asphalt Production	Dust Emission System Source ID: AP02	Truck Load out from Hot Mix Silo - Connected to the Baghouse Batch mix plant load-out (g/s)			Emission factor (kg/Mg) = $(0.000181 + 0.00141(-V)^{((0.0251)(T+ 460) - 20.43)})^{*0.5}$	from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
					Asphalt volatility, V	-0.5 Default value, from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
					HMA mix temperature, T (°F)	325 Default value, from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
					Loading rate of materials (Mg/hr)	208 from design engineer
		RSP	1.5078E-02	1.5078E-02		Total PM is assumed to be predominantly PM-2.5 since emissions consist of condensed vapors, with reference to USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
		FSP	1.5078E-02	1.5078E-02	FSP emission factor (kg/Mg)	2.61E-04 from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
		Fuel Oil Combustion in the Bitumen Heating System (g/s)			Sulphur content by weight (%)	1.00E-03 Ultra-low-sulfur diesel (ULSD) is used in industrial and its fuel sulphur content is at ≤ 0.001% w/w, with reference to EPD
					Maximum fuel consumption rate (L/hr)	164.1 from design engineer
		RSP	5.4716E-03	5.4716E-03	RSP emission factor (kg/1000L)	1.20E-01 from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-6
		FSP	1.3679E-03	1.3679E-03	FSP emission factor (kg/1000L)	3.00E-02 from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-6
		SO ₂		7.7696E-04	SO ₂ emission factor (kg/1000L)	1.70E-02 from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-1
		NO _x	1.0943E-01	1.0943E-01	NO _x emission factor (kg/1000L)	2.40E+00 from USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-1
		Sub-total			Removal efficiency by SCR (%)	80 mean SCR efficiency, from USEPA AP-42, section 1.3, 5/10 ed, pp. 1.3-8
					Removal efficiency by filter (%)	99.0 from design engineer
		RSP		9.0131E-03		
		FSP		7.8303E-03		
		SO ₂		9.6131E-03		
		NO _x		2.7079E-01		

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Asphalt Production						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
Asphalt Production	Loading of RAP and Rejected Aggregate to Storage and Hopper inside RAP storage area	Exhaust from Dust Collector				
	Source ID: AP03	TSP RSP FSP		1.2500E-02 6.6667E-03 3.0303E-03	TSP emission factor (mg/m3) Flow Rate (m3/hr) Ratio RSP to TSP (Controlled) Ratio FSP to RSP (Controlled)	9 from design engineer 5000 from design engineer 0.53 Refer to Table "RSP-to-TSP Ratio of Concrete Batching Process (by Emission Factors)" shown on P. 30 of Appendix 6.1 0.45 Refer to Table "Dust collector on Cement Silo / Cement Supplement Silo" shown on P. 31 of Appendix 6.1
	Aggregate unloading at Aggregate Reject Bin	Spoil handling (g/s·m²)				
	Source ID: AP04	RSP FSP		5.8426E-04 1.3686E-04	Emission Factor (kg/Mg) = k*(0.0016)*(U/2.2)^1.3/(M/2)^1.4 RSP Particle size multiplier, k FSP Particle size multiplier, k Moisture content, M (%) Average wind speed, U (m/s) Unloading rate of aggregate (Mg/hr) Area of storage (m²) Dust Suppression Efficiency for PM (6 - 10µm) Dust Suppression Efficiency for PM (2.5 - 6µm) Dust Suppression Efficiency for PM (0 - 2.5µm) RSP emission factor, E (kg/Mg) FSP emission factor, E (kg/Mg) Mitigated PM(2.5 - 10µm) emission factor (kg/Mg) Mitigated PM(2.5) emission factor (kg/Mg) Mitigated PM(2.5 - 10µm) emission rate (g/s) Mitigated PM(2.5) emission rate (g/s)	from USEPA AP-42 Section 13.2.4, 11/06 ed. 0.35 from USEPA AP-42 Section 13.2.4, 11/06 ed. 0.05 from USEPA AP-42 Section 13.2.4, 11/06 ed. 1 from design engineer 2.24 mean wind speed extracted from WRF (Grid 31,38) 9.0 from design engineer 2.5 from engineer 90 for dust suppression by water sprays 65 from Table B.2.3, Appendix B.2, USEPA AP-42 40 1.52E-03 by formula above 2.30E-04 by formula above 4.50E-04 1.38E-04 1.13E-03 3.45E-04

Appendix 4.2
Calculation of Emission Rates from Project

Proposed Asphalt Production						
Location	Source	Emission Rates	Unmitigated	Mitigated	Parameters	Remarks
Asphalt Production	Load-out to Foul Batch Hopper	Batch mix plant load-out			Emission factor = $0.000181 + 0.00141(-V)e^{((0.0251)(T+460) - 20.43)}$	from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
		(g/s·m²)			Asphalt volatility, V	-0.5 Default value, from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
					HMA mix temperature, T (°F)	325 Default value, from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
					Loading rate of materials (Mg/hr)	2 from design engineer
	Source ID: AP05				Area of storage (m²)	2.5 from engineer
		RSP	5.9834E-05	5.9834E-05		Total PM is assumed to be predominantly PM-2.5 since emissions consist of condensed vapors, with reference to USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
		FSP	5.9834E-05	5.9834E-05	FSP emission factor (kg/Mg)	2.61E-04 from USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-14
	Loading of aggregate to dump trucks	Spoil handling			Emission Factor (kg/Mg) = $k*(0.0016)*(U/2.2)^{1.3}/(M/2)^{1.4}$	from USEPA AP-42 Section 13.2.4, 11/06 ed.
		(g/s·m²)			RSP Particle size multiplier, k	0.35 from USEPA AP-42 Section 13.2.4, 11/06 ed.
					FSP Particle size multiplier, k	0.05 from USEPA AP-42 Section 13.2.4, 11/06 ed.
					Moisture content, M (%)	6 from design engineer with reference to typical asphalt production plant
					Average wind speed, U (m/s)	2.24 mean wind speed extracted from WRF (Grid 31,38)
					Loading rate of materials (Mg/hr)	15 from design engineer
					Area of storage (m²)	17
					Dust Suppression Efficiency for PM (6 - 10µm)	90 for dust suppression by water sprays
					Dust Suppression Efficiency for PM (2.5 - 6µm)	65 from Table B.2.3, Appendix B.2, USEPA AP-42
					Dust Suppression Efficiency for PM (0 - 2.5µm)	40
	Source ID: AP31-34	RSP		1.1731E-05	RSP emission factor, E (kg/Mg)	1.23E-04 by formula above
					FSP emission factor, E (kg/Mg)	1.87E-05 by formula above
		FSP		2.7481E-06	Mitigated PM(2.5 - 10µm) emission factor (kg/Mg)	3.67E-05
					Mitigated PM(2.5) emission factor (kg/Mg)	1.12E-05
					Mitigated PM(2.5 - 10µm) emission rate (g/s)	1.53E-04
					Mitigated PM(2.5) emission rate (g/s)	4.67E-05

Appendix 4.2 Calculation of Emission Rates from Project

Emission Source Listing in AERMOD

Processed Asphalt Production

Source ID	Schematic Diagram	Emission Point	Source	Type	X	Y	Base Elevation (m)	Release Height (mAG)	No. of Vertices	Exit Temperature (K)	Working Hour	RSP Emission Rate		FSP Emission Rate		NOx Emission Rate		SO2 Emission Rate		Bitumen Fume Emission Rate		Odour Emission Rate	
												Working hours	Non-working hours	Working hours	Non-working hours	Working hours	Non-working hours	Working hours	Non-working hours	Working hours	Non-working hours	Working hours	Non-working hours
AP01	Asphalt Production (SK3018)	EP1	Cold Aggregate Hopper	AREAPOLY	826561.06	824561.17	5.00	5.00	4	0	00:00 - 24:00	3.0668E-05	0.0000E+00	7.1842E-06	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP02		EP2	Dust Emission System	POINT	826549.21	824558.36	5.00	23.00	-	0	00:00 - 24:00	9.0131E-03	0.0000E+00	7.8303E-03	0.0000E+00	2.7079E-01	0.0000E+00	9.6131E-03	0.0000E+00	7.3333E-02	0.0000E+00	1.9725E+04	0.0000E+00
AP03		EP3	Dust Collector at RAP Storage	POINT	826531.33	824546.84	5.00	13.50	-	0	00:00 - 24:00	6.6667E-03	0.0000E+00	3.0303E-03	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP04		EP4	Aggregate Reject Bin	POINT	826534.04	824550.39	5.00	13.50	-	0	00:00 - 24:00	5.8426E-04	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP05		EP5	Foul Batch Hopper	AREAPOLY	826527.02	824556.61	5.00	4.00	4	0	00:00 - 24:00	5.9834E-05	0.0000E+00	5.9834E-05	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP31	Rock Processing Operation (SK3041)	EP31	Dump Truck	AREAPOLY	826757.32	824657.72	5.00	4.00	4	0	00:00 - 24:00	1.1731E-05	0.0000E+00	2.7481E-06	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP32		EP32	Dump Truck	AREAPOLY	826763.56	824647.70	5.00	4.00	4	0	00:00 - 24:00	1.1731E-05	0.0000E+00	2.7481E-06	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP33		EP33	Dump Truck	AREAPOLY	826770.24	824637.50	5.00	4.00	4	0	00:00 - 24:00	1.1731E-05	0.0000E+00	2.7481E-06	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
AP34		EP34	Dump Truck	AREAPOLY	826776.22	824628.10	5.00	4.00	4	0	00:00 - 24:00	1.1731E-05	0.0000E+00	2.7481E-06	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Remarks:

1. Source parameters (exit temperature, velocity, stack diameter, and release height) are obtained from engineer.

Location of Vertices for AREAPOLY

Source ID	Vertex 1		Vertex 2		Vertex 3		Vertex 4	
	X	Y	X	Y	X	Y	X	Y
AP01	826561.06	824561.17	826578.27	824569.91	826579.85	824566.80	826562.64	824558.06
AP05	826527.02	824556.61	826528.43	824557.41	826529.21	824556.01	826527.80	824555.22
AP31	826757.32	824657.72	826759.85	824659.40	826762.95	824654.75	826760.43	824653.06
AP32	826763.56	824647.70	826766.09	824649.38	826769.19	824644.72	826766.67	824643.04
AP33	826770.24	824637.50	826772.77	824639.19	826775.87	824634.53	826773.35	824632.85
AP34	826776.22	824628.10	826778.74	824629.78	826781.85	824625.12	826779.33	824623.44

Hourly Profile	Daily
Hour	
Hour 1	1.0000
Hour 2	1.0000
Hour 3	1.0000
Hour 4	1.0000
Hour 5	1.0000
Hour 6	1.0000
Hour 7	1.0000
Hour 8	1.0000
Hour 9	1.0000
Hour 10	1.0000
Hour 11	1.0000
Hour 12	1.0000
Hour 13	1.0000
Hour 14	1.0000
Hour 15	1.0000
Hour 16	1.0000
Hour 17	1.0000
Hour 18	1.0000
Hour 19	1.0000
Hour 20	1.0000
Hour 21	1.0000
Hour 22	1.0000
Hour 23	1.0000
Hour 24	1.0000

Hourly Profile	Annual
Hour	
Hour 1	0.4000
Hour 2	0.4000
Hour 3	0.4000
Hour 4	0.4000
Hour 5	0.4000
Hour 6	0.4000
Hour 7	0.4000
Hour 8	0.4000
Hour 9	0.4000
Hour 10	0.4000
Hour 11	0.4000
Hour 12	0.4000
Hour 13	0.4000
Hour 14	0.4000
Hour 15	0.4000
Hour 16	0.4000
Hour 17	0.4000
Hour 18	0.4000
Hour 19	0.4000
Hour 20	0.4000
Hour 21	0.4000
Hour 22	0.4000
Hour 23	0.4000
Hour 24	0.4000

Appendix 4.2 Calculation of Emission Rates from Project

Proposed Asphalt Production

Calculation of Bitumen Fume

Concentration limit of Bitumen Fume (mg/m3): 5
Bitumen Fume Emission Rate (g/s): 7.333E-02

Asphalt production rate (Mg/hr)^[1]: 208
Exhaust flow rate (m3/hr)^[1]: 52800
Exhaust flow rate (m3/s)^[1]: 14.67

Calculation of Non-PAH Hazardous Air Pollutants, PAH HAPs and Non-HAP Organic Compounds

<u>Species</u>	<u>Emission Factor lb/ton^[2]</u>	<u>Emission Factor kg/Mg</u>	<u>Emission Rate g/s</u>
<u>Non-PAH Hazardous Air Pollutants</u>			
Acetaldehyde	3.200E-04	1.600E-04	9.244E-03
Benzene	2.800E-04	1.400E-04	8.089E-03
Ethylbenzene	2.200E-03	1.100E-03	6.356E-02
Formaldehyde	7.400E-04	3.700E-04	2.138E-02
Quinone	2.700E-04	1.350E-04	7.800E-03
Toluene	1.000E-03	5.000E-04	2.889E-02
Xylene	2.700E-03	1.350E-03	7.800E-02
<u>PAH HAPs</u>			
2-Methylnaphthalene	7.100E-05	3.550E-05	2.051E-03
Acenaphthene	9.000E-07	4.500E-07	2.600E-05
Acenaphthylene	5.800E-07	2.900E-07	1.676E-05
Anthracene	2.100E-07	1.050E-07	6.067E-06
Benzo(a)anthracene	4.600E-09	2.300E-09	1.329E-07
Benzo(a)pyrene	3.100E-10	1.550E-10	8.956E-09
Benzo(b)fluoranthene	9.400E-09	4.700E-09	2.716E-07
Benzo(g,h,i)perylene	5.000E-10	2.500E-10	1.444E-08
Benzo(k)fluoranthene	1.300E-08	6.500E-09	3.756E-07
Chrysene	3.800E-09	1.900E-09	1.098E-07
Dibenz(a,h)anthracene	9.500E-11	4.750E-11	2.744E-09
Fluoranthene	1.600E-07	8.000E-08	4.622E-06
Fluorene	1.600E-06	8.000E-07	4.622E-05
Indeno(1,2,3-cd)pyrene	3.000E-10	1.500E-10	8.667E-09
Naphthalene	3.600E-05	1.800E-05	1.040E-03
Phenanthrene	2.600E-06	1.300E-06	7.511E-05
Pyrene	6.200E-08	3.100E-08	1.791E-06
<u>Non-HAP organic compound</u>			
Benzaldehyde	1.300E-04	6.500E-05	3.756E-03
Butyraldehyde/ Isobutyraldehyde	3.000E-05	1.500E-05	8.667E-04
Crotonaldehyde	2.900E-05	1.450E-05	8.378E-04
Hexanal	2.400E-05	1.200E-05	6.933E-04

Remark:

[1] Provided by engineer

[2] USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-9 (No.2 fuel oil-fired dryer, hot screens and mixer with fabric filter)

Appendix 4.2 Calculation of Emission Rates from Project

Exhaust flow rate (m3/hr)^[1]:52800

Exhaust flow rate (m3/s)^[1]:14.67

Species	Emission Factor lb/ton	Emission Factor kg/Mg	Emission Rate g/s	Emission Rate mg/m3	Odour Threshold (ppm)	Odour Threshold (mg/m ³)	Relative Odour Strength (OU/m3)
Non-PAH Hazardous Air Pollutants							
Acetaldehyde	3.200E-04	1.600E-04	9.244E-03	6.303E-01	1.50E-03	2.70E-03	2.33E+02
Benzene	2.800E-04	1.400E-04	8.089E-03	5.515E-01	4.70E-01	1.50E+00	3.67E-01
Ethylbenzene	2.200E-03	1.100E-03	6.356E-02	4.333E+00	9.21E-02	2.70E-01	1.60E+01
Formaldehyde	7.400E-04	3.700E-04	2.138E-02	1.458E+00	2.70E-02	3.32E-02	4.40E+01
Quinone	2.700E-04	1.350E-04	7.800E-03	5.318E-01	1.06E-02	4.69E-02	1.13E+01
Toluene	1.000E-03	5.000E-04	2.889E-02	1.970E+00	2.10E-02	7.91E-02	2.49E+01
Xylene	2.700E-03	1.350E-03	7.800E-02	5.318E+00	1.20E-02	5.21E-02	1.02E+02
PAH HAPs							
2-Methylnaphtalene	7.100E-05	3.550E-05	2.051E-03	1.398E-01	6.90E-04	4.01E-03	3.48E+01
Acenaphthene	9.000E-07	4.500E-07	2.600E-05	1.773E-03	8.00E-02	5.05E-01	3.51E-03
Naphthalene	3.600E-05	1.800E-05	1.040E-03	7.091E-02	1.30E-03	6.81E-03	1.04E+01
Non-HAP organic compound							
Benzaldehyde	1.300E-04	6.500E-05	3.756E-03	2.561E-01	1.50E-03	6.51E-03	3.93E+01
Butyraldehyde/ Isobutyraldehyde	3.000E-05	1.500E-05	8.667E-04	5.909E-02	3.00E-04	8.85E-04	6.68E+01
Crotonaldehyde	2.900E-05	1.450E-05	8.378E-04	5.712E-02	2.00E-02	5.73E-02	9.97E-01
Hexanal	2.400E-05	1.200E-05	6.933E-04	4.727E-02	2.50E-02	1.02E-01	4.62E-01
						Total Odour Concentration (OU/m3):	5.8474E+02
						Total Odour Emission Rate (OU/s):	8.5762E+03
						Conversion Multiplier for Stability Classes A - F ^[2] :	2.3000E+00
						Emission Rate with 5-second Peak Factor (OU/s)	1.9725E+04

Remark:

[1] Provided by engineer

[2] Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Table 6.1

Appendix 4.2 Calculation of Emission Rates from Project

Estimation of Heavy Metal Emission

Emission of dryer Drum and Mixing Tower

Production Capacity (Mg/hr)^[1]:208

Metal	Emission Factor (lb/ton)	Emission Factor (kg/Mg)	Emission rate (g/s)
Arsenic	4.60E-07	2.30E-07	1.33E-05
Barium	1.50E-06	7.50E-07	4.33E-05
Beryllium	1.50E-07	7.50E-08	4.33E-06
Cadmium	6.10E-07	3.05E-07	1.76E-05
Chromium	5.70E-07	2.85E-07	1.65E-05
Hexavalent chromium	4.80E-08	2.40E-08	1.39E-06
Copper	2.80E-06	1.40E-06	8.09E-05
Lead	8.90E-07	4.45E-07	2.57E-05
Maganese	6.90E-06	3.45E-06	1.99E-04
Mercury	4.10E-07	2.05E-07	1.18E-05
Nickel	3.00E-06	1.50E-06	8.67E-05
Selenium	4.90E-07	2.45E-07	1.42E-05
Zinc	6.80E-06	3.40E-06	1.96E-04
Total:			7.11E-04

Remark:

[1] Provided by the design engineer

[2] USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-11

Emission of Bitumen Heating System

Maximum fuel consumption rate (10³L/hr)^[1]0.164146667

Metal	Emission Factor (lb/10 ³ Gal	Emission Factor (kg/10 ³ L)	Emission rate (g/s)
Arsenic	1.32E-03	1.58E-04	7.22E-06
Barium	-	-	-
Beryllium	2.78E-05	3.34E-06	1.52E-07
Cadmium	3.98E-04	4.78E-05	2.18E-06
Chromium	8.45E-04	1.01E-04	4.62E-06
Hexavalent chromium	-	-	-
Copper	1.76E-03	2.11E-04	9.63E-06
Lead	1.51E-03	1.81E-04	8.26E-06
Maganese	3.00E-03	3.60E-04	1.64E-05
Mercury	1.13E-04	1.36E-05	6.18E-07
Nickel	8.45E-02	1.01E-02	4.62E-04
Selenium	6.83E-04	8.20E-05	3.74E-06
Zinc	2.91E-02	3.49E-03	1.59E-04
Total:			6.74E-04

Remark:

[1] Provided by the design engineer

[2] Fuel similar to distillate oil is used to power the Bitumen Heating System, the species in the exhaust emission refer to USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-10. However, the emission factors in the table (Table 1.3-10) are based on fuel consumption in energy. As only fuel consumption in litre is available by the engineer, emission factors from "Uncontrolled No. 6 Fuel Oil Combustion" (USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-11) which is expected to have more emissions are adopted as a conservative approach

823500 N

827500 E

A diagram illustrating a vertical stack of five colored rectangles (blue, purple, pink, orange, green) with small colored circles above them, all under a brown bar. A vertical line on the left is labeled f .

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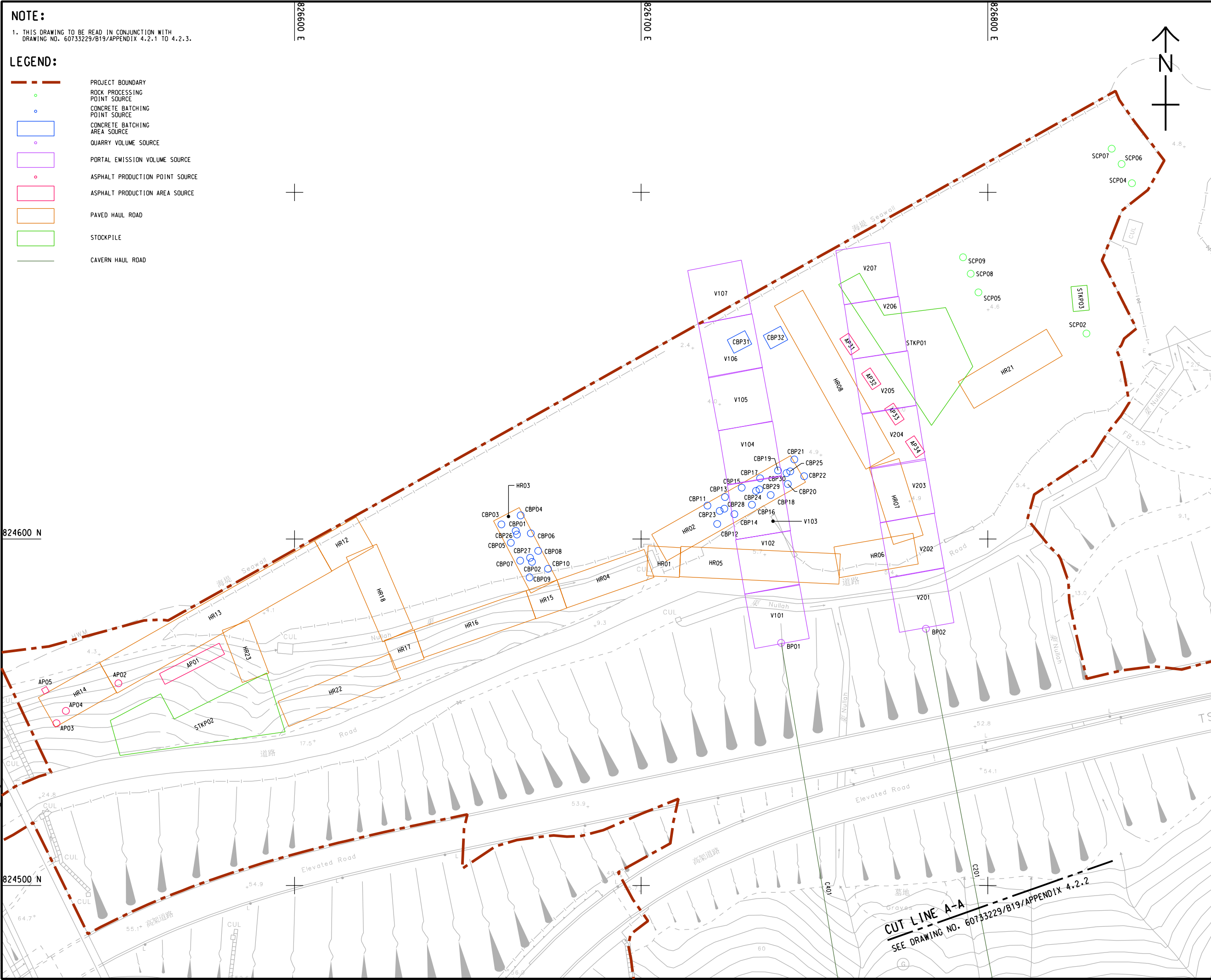
60733229/B19/APPENDIX 4.2

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- LEGEND:
- PROJECT BOUNDARY
 - ROCK PROCESSING POINT SOURCE
 - CONCRETE BATCHING POINT SOURCE
 - CONCRETE BATCHING AREA SOURCE
 - QUARRY VOLUME SOURCE
 - PORTAL EMISSION VOLUME SOURCE
 - ASPHALT PRODUCTION POINT SOURCE
 - ASPHALT PRODUCTION AREA SOURCE
 - PAVED HAUL ROAD
 - STOCKPILE
 - CAVERN HAUL ROAD



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SCALE
比例
A3 1: 1000

DIMENSION UNIT
尺寸單位
METRES

KEY PLAN
索引圖

PROJECT NO.
項目編號
60733229

AGREEMENT NO.
協議編號
CE 79/2023 (GE)

SHEET TITLE
圖紙名稱
INDICATIVE LOCATION OF PROJECT
EMISSION SOURCES

SHEET NUMBER
圖紙編號
60733229/B19/APPENDIX 4.2.1

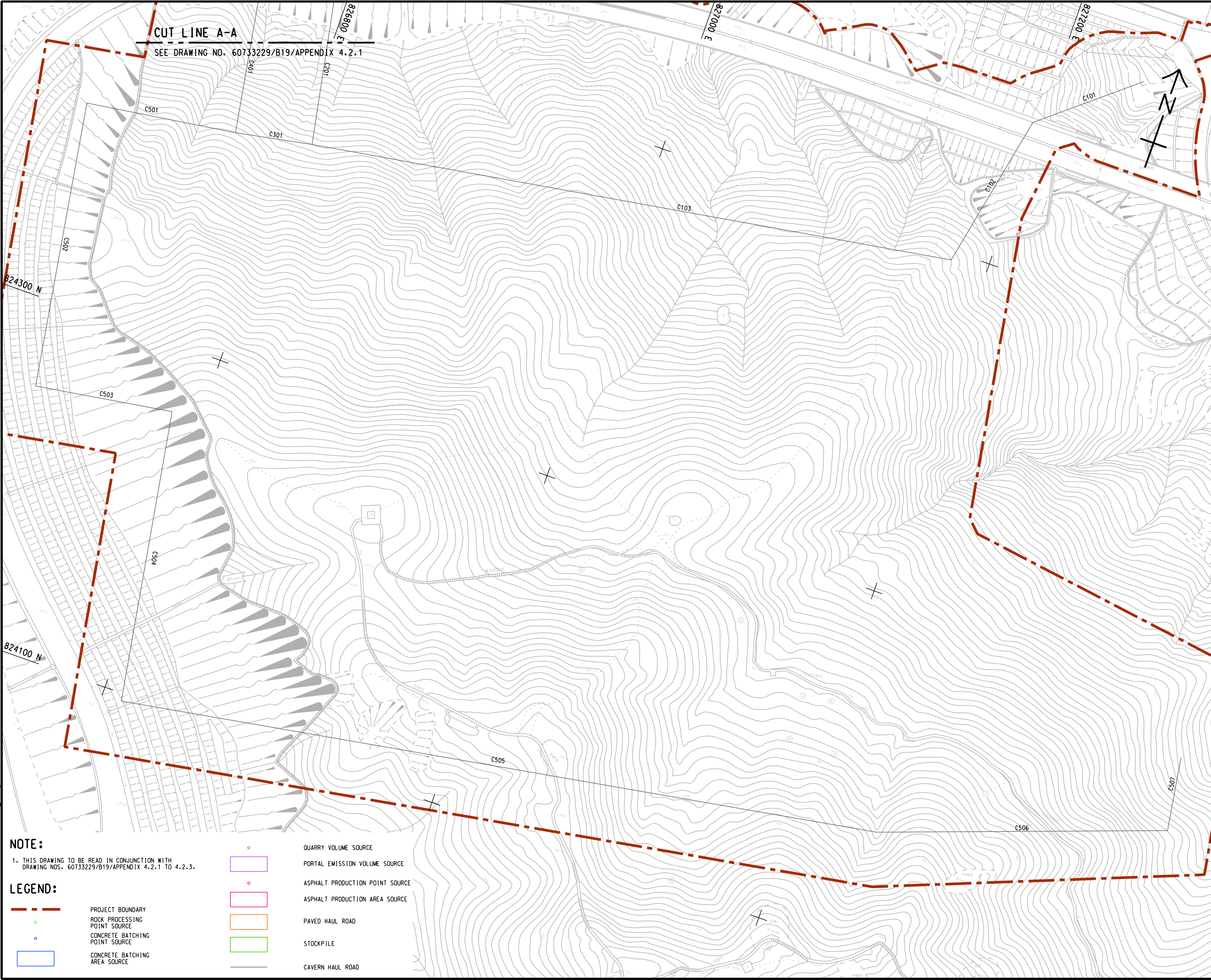
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- LEGEND:**
- PROJECT BOUNDARY
 - ROCK PROCESSING POINT SOURCE
 - CONCRETE BATCHING POINT SOURCE
 - CONCRETE BATCHING AREA SOURCE
 - QUARRY VOLUME SOURCE
 - PORTAL EMISSION VOLUME SOURCE
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STATUS
状态

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比例
A3 1 : 2000

DIMENSION UNIT
尺寸单位
METRES

KEY PLAN
索引图

PROJECT NO.
设计项目编号
60733229

AGREEMENT NO.
协议编号
CE 79/2023 (GE)

SHEET TITLE
图名/标题

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EMISSION SOURCES

SHEET NUMBER
图幅编号
60733229/B19/APPENDIX 4.2.2

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1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
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LEGEND:

-
- PROJECT BOUNDARY

ROCK PROCESSING
POINT SOURCE

CONCRETE BATCHING
POINT SOURCE

CONCRETE BATCHING
AREA SOURCE

QUARRY VOLUME SOURCE

PORTAL EMISSION VOLUME SOURCE

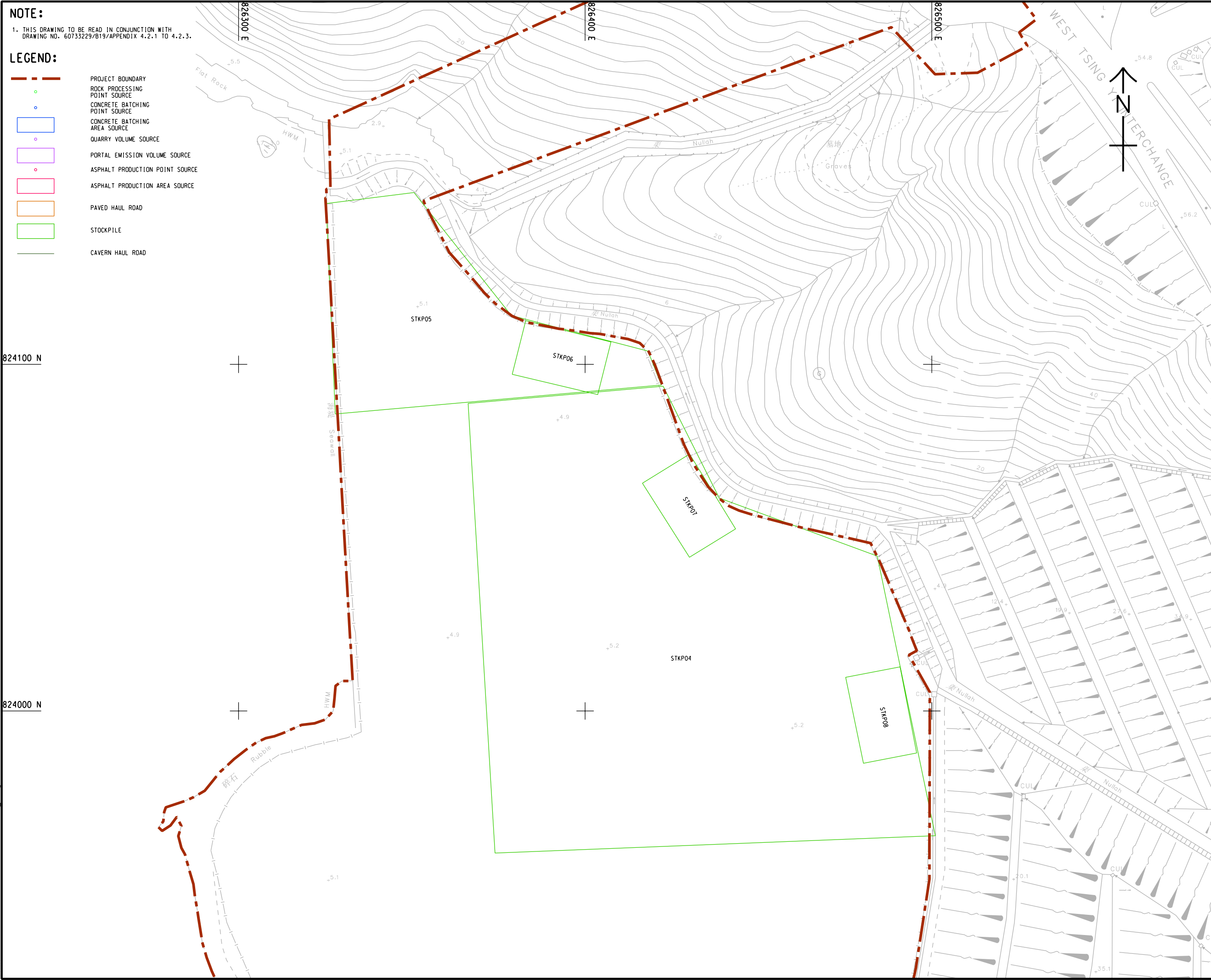
ASPHALT PRODUCTION POINT SOURCE

ASPHALT PRODUCTION AREA SOURCE

PAVED HAUL ROAD

STOCKPILE

CAVERN HAUL ROAD



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STATUS
校核

SCALE
比例
A3 1 : 1000

DIMENSION UNIT
尺寸單位
METRES

KEY PLAN
索引圖

PROJECT NO.
項目編號
60733229

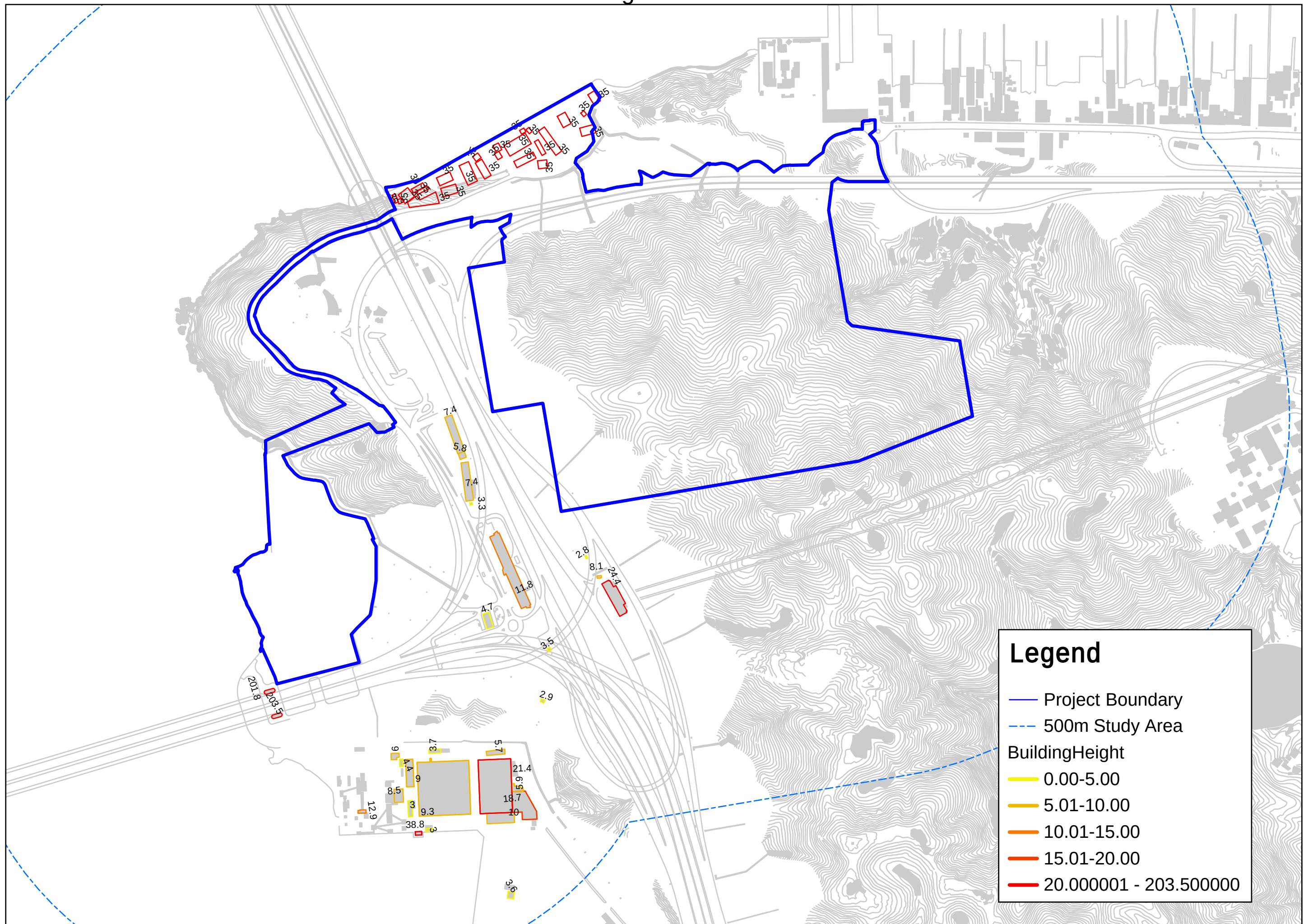
AGREEMENT NO.
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CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

INDICATIVE LOCATION OF PROJECT
EMISSION SOURCES

SHEET NUMBER
圖紙編號
60733229/B19/APPENDIX 4.2.3

Building Downwash



Appendix 4.3

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Existing Cement Works by Anderson Concrete Limited

														Long-term Assessment								Short-term Assessment ^[3]	
														RSP Emission Rate ^{[1][2]}				FSP Emission Rate ^{[1][2]}				RSP Emission Rate ^{[1][2]}	FSP Emission Rate ^{[1][2]}
Source ID	Type	Source Descriptions ^[1]	X ^[1]	Y ^[1]	Xinit ^[1]	Yinit ^[1]	Orientation Angle (Degree) ^[1]	Area (m ²) ^[1]	Szint ^[1]	Stack Diameter (m) ^[1]	Height (mAG) ^[1]	Exit Temperature (K) ^[1]	Exit Velocity (m/s) ^[1]	0700-1900	1900-2300	2300-0600	0600-0700	0700-1900	1900-2300	2300-0600	0600-0700	0000 - 2400	0000 - 2400
STW_EP1	POINT	Dust Collector on Cement Silos	826498.50	823612.05	-	-	-	-	-	0.23	31.0	Ambient	58.9	8.122E-03	8.122E-03	8.122E-03	8.122E-03	3.692E-03	3.692E-03	3.692E-03	3.692E-03	8.122E-03	3.692E-03
STW_EP2	POINT	Dust Collector on Cement Silos	826507.55	823612.37	-	-	-	-	-	0.23	31.0	Ambient	58.9	8.122E-03	8.122E-03	8.122E-03	8.122E-03	3.692E-03	3.692E-03	3.692E-03	3.692E-03	8.122E-03	3.692E-03
STW_EP3	POINT	Dust Collector on Cement Silos	826537.76	823613.42	-	-	-	-	-	0.23	31.0	Ambient	47.9	6.611E-03	6.611E-03	6.611E-03	6.611E-03	3.005E-03	3.005E-03	3.005E-03	3.005E-03	6.611E-03	3.005E-03
STW_EP4	POINT	Dust Collector on Cement Silos	826537.92	823608.93	-	-	-	-	-	0.23	31.0	Ambient	47.9	6.611E-03	6.611E-03	6.611E-03	6.611E-03	3.005E-03	3.005E-03	3.005E-03	3.005E-03	6.611E-03	3.005E-03
STW_EP5	POINT	Dust Collector on Cement Silos	826538.07	823604.43	-	-	-	-	-	0.23	31.0	Ambient	58.9	8.122E-03	8.122E-03	8.122E-03	8.122E-03	3.692E-03	3.692E-03	3.692E-03	3.692E-03	8.122E-03	3.692E-03
STW_EP6	POINT	Dust Collector on Cement Silos	826533.26	823613.26	-	-	-	-	-	0.23	31.0	Ambient	58.9	8.122E-03	8.122E-03	8.122E-03	8.122E-03	3.692E-03	3.692E-03	3.692E-03	3.692E-03	8.122E-03	3.692E-03
STW_EP7	POINT	Dust Collector on CSF Silos	826533.42	823608.77	-	-	-	-	-	0.23	31.0	Ambient	19.2	4.148E-03	4.148E-03	4.148E-03	4.148E-03	1.886E-03	1.886E-03	1.886E-03	1.886E-03	4.148E-03	1.886E-03
STW_EP8	POINT	Dust Collector on Cement Silos	826533.58	823604.27	-	-	-	-	-	0.23	31.0	Ambient	19.2	2.644E-03	2.644E-03	2.644E-03	2.644E-03	1.202E-03	1.202E-03	1.202E-03	1.202E-03	2.644E-03	1.202E-03
STW_EP9	POINT	Weigh Hopper Loading	826529.25	823612.08	-	-	-	-	-	0.23	14.2	Ambient	1.0	6.922E-04	2.076E-04	6.922E-05	6.922E-05	2.036E-04	6.107E-05	2.036E-05	2.036E-05	6.922E-04	2.036E-04
STW_EP10	POINT	Weigh Hopper Loading	826533.68	823608.53	-	-	-	-	-	0.23	14.2	Ambient	1.0	6.922E-04	2.076E-04	6.922E-05	6.922E-05	2.036E-04	6.107E-05	2.036E-05	2.036E-05	6.922E-04	2.036E-04
STW_EP11	POINT	Weigh Hopper Loading	826538.44	823603.99	-	-	-	-	-	0.23	14.2	Ambient	1.0	6.922E-04	2.076E-04	6.922E-05	6.922E-05	2.036E-04	6.107E-05	2.036E-05	2.036E-05	6.922E-04	2.036E-04
STW_EP12	POINT	Dust Collector on Mixers	826527.95	823612.03	-	-	-	-	-	0.23	14.2	Ambient	19.2	2.367E-03	7.101E-04	2.367E-04	2.367E-04	1.076E-03	3.228E-04	1.076E-04	1.076E-04	2.367E-03	1.076E-03
STW_EP13	POINT	Dust Collector on Mixers	826532.38	823608.48	-	-	-	-	-	0.23	14.2	Ambient	19.2	2.367E-03	7.101E-04	2.367E-04	2.367E-04	1.076E-03	3.228E-04	1.076E-04	1.076E-04	2.367E-03	1.076E-03
STW_EP14	POINT	Dust Collector on Mixers	826537.14	823603.95	-	-	-	-	-	0.23	14.2	Ambient	19.2	2.367E-03	7.101E-04	2.367E-04	2.367E-04	1.076E-03	3.228E-04	1.076E-04	1.076E-04	2.367E-03	1.076E-03
STW_EP16	POINT	Unloading of aggregates (Mixed with sand)	826475.29	823553.69	-	-	-	-	-	0.23	7.8	Ambient	1.0	2.958E-02	2.958E-02	2.958E-02	2.958E-02	6.930E-03	6.930E-03	6.930E-03	6.930E-03	2.958E-02	6.930E-03
STW_EP17A	AREA	Paved Haul Road inside CBP	826543.48	823689.70	54.41	6.00	179.26	326.46	0.00001	-	0.5	-	-	3.960E-05	4.260E-05	5.920E-06	3.960E-06	9.570E-06	1.030E-05	1.430E-06	9.570E-07	4.260E-05	1.030E-05
STW_EP17B	AREA	Paved Haul Road inside CBP	826491.85	823686.66	6.00	22.65	176.32	135.90	0.00001	-	0.5	-	-	3.960E-05	4.260E-05	5.920E-06	3.960E-06	9.570E-06	1.030E-05	1.430E-06	9.570E-07	4.260E-05	1.030E-05
STW_EP17C	AREA	Paved Haul Road inside CBP	826490.74	823663.91	3.50	12.40	176.00	43.40	0.00001	-	0.5	-	-	1.800E-05	1.980E-05	2.630E-06	1.800E-06	4.350E-06	4.800E-06	6.360E-07	4.350E-07	1.980E-05	4.800E-06
STW_EP17D	AREA	Paved Haul Road inside CBP	826491.55	823651.53	3.50	40.00	179.17	140.00	0.00001	-	0.5	-	-	1.800E-05	1.980E-05	2.630E-06	1.800E-06	4.350E-06	4.800E-06	6.360E-07	4.350E-07	1.980E-05	4.800E-06
STW_EP17E	AREA	Paved Haul Road inside CBP	826492.23	823611.78	3.50	16.90	175.52	59.15	0.00001	-	0.5	-	-	1.800E-05	2.300E-05	4.320E-06	1.800E-06	4.350E-06	5.570E-06	1.050E-06	4.350E-07	2.300E-05	5.570E-06
STW_EP17F	AREA	Paved Haul Road inside CBP	826493.34	823597.04	3.50	27.70	90.07	96.95	0.00001	-	0.5	-	-	0.000E+00	1.540E-05	0.000E+00	0.000E+00	0.000E+00	3.720E-06	0.000E+00	0.000E+00	1.540E-05	3.720E-06
STW_EP17G	AREA	Paved Haul Road inside CBP	826521.20	823586.29	26.87	3.50	180.00	94.05	0.00001	-	0.5	-	-	0.000E+00	4.260E-06	0.000E+00	0.000E+00	0.000E+00	1.030E-06	0.000E+00	0.000E+00	4.260E-06	1.030E-06
STW_EP17H	AREA	Paved Haul Road inside CBP	826521.53	823575.56	25.91	3.50	180.00	90.69	0.00001	-	0.5	-	-	0.000E+00	4.260E-06	0.000E+00	0.000E+00	0.000E+00	1.030E-06	0.000E+00	0.000E+00	4.260E-06	1.030E-06
STW_EP17I	AREA	Paved Haul Road inside CBP	826527.19	823586.29	5.98	3.50	180.00	20.93	0.00001	-	0.5	-	-	0.000E+00	1.120E-05	0.000E+00	0.000E+00	0.000E+00	2.700E-06	0.000E+00	0.000E+00	1.120E-05	2.700E-06
STW_EP17J	AREA	Paved Haul Road inside CBP	826527.19	823575.56	5.65	3.50	180.00	19.78	0.00001	-	0.5	-	-	0.000E+00	1.120E-05	0.000E+00	0.000E+00	0.000E+00	2.700E-06	0.000E+00	0.000E+00	1.120E-05	2.700E-06
STW_EP17K	AREA	Paved Haul Road inside CBP	826493.69	823595.04	3.50	28.00	174.40	98.00	0.00001	-	0.5	-	-	1.800E-05	2.140E-05	4.320E-06	1.800E-06	4.350E-06	5.170E-06	1.050E-06	4.350E-07	2.140E-05	5.170E-06
STW_EP17L	AREA	Paved Haul Road inside CBP	826494.91	823570.23	3.50	25.00	104.00	87.50	0.00001	-	0.5	-	-	1.800E-05	2.140E-05	4.320E-06	1.800E-06	4.350E-06	5.170E-06	1.050E-06	4.350E-07	2.140E-05	5.170E-06
STW_EP17M	AREA	Paved Haul Road inside CBP	826535.11	823572.27	20.00	3.50	155.62	70.00	0.00001	-	0.5	-	-	1.800E-05	2.140E-05	4.320E-06	1.800E-06	4.350E-06	5.170E-06	1.050E-06	4.350E-07	2.140E-05	5.170E-06
STW_EP17N	AREA	Paved Haul Road inside CBP	826541.19	823602.16	14.00	31.00	180.00	434.00	0.00001	-	0.5	-	-	4.490E-06	1.090E-05	1.080E-06	4.490E-07	1.090E-06	2.640E-06	2.620E-07	1.090E-07	1.090E-05	2.640E-06
STW_EP17O	AREA	Paved Haul Road inside CBP	826539.61	823650.99	14.00	35.00	178.00	490.00	0.00001	-	0.5	-	-	1.250E-05	1.330E-05	1.890E-06	1.250E-06	3.030E-06	3.230E-06	4.560E-07	3.030E-07	1.330E-05	3.230E-06
STW_EP17P	AREA	Paved Haul Road inside CBP	826510.86	823658.85	3.50	30.00	102.00	105.00	0.00001	-	0.5	-	-	5.000E-05	5.340E-05	7.550E-06	5.000E-06	1.210E-05	1.290E-05	1.830E-06	1.210E-06	5.340E-05	1.290E-05
STW_EP17Q	AREA	Paved Haul Road inside CBP	826491.74	823664.87	3.50	20.00	107.00	70.00	0.00001	-	0.5	-	-	5.000E-05	5.340E-05	7.550E-06	5.000E-06	1.210E-05	1.290E-05	1.830E-06	1.210E-06	5.340E-05	1.290E-05
STW_EP17R	AREA	Paved Haul Road inside CBP	826523.12	823654.00	10.50	10.00	178.00	105.00	0.00001	-	0.5	-	-	3.500E-05	1.050E-05	3.500E-06	3.500E-06	8.470E-06	2.540E-06	8.470E-07	8.470E-07	3.500E-05	8.470E-06
STW_EP18	AREA	Unloading of aggregates (Mixed with sand)	826515.20	823594.11	5.60	2.30	0.00	12.88	0.00001	-	6.0	-	-	0.00E+00	7.93E-04	0.00E+00	0.00E+00	0.00E+00	1.86E-04	0.00E+00	0.00E+00	7.927E-04	1.857E-04
STW_EP19	AREA	Unloading of aggregates (Mixed with sand)	826515.38	823583.29	5.60	2.30	0.00	12.88	0.00001	-	6.0	-	-	0.00E+00	7.93E-04	0.00E+00	0.00E+00	0.00E+00	1.86E-04	0.00E+00	0.00E+00	7.927E-04	1.857E-04
STW_EP20	AREA	Unloading of aggregates (Mixed with sand)	826515.81	823572.26	5.60	2.30	0.00	12.88	0.00001	-	6.0	-	-	0.00E+00	7.93E-04	0.00E+00	0.00E+00	0.00E+00	1.86E-04	0.00E+00	0.00E+00	7.927E-04	1.857E-04

Notes:

- [1] The stack parameters, and emission rates of RSP and FSP of the emission sources refer to the approved EIA Report of Tsing Yi - Lantau Link (EIA-314/2025).
- [2] The units of emission rates are g/s and g/s-m² for point sources and area sources, respectively
- [3] For short-term assessment (i.e., Daily RSP/FSP), the maximum emission rates are adopted for every hour as a conservative approach.

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Existing Cement Works by Alliance Construction Materials Limited

Source ID	Exhaust Gas Flow Rate (m ³ /h) ^[1]	Type	X ^[2]	Y ^[2]	Xinit ^[1]	Yinit ^[1]	Orientation Angle (Degree) ^[2]	Area (m ²) ^[1]	Szint ^[1]	Stack Diameter (m) ^[1]	Height (mAG) ^[1]	Exit Temperature (K) ^[1]	Exit Velocity (m/s) ^[1]	Working Hours ^[1]	RSP Emission ^{[1],[3]}	FSP Emission ^{[1],[3]}
G_EP1	N.A.	AREA	826459.21	823552.68	6	6	0	36	0.00001	-	1.0	Ambient	-	0000 - 2400	9.197E-07	1.393E-07
G_EP1A	N.A.	AREA	826455.83	823533.42	15.8	36.5	194.00	576.70	0.00001	-	1.0	Ambient	-	0000 - 2400	1.332E-04	2.016E-05
G_EP2	N.A.	AREA	826449.35	823564.82	3	5	357	15	0.00001	-	1.0	Ambient	-	0000 - 2400	3.626E-07	5.491E-08
G_EP3	4200	POINT	826447.00	823639.00	-	-	-	-	-	0.29	19.8	Ambient	17.3	0000 - 2400	5.833E-02	5.833E-02
G_EP4	4200	POINT	826448.00	823626.00	-	-	-	-	-	0.29	19.8	Ambient	17.3	0000 - 2400	5.833E-02	5.833E-02
G_EP5	1780	POINT	826484.00	823634.00	-	-	-	-	-	0.16	27.5	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP6	1780	POINT	826484.00	823631.00	-	-	-	-	-	0.16	22.5	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP7	1780	POINT	826484.00	823627.00	-	-	-	-	-	0.16	27.5	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP8	1780	POINT	826484.00	823624.00	-	-	-	-	-	0.16	27.5	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP9	1780	POINT	826484.00	823621.00	-	-	-	-	-	0.16	22.5	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP10A	N.A.	AREA	826541.74	823691.62	40.00	3.50	179.26	140.00	0.00001	-	0.0	Ambient	-	0000 - 2400	1.123E-04	2.716E-05
G_EP10B	N.A.	AREA	826502.34	823688.33	3.50	45.00	181.20	157.50	0.00001	-	0.0	Ambient	-	0000 - 2400	1.123E-04	2.716E-05
G_EP11	1780	POINT	826477.00	823627.00	-	-	-	-	-	0.16	10.0	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP12	1780	POINT	826477.00	823625.00	-	-	-	-	-	0.16	10.0	Ambient	25.5	0000 - 2400	2.472E-02	2.472E-02
G_EP13	3000	POINT	826442.00	823551.00	-	-	-	-	-	0.26	6.3	Ambient	15.6	0000 - 2400	4.167E-02	4.167E-02
G_EP14	4800	POINT	826439.00	823622.00	-	-	-	-	-	0.29	6.4	Ambient	19.7	0000 - 2400	6.667E-02	6.667E-02
G_EP16	1800	POINT	826442.00	823632.00	-	-	-	-	-	0.21	9.8	Ambient	14.9	0000 - 2400	2.500E-02	2.500E-02
G_EP17	1800	POINT	826452.00	823633.00	-	-	-	-	-	0.26	9.8	Ambient	9.2	0000 - 2400	2.500E-02	2.500E-02
G_EP18	N.A.	AREA	826451.04	823579.59	2	2	180.00	4.00	0.00001	-	1.0	Ambient	-	0000 - 2400	3.429E-06	5.193E-07
G_EP19	N.A.	AREA	826456.05	823533.25	15.8	36.5	195.70	576.70	0.00001	-	1.0	Ambient	-	0000 - 2400	1.332E-05	2.016E-06

Notes:

- [1] The stack parameters, and emission rates of RSP and FSP of the emission sources refer to the approved EIA Report of Tsing Yi - Lantau Link (EIA-314/2025).
- [2] The coordinates and orientation angle of the emission sources refer to refer to the approved EIA Report of Tsing Yi - Lantau Link (EIA-314/2025).
- [3] The units of emission rates are g/s and g/s-m² for point sources and area sources, respectively

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Existing Tar and Bitumen Works by Asphalt Surfaces (International) Limited

Source	Type ^[1]	X1 ^[2]	Y1 ^[2]	X2 ^[2]	Y2 ^[2]	Elevation	Height (mAG) ^[1]	Temperature (K) ^[1]	Exit Velocity (m/s) ^[1]	Diameter (m) ^[1]	Width (m) ^[1]	Length (m) ^[1]	Angle (degree) ^[2]	Initial Vertical Dimension (m)	RSP Emission Rate (g/s or g/m²/s) ^[1]	FSP Emission Rate (g/s or g/m²/s) ^[1]	NOx Emission Rate (g/s or g/m²/s) ^[1]	SO2 Emission Rate (g/s or g/m²/s) ^{[1],[3]}	Bitumen Emision Rate (g/s) ^[1]	Odour Emission Rate (OU/s) ^[1]	Working Hours
AP5_EP1	POINT	826461.00	823598.00	-	-	5.20	16.00	383.15	21.05	1.25	-	-	-	-	2.400E-01	2.400E-01	3.0000	1.109E+00	2.750E-03	6.451E-03	0000 - 2400
AP5_EP2	POINT	826471.93	823593.46	-	-	5.20	15.00	-	0.00	4.37	3.00	5.00	-	-	4.722E-04	4.722E-04	-	-	-	-	0000 - 2400
AP5_EP3	POINT	826471.00	823575.00	-	-	5.20	5.00	493.15	6.88	0.25	-	-	-	-	2.733E-03	2.733E-03	2.733E-02	1.832E-02	-	3.862E-01	0000 - 2400
AP5_EP4A	AREA	826543.40	823689.70	54.41	6.00	5.20	0.00	-	-	-	5.00	10.00	179.26	3.07581	3.255E-06	7.876E-07	-	-	-	-	0000 - 2400
AP5_EP4B	AREA	826492.12	823686.26	6.00	60.00	5.20	0.00	-	-	-	5.00	32.50	176.31	3.07581	3.255E-06	7.876E-07	-	-	-	-	0000 - 2400
AP5_EP4C	AREA	826495.68	823626.76	6.00	20.41	5.20	0.00	-	-	-	5.00	32.50	176.32	3.07581	3.255E-06	7.876E-07	-	-	-	-	0000 - 2400
AP5_EP4D	AREA	826494.15	823608.97	15.18	6.00	5.20	0.00	-	-	-	5.00	105.00	176.37	3.07581	3.255E-06	7.876E-07	-	-	-	-	0000 - 2400
AP5_EP5	AREA	826448.10	823577.24	3.50	3.50	5.20	4.30	-	-	-	3.50	3.50	0.00	0.00001	8.580E-07	8.580E-07	-	-	-	-	0000 - 2400
AP5_EP6	AREA	826457.15	823574.26	10.00	8.00	5.20	3.00	-	-	-	10.00	8.00	0.00	0.00001	8.448E-05	8.448E-05	-	-	-	-	0000 - 2400
AP5_EP7	AREA	826446.79	823603.24	3.00	5.00	5.20	3.00	-	-	-	3.00	5.00	0.00	0.00001	2.540E-06	2.540E-06	-	-	-	-	0000 - 2400
AP5_EP8	AREA	826477.39	823576.38	10.00	8.00	5.20	3.00	-	-	-	10.00	8.00	0.00	0.00001	1.314E-07	1.314E-07	-	-	-	-	0000 - 2400
AP5_EP9	AREA	826469.48	823550.64	3.00	5.00	5.20	1.00	-	-	-	3.00	5.00	0.00	0.00001	1.126E-06	1.126E-06	-	-	-	-	0000 - 2400
AP5_EP10	AREA	826480.49	823510.83	15.80	36.50	5.20	1.00	-	-	-	36.50	15.80	192.97	0.00001	1.252E-04	1.896E-05	-	-	-	-	0000 - 2400
AP5_EP11	POINT	826477.00	823595.00	-	-	5.20	3.00	493.15	10.74	0.20	-	-	-	-	2.000E-03	7.850E-02	2.000E-02	1.570E-02	2.500E-05	3.600E-01	0000 - 2400
AP5_EP12	AREA	826455.00	823568.00	0.80	0.60	5.20	2.50	-	-	-	0.80	0.60	0.00	0.00001	5.748E-05	5.748E-05	-	-	-	-	0000 - 2400
AP5_EP13	AREA	826481.00	823587.00	0.50	0.40	5.20	0.00	-	-	-	0.50	0.40	0.00	0.00001	2.168E-05	2.168E-05	-	-	-	-	0000 - 2400
AP5_EP15	POINT	826465.90	823582.30	-	-	5.20	4.50	0.00	0.50	0.45	0.40	0.40	-	-	-	-	-	-	4.000E-10	-	0000 - 2400
AP5_EP16	POINT	826461.20	823582.00	-	-	5.20	2.50	0.00	0.50	0.05	-	-	-	-	-	-	-	-	1.964E-11	-	0000 - 2400
AP5_EP17	POINT	826462.30	823576.10	-	-	5.20	4.50	0.00	0.50	0.05	-	-	-	-	-	-	-	-	1.964E-11	-	0000 - 2400

Notes:

[1] The stack parameters, and emission rates of RSP, FSP and NOx of the emission sources refer to the approved EIA Report of Tsing Yi - Lantau Link (EIA-314/2025).
The emission rates of SO₂ and bitumen refer to SP Licence of Asphalt Surface (International) Limited extracted from SAMP. The odour emission rate refer to Environmental Assessment Report of Anderson Asphalt Limited (18 April 2024).

[2] The coordinates and orientation angle of the emission sources refer to the approved EIA Report of Tsing Yi - Lantau Link (EIA-314/2025)

[3] The SO2 emission rate is adjusted to one-fifth the rate stated on APCP as the sulphur content of liquid fuel for industrial use has been tightened from 0.005% to 0.001% under the Air Pollution Control (Fuel Restriction) Regulation 2024 (Cap.3111) since 1 April 2025.

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Sources from Existing Tar and Bitumen Works by Asphalt Surfaces (International) Limited under SP Licence No.: L-15-027(5)

Calculation of Non-PAH Hazardous Air Pollutants, PAH HAPs and Non-HAP Organic Compounds

Production Capacity (Mg/hr) ^[1]:

180

<u>Species</u>	<u>Emission Factor lb/ton^[2]</u>	<u>Emission Factor kg/Mg</u>	<u>Emission Rate g/s^[3]</u>
<u>Non-PAH Hazardous Air Pollutants</u>			
Acetaldehyde	3.200E-04	1.600E-04	8.000E-03
Benzene	2.800E-04	1.400E-04	7.000E-03
Ethylbenzene	2.200E-03	1.100E-03	5.500E-02
Formaldehyde	7.400E-04	3.700E-04	1.850E-02
Quinone	2.700E-04	1.350E-04	6.750E-03
Toluene	1.000E-03	5.000E-04	2.500E-02
Xylene	2.700E-03	1.350E-03	6.750E-02
<u>PAH HAPs</u>			
2-Methylnaphthalene	7.100E-05	3.550E-05	1.775E-03
Acenaphthene	9.000E-07	4.500E-07	2.250E-05
Acenaphthylene	5.800E-07	2.900E-07	1.450E-05
Anthracene	2.100E-07	1.050E-07	5.250E-06
Benzo(a)anthracene	4.600E-09	2.300E-09	1.150E-07
Benzo(a)pyrene	3.100E-10	1.550E-10	7.750E-09
Benzo(b)fluoranthene	9.400E-09	4.700E-09	2.350E-07
Benzo(g,h,i)perylene	5.000E-10	2.500E-10	1.250E-08
Benzo(k)fluoranthene	1.300E-08	6.500E-09	3.250E-07
Chrysene	3.800E-09	1.900E-09	9.500E-08
Dibenz(a,h)anthracene	9.500E-11	4.750E-11	2.375E-09
Fluoranthene	1.600E-07	8.000E-08	4.000E-06
Fluorene	1.600E-06	8.000E-07	4.000E-05
Indeno(1,2,3-cd)pyrene	3.000E-10	1.500E-10	7.500E-09
Naphthalene	3.600E-05	1.800E-05	9.000E-04
Phenanthrene	2.600E-06	1.300E-06	6.500E-05
Pyrene	6.200E-08	3.100E-08	1.550E-06
<u>Non-HAP organic compound</u>			
Benzaldehyde	1.300E-04	6.500E-05	3.250E-03
Butyraldehyde/ Isobutyraldehyde	3.000E-05	1.500E-05	7.500E-04
Crotonaldehyde	2.900E-05	1.450E-05	7.250E-04
Hexanal	2.400E-05	1.200E-05	6.000E-04

Remark:

[1] Reference made to the SP Licence of Asphalt Surface (International) Limited extracted from SAMP.

[2] USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-9 (No.2 fuel oil-fired dryer, hot screens and mixer with fabric filter)

[3] The emission rate is calculated by: Emission Factor (kg [Pollutant] / Mg [Asphalt produced]) × Production Capacity (Mg [Asphalt Produced] / hr) × 1 / 3.6

L:\Secure\Environment_Projects\60733229\1.01\Others\Air\Modelling\Appendix\IndustrialEmission_OtherPlants_20260615.xlsx

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Sources from Existing Tar and Bitumen Works by Asphalt Surfaces (International) Limited under SP Licence No.: L-15-027(5)
Estimation of Heavy Metal Emission

Emission of dryer Drum and Mixing Tower

Production Capacity (Mg/hr)^[1]:180

Metal	Emission Factor (lb/ton) ^[2]	Emission Factor (kg/Mg)	Emission rate (g/s)
Arsenic	4.60E-07	2.30E-07	1.15E-05
Barium	1.50E-06	7.50E-07	3.75E-05
Beryllium	1.50E-07	7.50E-08	3.75E-06
Cadmium	6.10E-07	3.05E-07	1.53E-05
Chromium	5.70E-07	2.85E-07	1.43E-05
Hexavalent chromium	4.80E-08	2.40E-08	1.20E-06
Copper	2.80E-06	1.40E-06	7.00E-05
Lead	8.90E-07	4.45E-07	2.23E-05
Maganese	6.90E-06	3.45E-06	1.73E-04
Mercury	4.10E-07	2.05E-07	1.03E-05
Nickel	3.00E-06	1.50E-06	7.50E-05
Selenium	4.90E-07	2.45E-07	1.23E-05
Zinc	6.80E-06	3.40E-06	1.70E-04
Total:			6.16E-04

Remark:
[1] Reference made to the SP Licence of Asphalt Surface (International) Limited extracted from SAMP.
[2] USEPA AP-42, section 11.1, 3/04 ed. Table 11.1-11

Emission of Bitumen Heating System

Maximum fuel consumption rate (10³L/hr)^[1]:0.022

Metal	Emission Factor (lb/10 ³ Gal)	Emission Factor (kg/10 ³ L)	Emission rate (g/s)
Arsenic	1.32E-03	1.58E-04	9.68E-07
Barium	-	-	-
Beryllium	2.78E-05	3.34E-06	2.04E-08
Cadmium	3.98E-04	4.78E-05	2.92E-07
Chromium	8.45E-04	1.01E-04	6.20E-07
Hexavalent chromium	-	-	-
Copper	1.76E-03	2.11E-04	1.29E-06
Lead	1.51E-03	1.81E-04	1.11E-06
Maganese	3.00E-03	3.60E-04	2.20E-06
Mercury	1.13E-04	1.36E-05	8.29E-08
Nickel	8.45E-02	1.01E-02	6.20E-05
Selenium	6.83E-04	8.20E-05	5.01E-07
Zinc	2.91E-02	3.49E-03	2.13E-05
Total:			9.04E-05

Remark:
[1] Reference made to the Supplementary Report for Approved APCP of Asphalt Surfaces (International) Ltd. (September 2024)
[2] Fuel similar to distillate oil is used to power the Bitumen Heating System, the species in the exhaust emission refer to USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-10. However, the emission factors in the table (Table 1.3-10) are based on fuel consumption in energy. As only fuel consumption in litre is available by the engineer, emission factors from "Uncontrolled No. 6 Fuel Oil Combustion" (USEPA AP-42, section 1.3, 5/10 ed. Table 1.3-11) which is expected to have more emissions are adopted as a conservative approach

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Sources from Existing Tar and Bitumen Works by Asphalt Surfaces (International) Limited under SP Licence No.: L-15-027(5)

Estimation of Heavy Metal Emission

Total Emission of Heavy Metal at EP1

Metal	Emission rate (g/s)
Arsenic	1.247E-05
Barium	3.750E-05
Beryllium	3.770E-06
Cadmium	1.554E-05
Chromium	1.487E-05
Hexavalent chromium	1.200E-06
Copper	7.129E-05
Lead	2.336E-05
Maganese	1.747E-04
Mercury	1.033E-05
Nickel	1.370E-04
Selenium	1.275E-05
Zinc	1.913E-04
Total	7.061E-04

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Existing Cement Works by Hong Kong Cement Co. Ltd ¹

Source ID	Type	X1	Y1	X2	Y2	Height (mAG)	Width (m) / Angle (degree)	Exit Temp. (K)	Exit velocity (m/s)	Stack Diameter (m)	Szint	Working Hours	RSP Emission Rate ²	FSP Emission Rate ²
HKCE1	POINT	827176.00	824760.00	-	-	45.00	-	0	6.67	0.52	-	0000-2400	4.250E-03	1.932E-03
HKCE2	POINT	827181.00	824760.00	-	-	45.00	-	0	6.67	0.52	-	0000-2400	4.250E-03	1.932E-03
HKCE3	POINT	827178.00	824763.00	-	-	20.05	-	0	19.62	0.52	-	0000-2400	2.242E-02	1.019E-02
HKCE4	POINT	827176.00	824739.00	-	-	45.00	-	0	6.67	0.52	-	0000-2400	4.250E-03	1.932E-03
HKCE5	POINT	827181.00	824739.00	-	-	45.00	-	0	6.67	0.52	-	0000-2400	4.250E-03	1.932E-03
HKCE6	POINT	827178.00	824736.00	-	-	20.05	-	0	13.56	0.65	-	0000-2400	2.015E-02	9.159E-03
HKCE9	POINT	827170.00	824737.00	-	-	20.00	-	0	12.03	0.50	-	0000-2400	1.515E-02	6.886E-03

Remarks:

1 - The emission inventory is extracted from Air Pollution Control Plan (dated August, 2023) for Cement Works by Hong Kong Concrete Co. Ltd.

2 - Emission rate of point source is in gram per second (g/s) while the one of area source is in gram per square meter per second (g/m2/s).

Existing Cement works by Hong Kong Concrete Co. Ltd.

Source ID	Type ¹	X1 ²	Y1 ²	X2	Y2	Height (mAG) ¹	Width (m) / Angle (degree)	Exit Temp. (K) ¹	Exit velocity (m/s)	Stack Diameter (m) ¹	Szint	Working Hours ¹	RSP Emission Rate ^{1,3}	FSP/RSP Factor ⁴	FSP Emission Rate ³
HKCO1	POINT	827119.51	824752.66	-	-	28.50	-	0.0	18.74	0.38	-	0000-2400	7.000E-03	0.45	3.182E-03
HKCO2	POINT	827116.17	824752.61	-	-	28.50	-	0.0	18.74	0.38	-	0000-2400	7.000E-03	0.45	3.182E-03
HKCO3	POINT	827112.84	824752.56	-	-	28.50	-	0.0	18.74	0.38	-	0000-2400	7.000E-03	0.45	3.182E-03
HKCO4	POINT	827109.63	824752.51	-	-	28.50	-	0.0	18.74	0.38	-	0000-2400	7.000E-03	0.45	3.182E-03
HKCO5	POINT	827118.91	824762.13	-	-	36.90	-	0.0	18.74	0.38	-	0000-2400	1.984E-02	0.45	9.019E-03
HKCO6	POINT	827109.35	824760.45	-	-	36.00	-	0.0	18.74	0.38	-	0000-2400	1.984E-02	0.45	9.019E-03
HKCO7	POINT	827116.12	824755.98	-	-	28.00	-	0.0	9.90	0.25	-	0000-2400	4.578E-03	0.45	2.081E-03
HKCO8	POINT	827119.46	824759.03	-	-	28.00	-	0.0	12.05	0.27	-	0000-2400	6.869E-03	0.45	3.122E-03
HKCO9	POINT	827112.79	824755.93	-	-	28.00	-	0.0	12.05	0.27	-	0000-2400	6.869E-03	0.45	3.122E-03
HKCO10	POINT	827109.58	824755.88	-	-	28.00	-	0.0	12.05	0.27	-	0000-2400	6.869E-03	0.45	3.122E-03
HKCO11	POINT	827108.82	824750.17	-	-	19.50	-	0.0	14.46	0.25	-	0000-2400	6.411E-03	0.45	2.914E-03
HKCO12	POINT	827119.54	824750.33	-	-	19.50	-	0.0	12.05	0.27	-	0000-2400	6.411E-03	0.45	2.914E-03
HKCO13	POINT	827118.28	824750.32	-	-	19.50	-	0.0	12.05	0.27	-	0000-2400	6.411E-03	0.45	2.914E-03
HKCO15	POINT	827104.91	824755.02	-	-	10.90	-	0.0	12.37	0.27	-	0000-2400	4.122E-03	0.45	1.874E-03
HKCO16	POINT	827104.97	824753.44	-	-	10.90	-	0.0	12.37	0.27	-	0000-2400	4.122E-03	0.45	1.874E-03

Remarks:

1 - Data extracted from Specified Processes License Registry maintained by HKEPD.

2 - The coordinates of the sources refer to satellite image and site visit

3 - Emission rate of point source is in gram per second (g/s) while the one of area source is in gram per square meter per second (g/m2/s).

4 -The FSP-to-RSP ratio refer to "Particle Size Distribution of General Concrete Batching Process (Controlled by Fabric Filter) (Applied for FSP Calculation)"

Existing Cement works by Quon Hing Concrete Company Limited ¹

Source ID	Type	X1	Y1	X2	Y2	Height (mAG)	Width (m) / Angle (degree)	Exit Temp. (K)	Exit velocity (m/s)	Stack Diameter (m)	Szint	Working Hours	RSP Emission Rate ²	FSP Emission Rate ²
QHC1	POINT	827146.00	824735.00	-	-	28.00	-	0.00	1.33	1.07	-	0700-1900	4.061E-03	1.846E-03
QHC2	POINT	827146.00	824732.00	-	-	28.00	-	0.00	2.01	1.07	-	0700-1900	6.139E-03	2.790E-03
QHC3	POINT	827142.00	824732.00	-	-	28.00	-	0.00	1.33	1.07	-	0700-1900	6.370E-03	2.896E-03
QHC4	POINT	827139.00	824732.00	-	-	28.00	-	0.00	14.84	0.22	-	0700-1900	1.889E-03	8.586E-04
QHC5	POINT	827139.00	824735.00	-	-	28.00	-	0.00	1.33	1.07	-	0700-1900	4.061E-03	1.846E-03
QHC6	POINT	827145.00	824740.00	-	-	18.00	-	0.00	1.23	1.07	-	0700-1900	3.333E-03	1.515E-03
QHC7	POINT	827134.00	824735.00	-	-	10.50	-	0.00	14.02	0.19	-	0700-1900	1.250E-03	5.682E-04
QHC8	POINT	827132.00	824769.00	-	-	23.50	-	0.00	2.01	1.07	-	0700-1900	9.630E-03	4.377E-03
QHC9	POINT	827132.00	824777.00	-	-	29.00	-	0.00	2.01	1.07	-	0700-1900	9.630E-03	4.377E-03
QHC10	AREA	827141.80	824799.26	4.64	3.04	10.00	178.44	0.00	-	-	0.00001	0700-1900	1.155E-02	2.707E-03
QHC11a	AREA	827150.07	824723.63	3.00	4.44	0.50	134.83	0.00	-	-	0.00001	0700-1900	1.074E-04	2.598E-05
QHC11b	AREA	827150.94	824752.98	3.00	29.36	0.50	178.58	0.00	-	-	0.00001	0700-1900	3.128E-05	7.568E-06
QHC11c	AREA	827150.40	824773.62	3.00	20.76	0.50	178.83	0.00	-	-	0.00001	0700-1900	7.338E-05	1.775E-05
QHC11d	AREA	827145.80	824753.36	10.74	3.00	0.50	101.56	0.00	-	-	0.00001	0700-1900	4.211E-05	1.019E-05
QHC11e	AREA	827144.14	824728.78	3.00	7.93	0.50	134.76	0.00	-	-	0.00001	0700-1900	7.630E-05	1.846E-05

Remarks:

1 - The emission inventory is extracted from Air Pollution Control Plan (dated August, 2023) for Cement Works by Hong Kong Concrete Co. Ltd.

2 - Emission rate of point source is in gram per second (g/s) while the one of area source is in gram per square meter per second (g/m²/s).

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Particle Size Distribution of General Concrete Batching Process (Controlled by Fabric Filter) (Applied for FSP Calculation)

Perentage of Particle Size Range							
Particale Size Range ^a	Average Partical Size ^a	% before Removal ^a	Removal Efficiency % ^b	% after Removal	ormalised Fractio	Normalised Fraction for PM10 Model ^c	Normalised Fraction for PM2.5 Model ^c
≤ 1.0	0.50	4	99.0%	4.0%	7%	12%	27%
1.0 ≤ 2.0	1.50	7	99.0%	7.0%	12%	21%	47%
2.0 ≤ 2.5	2.25	4	99.0%	4.0%	7%	12%	27%
2.5 ≤ 3.0	2.75	3	99.5%	1.5%	3%	5%	-
3.0 ≤ 4.0	3.50	7	99.5%	3.5%	6%	11%	-
4.0 ≤ 5.0	4.50	5	99.5%	2.5%	4%	8%	-
5.0 ≤ 6.0	5.50	4	99.5%	2.0%	3%	6%	-
6.0 ≤ 10	8.00	17	99.5%	8.5%	15%	26%	-
10 ≤ 30	20.00	49	99.5%	24.5%	43%	-	-

Remarks

(a) Deducted from Table B.2.2 "Description of Particle Size Categories" for Category 3 “Mechanically Generated Aggregate, Unprocessed Ores”, Page B.2-13 of Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95) (see below)

(b) Control efficiency of fabric filter on different size of particle refers to Table B.2-3 Typical Collection Efficiencies of Various Particulate Control Device, Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95) (see below)

(c) Normalised Fraction = % after normal of each particale size range / sum of % after removal of all particle size ranges

Cumulative Perentage of Particle Size		
Particale Size ^a	Cumulative % before Removal ^a	Cumulative % after Removal ^b
≤ 1.0	4	7%
≤ 2.0	11	19%
≤ 2.5	15	26%
≤ 3.0	18	29%
≤ 4.0	25	35%
≤ 5.0	30	39%
≤ 6.0	34	43%
≤ 10	51	57%
≤ 30	100	100%

Remarks

(a) Reference from Table B.2.2 "Description of Particle Size Categories" for Category 3 “Mechanically Generated Aggregate, Unprocessed Ores”, Page B.2-13 of Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95) (see below)

(b) Deducted from Normalised Fraction of Table "Percentage of Partical Size Range"

Emission Ratio for FSP calculation	
FSP-to-RSP ratio (Uncontrolled)	0.294
FSP-to-RSP ratio (Controlled)	0.455
FSP-to-TSP ratio (Uncontrolled)	0.150

Remarks

(a) Deducted from Table "Percentage of Partical Size Range"

Appendix 4.3 Emission Inventory of Adjacent Industrial Emissions

Table B.2-2. DESCRIPTION OF PARTICLE SIZE CATEGORIES

Particle Size, μm	Cumulative % ≤ Stated Size (Uncontrolled)	Minimum Value	Maximum Value	Standard Deviation
1.0 ^a	4	3	35	7
2.0 ^a	11			
2.5	15			
3.0 ^a	18			
4.0 ^a	25			
5.0 ^a	30	15	65	13
6.0	34			
10.0	51	23	81	14

^a Value calculated from data reported at 2.5, 6.0, and 10.0 μm. No statistical parameters are given for the calculated value.

Remarks

(a) Reference from Table B.2.2 "Description of Particle Size Categories" for Category 3 “Mechanically Generated Aggregate, Unprocessed Ores”, Page B.2-13 of Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95)

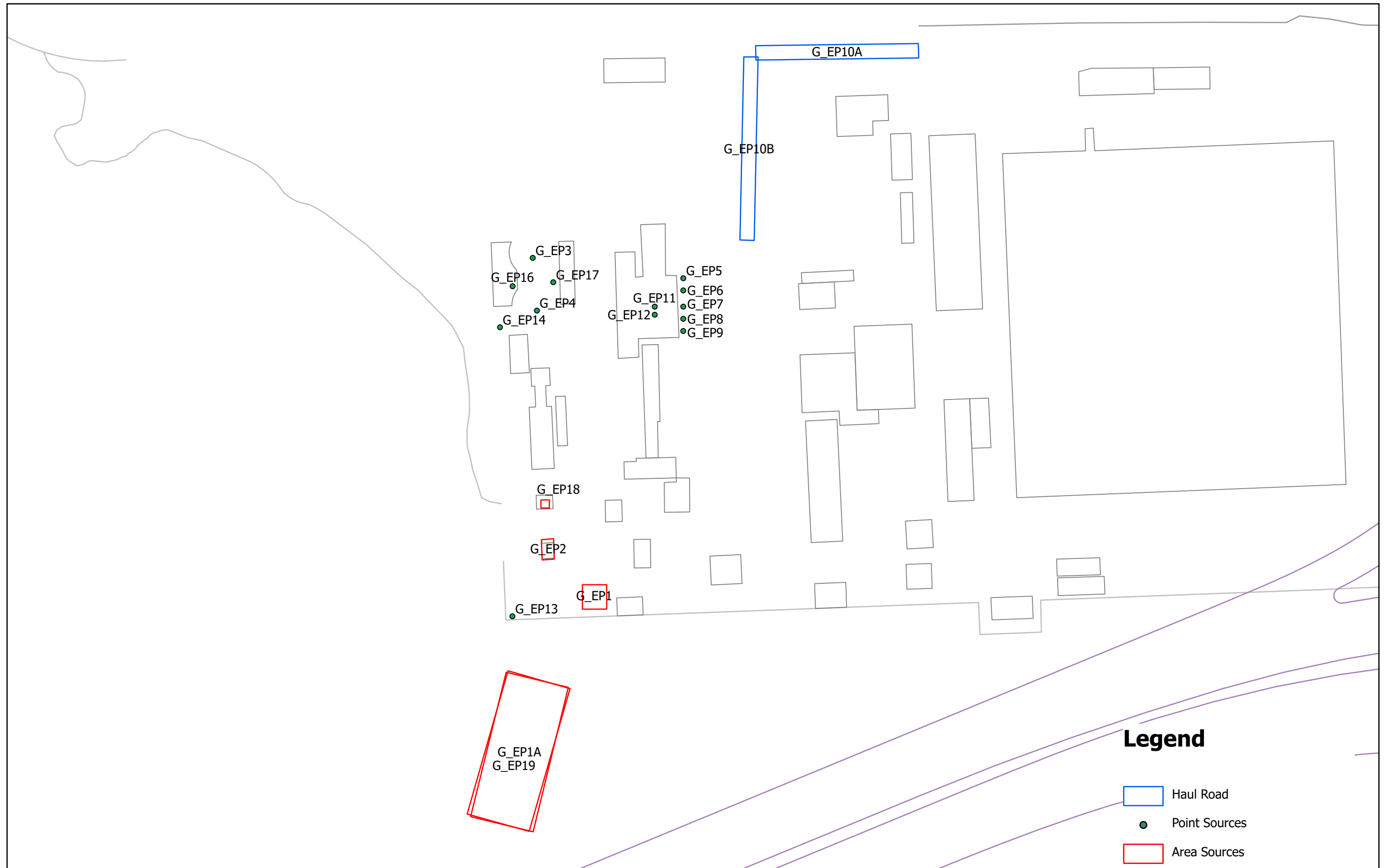
Table B.2-3. TYPICAL COLLECTION EFFICIENCIES OF VARIOUS PARTICULATE CONTROL DEVICES^a
(%)

AIRS Code ^b	Type Of Collector	Particle Size (μm)		
		0 - 2.5	2.5 - 6	6 - 10
016	Fabric filter - high temperature	99	99.5	99.5
017	Fabric filter - med temperature	99	99.5	99.5
018	Fabric filter - low temperature	99	99.5	99.5

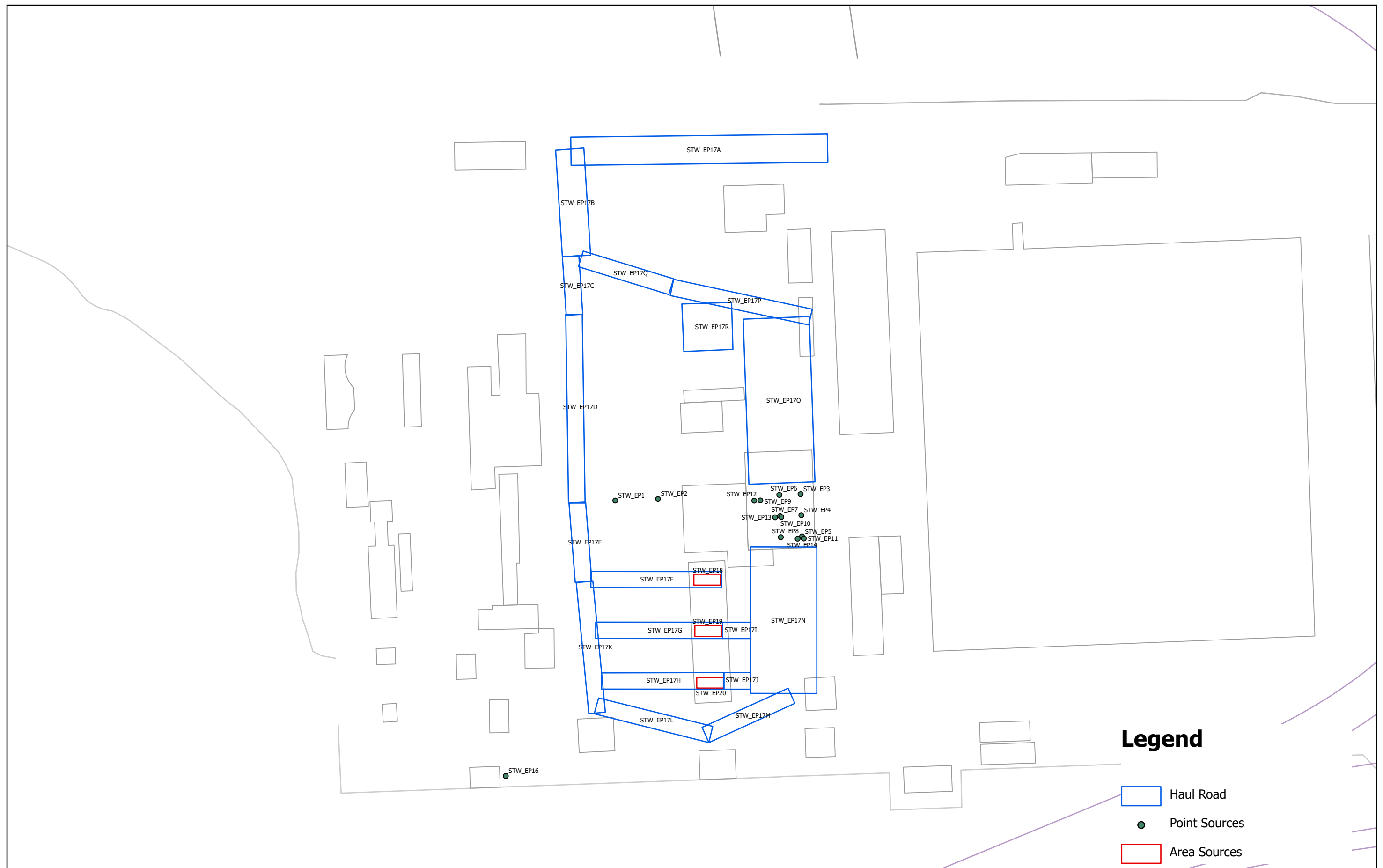
Remarks

(a) Reference from Table B.2-3. "Typical Collection Efficiencies of Various Particulate Control Devices", Page B.2-21 of Appendix B.2 Generalized Particle Size Distributions, AP-42, USEPA (Version 1/95)

Locations of Industrial Sources (Alliance Construction Materials Limited Concrete Batching Plant)

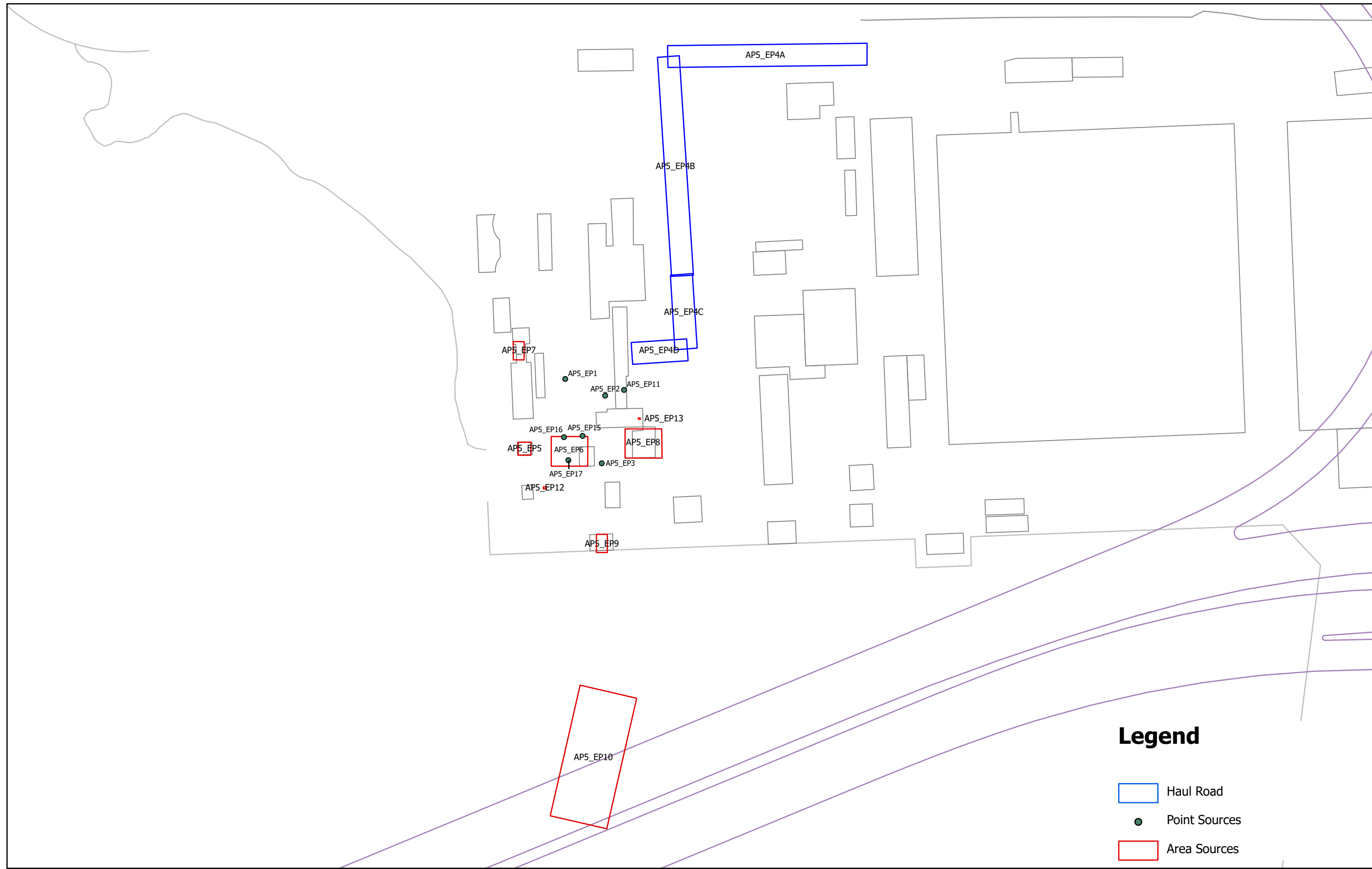


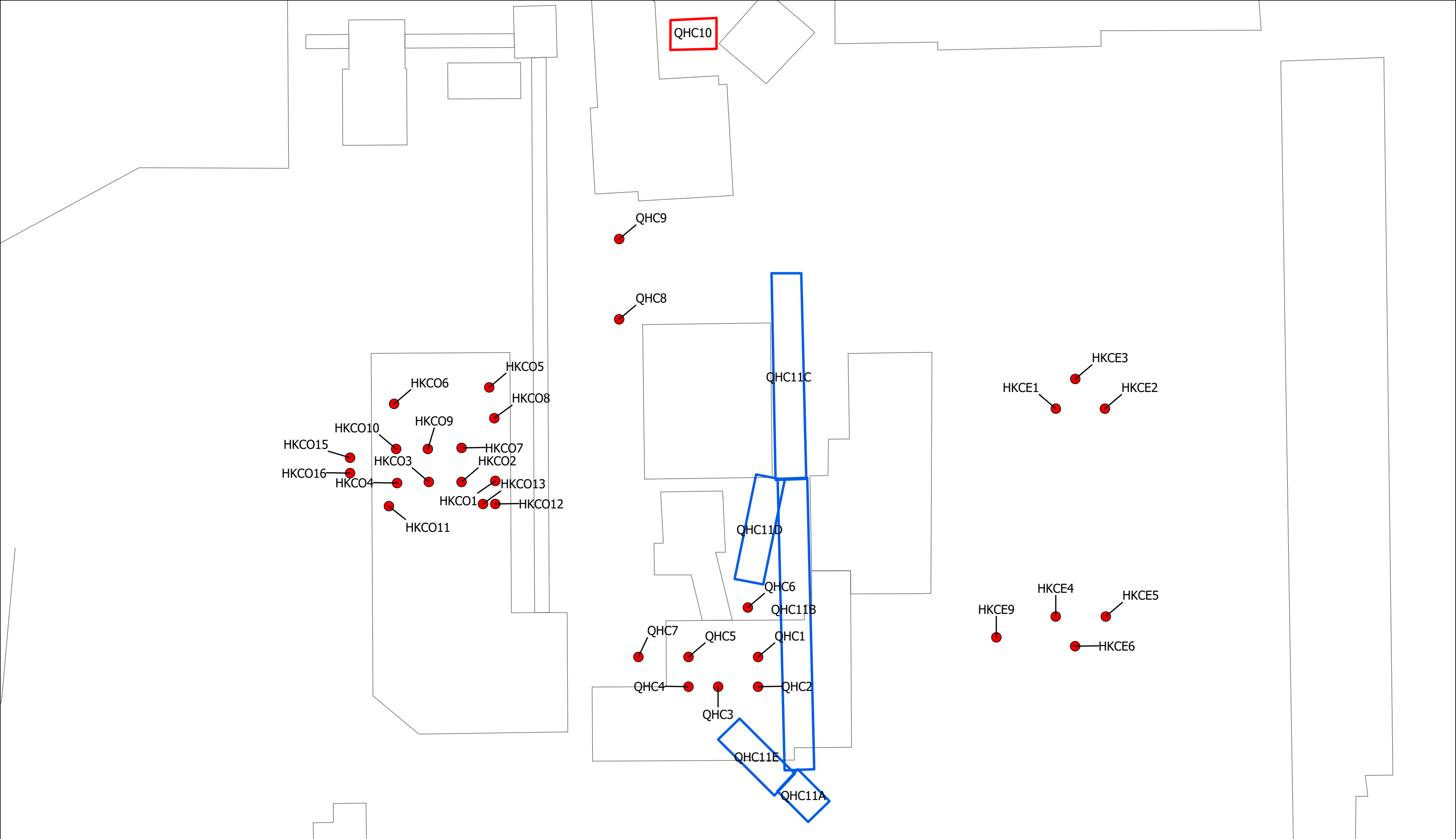
Locations of Industrial Sources Anderson Concrete Limited (STW)



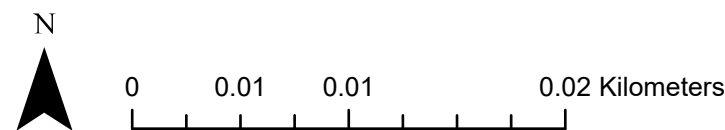
Locations of Industrial Sources

Asphalt Surfaces (International) Limited





**Location of Adjacent Industrial Emission Points
(Quon Hing Concrete Co. Ltd., Hong Kong Cement Co. Ltd, and
Hong Kong Concrete Co. Ltd.)**



Legend

- POINT Sources
- ▭ AREA Source
- ▭ Haul Road

Appendix 4.4

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic to Rock Processing Operation (Route 1)

Speed Distribution																										
Speed distribution by vessel type (Route 1)																										
	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20	20 - 22	22 - 24	24 - 26	26 - 28	28 - 30	30 - 32	32 - 34	34 - 36	36 - 38	38 - 40	40 - 42	42 - 44	44 - 46	46 - 48	48 - 50	
Speed Range (knots)	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	Total
Speed Median (knots)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00%
RTV																										

Operation Mode by Vessel Speed	
Vessel Speed	Operation Mode
0	Hotelling
1	Maneuvering
8	Slow Cruise
12	Fairway Cruise

Hourly Traffic Volume of Marine Traffic																										
Route #																										
1																										
Hourly Traffic Volume																										
Vessel ID	Vessel Category	Vessel Type	0000 - 0100	0100 - 0200	0200 - 0300	0300 - 0400	0400 - 0500	0500 - 0600	0600 - 0700	0700 - 0800	0800 - 0900	0900 - 1000	1000 - 1100	1100 - 1200	1200 - 1300	1300 - 1400	1400 - 1500	1500 - 1600	1600 - 1700	1700 - 1800	1800 - 1900	1900 - 2000	2000 - 2100	2100 - 2200	2200 - 2300	2300 - 2400
R1_RTV03M	RTV	Dry Bulk Carrier	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
R1_RTV03H	RTV	Dry Bulk Carrier	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Remark

1. The speed distribution and hourly traffic volume are provided from Project Engineer, based on project design

2. The hourly traffic volume for each vessel ID is used as their hourly profile in air dispersion modelling.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 1)

Load Factor by Vessel

Vessel Category	Vessel Type	Engine Category	GRT/DWT/PAX Sub-group	Fairway Cruise	Slow Cruise	Maneuvering	Hotelling
RTV	Fully Cellular Container Vessel	Main Engine	GRT >= 1000	0.45	0.45	0.3	0
RTV	Conventional Cargo Vessel	Main Engine	GRT >= 1000	0.45	0.45	0.3	0

Remark

1. The load factors refers to Study on Marine Vessels Emission Inventory (MVEIS):
- Load factors of main engine of RTV (Table 4-7)
 - Load factors of auxiliary engine of RTV (Table 4-10)

Emission Factors by Vessel

Vessel Category	Vessel Type	Engine Category	Engine Type ¹	Fuel ²	GRT/DWT/PAX Sub-group ³	Engine Power (kW) ⁴	Baseline Specific Fuel Consumption (g/kWh) ⁵	NOx Emission Factors (g/kWh) ⁶	SO ₂ Emission Factors (g/kWh) ⁷	RSP Emission Factors (g/kWh) ₈	FSP Emission Factor (g/kWh) ⁹
RTV	Dry Bulk Carrier	Main Engine	Diesel Engine	Fuel with sulphur content not exceeding 0.5%	GRT >= 1000	744.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01
RTV	Dry Bulk Carrier	Auxiliary Engine	-	-	GRT >= 1000	448.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01

Remarks

1. The main engine type of RTV refers to S4.2.6 of MVEIS.
2. According to the Air Pollution Control (Fuel for Vessels) Regulation stipulates the use of fuel with sulphur content of 0.5% for all vessels within Hong Kong waters.
3. The GRT sub-group refers to Table 4-5 of MVEIS; the highest GRT for each vessel type is adopted as a conservative approach.
4. Average engine power main engine power of RTV makes reference to Table 4-5 of MVEIS, while auxiliary engine power of RTV is given by Engineer.
5. BSFC of RTV makes reference to Table 4-16 of MVEIS.
6. The NOx emission factor refers to MVEIS and IMO Fourth Greenhouse Gas Study 2020:- NOx emission of RTV (Table 4-16, MVEIS)
7. The SO2 emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:SO2 EF = BSFC x 2 x 0.97753 x Fuel Sulphur Fraction
8. The RSP emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:PM10 EF = 0.23 + BSFC x 7 x 0.02247 x (Fuel Sulphur Fraction - 0.0024)
9. RSP to FSP conversion factor of 0.97 is used, with reference to paragraph 4.2.32 of MVEIS.

Emission Factors by Engine Category by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Engine Category	Load Factor	NOx Emission Factors (g/hr) ^{1,2}	SO ₂ Emission Factors (g/hr) ^{1,2}	RSP Emission Factors (g/hr) ^{1,2}	FSP Emission Factor (g/hr) ^{1,2}
RTV	Dry Bulk Carrier	1	Maneuvering	Main Engine	0.300	2.2320E+03	4.6473E+02	3.7128E+01	3.6014E+01
RTV	Dry Bulk Carrier	1	Maneuvering	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01
RTV	Dry Bulk Carrier	1	Hotelling	Main Engine	0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
RTV	Dry Bulk Carrier	1	Hotelling	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remarks

1. The load factor makes reference to the table 'Load Factor by Vessel'.
2. The calculations of the emission factor of each engine type refer to the following equation: Emission Factor of an Engine Type (g/hr) = Engine Power (kW) * Emission Factor (g/kWh) * Engine Load Factor.

Composite Emission Factors by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Composite NOx Emission Factors (g/hr) ¹	Composite SO2 Emission Factors (g/hr) ¹	Composite RSP Emission Factors (g/hr) ¹	Composite FSP Emission Factor (g/hr) ¹
RTV	Dry Bulk Carrier	1	Maneuvering	4.1584E+03	8.6584E+02	6.9173E+01	6.7098E+01
RTV	Dry Bulk Carrier	1	Hotelling	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remark

1. Total Emission Rate is determined by this equation : Main Engine Emission Rate + Auxiliary Engine Emission Rate + Auxiliary Boiler Emission Rate (if applicable).

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 1)

Vessel Parameters by Vessel

Vessel Category	Vessel Type	Parameter Group	Source Type	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	Remarks
RTV	Dry Bulk Carrier	Group 3 of RTV	POINT	1.3	6	503.15	25	0.8	1, 2, 3

Remarks

- The release height of the vessels are determined by on-site observations.
- The exhaust temperature refer to the journal article: Dong, Thi Minh Hao & Xuan Phuong Nguyen. (2019). Exhaust Gas Recovery from Marine Diesel Engine in Order to Reduce the Toxic Emission and Save Energy: A Mini Review. Journal of Mechanical Engineering Research & Developments, 42(5):143-147. <https://doi.org/10.26480/jmerd.05.2019.143.147>. Given that other emission sources identified in this study (i.e., industrial/vehicular emission sources) mostly affect the air quality at a lower level, the lowest temperature of documented in this article was adopted as a conservative approach.
- The stack parameters, except release height and exit temperature, refer to approved EIA - "Route 11 (Section between Yuen Long and North Lantau)" (EIA-297/2023).

Total Emission Rate of the Marine Emission

Route #
1

Total Emission Rate

Vessel ID	Vessel Category	Vessel Type	Route Code ¹	Average Speed (Knot) ²	Operation Mode	Distance (nautical miles) ₃	Time-in-mode (hr)	NOx Emission Rate (g/s-vessel) ⁴	SO ₂ Emission Rate (g/s-vessel) ⁴	RSP Emission Rate (g/s- vessel) ⁴	FSP Emission Rate (g/s-vessel) ₄
R1_RTVO3M	RTV	Dry Bulk Carrier	1	1	Maneuvering	3.11E-01	3.11E-01	3.5907E-01	7.4762E-02	5.9729E-03	5.7937E-03
R1_RTVO3H	RTV	Dry Bulk Carrier	1	0	Hotelling	0.00E+00	1.00E+00	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03

Remark

- Despite the actual routes, all general marine vessels are considered travelling in the water at the nearest and safe distance from the project site / nearby shipyards.
- The average speed is calculated from the speed distribution for each vessel on each route.
- The distance is measured for each route.
- The calculations of emission factors refer to the following equation: Emission Factor (g/s-vessel) = Composite Emission Factor (g/hr) * Time-in-mode (hr) / 3600.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 1)

Emission Inventory

Source ID	Vessel ID	Vessel Category	Vessel Type	Source Type	X	Y	Number of Point Sources	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	NOx Emission Rate (g/s/vessel)	SO ₂ Emission Rate (g/s/vessel)	RSP Emission Rate (g/s/vessel)	FSP Emission Rate (g/s/vessel)
R1_RTV03H_01	R1_RTV03H	RTV	Dry Bulk Carrier	POINT	826754.79	824686.0919	1	1.3	6	503.15	25	0.8	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03
R1_RTV03M_01	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826736.9388	824695.1091	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_02	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826719.3531	824704.6335	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_03	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826701.9009	824714.4013	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_04	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826683.7203	824722.6904	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_05	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826664.5401	824728.3219	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_06	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826644.9948	824732.555	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_07	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826625.3322	824736.2111	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_08	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826605.5933	824739.4295	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_09	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826585.7783	824742.1387	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_10	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826565.8912	824744.2532	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_11	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826545.9438	824745.6875	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_12	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826525.9576	824746.4006	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_13	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826505.9583	824746.5356	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_14	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826485.9586	824746.6219	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_15	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826465.9595	824746.472	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_16	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826445.972	824745.7879	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_17	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826426.0138	824744.5067	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_18	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826406.1	824742.6578	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_19	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826386.2401	824740.2989	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_20	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826366.3879	824737.8739	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_21	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826346.4916	824735.8446	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_22	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826326.5593	824734.2022	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_23	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826306.6277	824732.5516	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_24	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826286.7339	824730.497	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_25	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826266.8863	824728.035	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_26	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826247.0718	824725.3175	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_27	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826227.2745	824722.4775	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_28	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826207.4979	824719.4968	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_29	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826187.7312	824716.451	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_30	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826167.9412	824713.5613	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_31	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826148.1183	824710.9064	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_32	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826128.287	824708.3142	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_33	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826108.4677	824705.632	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_34	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826088.64	824703.013	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_35	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826068.776	824700.6863	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_36	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826048.8886	824698.5673	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_37	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826028.9875	824696.5812	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_38	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	826009.1093	824694.381	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_39	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825989.2947	824691.6685	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_40	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825969.5435	824688.5253	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_41	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825949.8571	824685.0016	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_42	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825930.312	824680.7665	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_43	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825910.9725	824675.677	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_44	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825891.9781	824669.4317	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04
R1_RTV03M_45	R1_RTV03M	RTV	Dry Bulk Carrier	POINT	825890.4405	824668.8239	45	1.3	6	503.15	25	0.8	1.2220E-02	2.5444E-03	2.0327E-04	1.9717E-04

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic to Concrete Batching Operation (Route 2)

Speed Distribution																										
Speed distribution by vessel type (Route 2)																										
Speed Range (knots)	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20	20 - 22	22 - 24	24 - 26	26 - 28	28 - 30	30 - 32	32 - 34	34 - 36	36 - 38	38 - 40	40 - 42	42 - 44	44 - 46	46 - 48	48 - 50	Total
Speed Median (knots)	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	
RTV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00%

Operation Mode by Vessel Speed	
Vessel Speed	Operation Mode
0	Hotelling
1	Maneuvering
8	Slow Cruise
12	Fairway Cruise

Hourly Traffic Volume of Marine Traffic

Route #

2

Hourly Traffic Volume

Vessel ID	Vessel Category	Vessel Type	0000 - 0100	0100 - 0200	0200 - 0300	0300 - 0400	0400 - 0500	0500 - 0600	0600 - 0700	0700 - 0800	0800 - 0900	0900 - 1000	1000 - 1100	1100 - 1200	1200 - 1300	1300 - 1400	1400 - 1500	1500 - 1600	1600 - 1700	1700 - 1800	1800 - 1900	1900 - 2000	2000 - 2100	2100 - 2200	2200 - 2300	2300 - 2400
R2_RTV03M	RTV	Dry Bulk Carrier	0	0	2	0	0	0	2	2	0	0	0	2	2	0	0	0	2	2	0	0	0	2	0	0
R2_RTV03H	RTV	Dry Bulk Carrier	0	0	0	2	2	2	0	0	2	2	2	0	0	2	2	2	0	0	2	2	2	0	0	0

Remark

1. The speed distribution and hourly traffic volume are provided from Project Engineer, based on project design

2. The hourly traffic volume for each vessel ID is used as their hourly profile in air dispersion modelling.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 2)

Load Factor by Vessel

Vessel Category	Vessel Type	Engine Category	GRT/DWT/PAX Sub-group	Fairway Cruise	Slow Cruise	Maneuvering	Hotelling
RTV	Fully Cellular Container Vessel	Main Engine	GRT >= 1000	0.45	0.45	0.3	0
RTV	Conventional Cargo Vessel	Main Engine	GRT >= 1000	0.45	0.45	0.3	0

Remark

1. The load factors refers to Study on Marine Vessels Emission Inventory (MVEIS):
- Load factors of main engine of RTV (Table 4-7)
 - Load factors of auxiliary engine of RTV (Table 4-10)

Emission Factors by Vessel

Vessel Category	Vessel Type	Engine Category	Engine Type ¹	Fuel ²	GRT/DWT/PAX Sub-group ³	Engine Power (kW) ⁴	Baseline Specific Fuel Consumption (g/kWh) ⁵	NOx Emission Factors (g/kWh) ⁶	SO ₂ Emission Factors (g/kWh) ⁷	RSP Emission Factors (g/kWh) ₈	FSP Emission Factor (g/kWh) ⁹
RTV	Dry Bulk Carrier	Main Engine	Diesel Engine	Fuel with sulphur content not exceeding 0.5%	GRT >= 1000	744.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01
RTV	Dry Bulk Carrier	Auxiliary Engine	-	-	GRT >= 1000	448.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01

Remarks

1. The main engine type of RTV refers to S4.2.6 of MVEIS.
2. According to the Air Pollution Control (Fuel for Vessels) Regulation stipulates the use of fuel with sulphur content of 0.5% for all vessels within Hong Kong waters.
3. The GRT sub-group refers to Table 4-5 of MVEIS; the highest GRT for each vessel type is adopted as a conservative approach.
4. Average engine power main engine power of RTV makes reference to Table 4-5 of MVEIS, while auxiliary engine power of RTV is given by Engineer.
5. BSFC of RTV makes reference to Table 4-16 of MVEIS.
6. The NOx emission factor refers to MVEIS and IMO Fourth Greenhouse Gas Study 2020:- NOx emission of RTV (Table 4-16, MVEIS)
7. The SO2 emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:SO2 EF = BSFC x 2 x 0.97753 x Fuel Sulphur Fraction
8. The RSP emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:PM10 EF = 0.23 + BSFC x 7 x 0.02247 x (Fuel Sulphur Fraction - 0.0024)
9. RSP to FSP conversion factor of 0.97 is used, with reference to paragraph 4.2.32 of MVEIS.

Emission Factors by Engine Category by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Engine Category	Load Factor	NOx Emission Factors (g/hr) ^{1,2}	SO ₂ Emission Factors (g/hr) ^{1,2}	RSP Emission Factors (g/hr) ^{1,2}	FSP Emission Factor (g/hr) ^{1,2}
RTV	Dry Bulk Carrier	2	Maneuvering	Main Engine	0.300	2.2320E+03	4.6473E+02	3.7128E+01	3.6014E+01
RTV	Dry Bulk Carrier	2	Maneuvering	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01
RTV	Dry Bulk Carrier	2	Hotelling	Main Engine	0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
RTV	Dry Bulk Carrier	2	Hotelling	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remarks

1. The load factor makes reference to the table 'Load Factor by Vessel'.
2. The calculations of the emission factor of each engine type refer to the following equation: Emission Factor of an Engine Type (g/hr) = Engine Power (kW) * Emission Factor (g/kWh) * Engine Load Factor.

Composite Emission Factors by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Composite NOx Emission Factors (g/hr) ¹	Composite SO2 Emission Factors (g/hr) ¹	Composite RSP Emission Factors (g/hr) ¹	Composite FSP Emission Factor (g/hr) ¹
RTV	Dry Bulk Carrier	2	Maneuvering	4.1584E+03	8.6584E+02	6.9173E+01	6.7098E+01
RTV	Dry Bulk Carrier	2	Hotelling	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remark

1. Total Emission Rate is determined by this equation : Main Engine Emission Rate + Auxiliary Engine Emission Rate + Auxiliary Boiler Emission Rate (if applicable).

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 2)

Vessel Parameters by Vessel

Vessel Category	Vessel Type	Parameter Group	Source Type	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	Remarks
RTV	Dry Bulk Carrier	Group 3 of RTV	POINT	1.30	6	503.15	25.00	0.80	1, 2, 3

Remarks

- The release height of the vessels are determined by on-site observations.
- The exhaust temperature refer to the journal article: Dong, Thi Minh Hao & Xuan Phuong Nguyen. (2019). Exhaust Gas Recovery from Marine Diesel Engine in Order to Reduce the Toxic Emission and Save Energy: A Mini Review. Journal of Mechanical Engineering Research & Developments, 42(5):143-147. <https://doi.org/10.26480/jmerd.05.2019.143.147>. Given that other emission sources identified in this study (i.e., industrial/vehicular emission sources) mostly affect the air quality at a lower level, the lowest temperature of documented in this article was adopted as a conservative approach.
- The stack parameters, except release height and exit temperature, refer to approved EIA - "Route 11 (Section between Yuen Long and North Lantau)" (EIA-297/2023).

Total Emission Rate of the Marine Emission

Route #
2

Total Emission Rate

Vessel ID	Vessel Category	Vessel Type	Route Code ¹	Average Speed (Knot) ²	Operation Mode	Distance (nautical miles) ₃	Time-in-mode (hr)	NOx Emission Rate (g/s-vessel) ⁴	SO ₂ Emission Rate (g/s-vessel) ⁴	RSP Emission Rate (g/s- vessel) ⁴	FSP Emission Rate (g/s-vessel) ₄
R2_RTU03M	RTV	Dry Bulk Carrier	2	1	Maneuvering	3.11E-01	3.11E-01	3.5907E-01	7.4762E-02	5.9729E-03	5.7937E-03
R2_RTU03H	RTV	Dry Bulk Carrier	2	0	Hotelling	0.00E+00	1.00E+00	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03

Remark

- Despite the actual routes, all general marine vessels are considered travelling in the water at the nearest and safe distance from the project site / nearby shipyards.
- The average speed is calculated from the speed distribution for each vessel on each route.
- The distance is measured for each route.
- The calculations of emission factors refer to the following equation: Emission Factor (g/s-vessel) = Composite Emission Factor (g/hr) * Time-in-mode (hr) / 3600.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 2)

Emission Inventory

Source ID	Vessel ID	Vessel Category	Vessel Type	Source Type	X	Y	Number of Point Sources	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	NOx Emission Rate (g/s/vessel)	SO ₂ Emission Rate (g/s/vessel)	RSP Emission Rate (g/s/vessel)	FSP Emission Rate (g/s/vessel)
R2_RTV03H_01	R2_RTV03H	RTV	Dry Bulk Carrier	POINT	826717.0621	824662.4712	1	1.30	6.00	503.15	25.00	0.80	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03
R2_RTV03M_01	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826697.065	824662.8121	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_02	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826677.0689	824663.2078	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_03	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826657.0734	824663.6326	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_04	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826637.0772	824664.02	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_05	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826617.0784	824664.2172	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_06	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826597.0813	824663.9374	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_07	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826577.1123	824662.8545	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_08	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826557.2087	824660.9059	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_09	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826537.3754	824658.3326	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_10	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826517.5287	824655.8658	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_11	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826497.6309	824653.8497	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_12	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826477.7171	824651.9942	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_13	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826457.8285	824649.8897	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_14	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826437.9956	824647.3142	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_15	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826418.2296	824644.266	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_16	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826398.528	824640.826	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_17	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826378.8824	824637.0783	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_18	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826359.2842	824633.0899	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_19	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826339.7043	824629.0124	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_20	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826320.0987	824625.0604	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_21	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826300.4622	824621.2651	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_22	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826280.7942	824617.6361	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_23	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826261.1085	824614.1046	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_24	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826241.442	824610.4678	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_25	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826221.8334	824606.5317	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_26	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826202.2914	824602.2772	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_27	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826182.8038	824597.7792	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_28	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826163.3564	824593.1105	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_29	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826143.9363	824588.3293	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_30	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826124.5099	824583.5738	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_31	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826105.0649	824578.8951	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_32	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826085.5979	824574.3089	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_33	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826066.105	824569.8336	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_34	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826046.5827	824565.489	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_35	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826027.0272	824561.2959	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_36	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	826007.436	824557.2734	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_37	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825987.8076	824553.4364	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_38	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825968.1425	824549.7922	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_39	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825948.4429	824546.3388	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_40	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825928.713	824543.0637	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_41	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825908.9575	824539.9461	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_42	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825889.209	824536.7877	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_43	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825869.5874	824532.924	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_44	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825850.2161	824527.9656	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_45	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825831.4551	824521.086	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04
R2_RTV03M_46	R2_RTV03M	RTV	Dry Bulk Carrier	POINT	825818.2833	824511.6009	46	1.30	6.00	503.15	25.00	0.80	1.2426E-02	2.5873E-03	2.0670E-04	2.0050E-04

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic travelling between Ngau Kok Wan and Wok Tai Wan (Route 3)

1. The speed distribution and hourly traffic volume are provided from Project Engineer, based on project design
2. The hourly traffic volume for each vessel ID is used as their hourly profile in air dispersion modelling.

Speed distribution by vessel type (Route 3)

Speed Range (knots)	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20	20 - 22	22 - 24	24 - 26	26 - 28	28 - 30	30 - 32	32 - 34	34 - 36	36 - 38	38 - 40	40 - 42	42 - 44	44 - 46	46 - 48	48 - 50	Total
Speed Median (knots)	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	
RTV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00%

Operation Mode by Vessel Speed

Vessel Speed	Operation Mode
0	Hotelling
1	Maneuvering
8	Slow Cruise
12	Fairway Cruise

Hourly Traffic Volume of Marine Traffic

Route #
3

Hourly Traffic Volume

Vessel ID	Vessel Category	Vessel Type	0000 - 0100	0100 - 0200	0200 - 0300	0300 - 0400	0400 - 0500	0500 - 0600	0600 - 0700	0700 - 0800	0800 - 0900	0900 - 1000	1000 - 1100	1100 - 1200	1200 - 1300	1300 - 1400	1400 - 1500	1500 - 1600	1600 - 1700	1700 - 1800	1800 - 1900	1900 - 2000	2000 - 2100	2100 - 2200	2200 - 2300	2300 - 2400
R3_RTV03M	RTV	Dry Bulk Carrier	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
R3_RTV03H	RTV	Dry Bulk Carrier	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0

Remark

1. The speed distribution and hourly traffic volume are provided from Project Engineer, based on project design
2. The hourly traffic volume for each vessel ID is used as their hourly profile in air dispersion modelling.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 3)

Load Factor by Vessel

Vessel Category	Vessel Type	Engine Category	GRT/DWT/PAX Sub-group	Fairway Cruise	Slow Cruise	Maneuvering	Hotelling
RTV	Fully Cellular Container Vessel	Main Engine	GRT >= 1000	0.45	0.45	0.3	0
RTV	Conventional Cargo Vessel	Main Engine	GRT >= 1000	0.45	0.45	0.3	0

Remark

1. The load factors refers to Study on Marine Vessels Emission Inventory (MVEIS):
- Load factors of main engine of RTV (Table 4-7)
- Load factors of auxiliary engine of RTV (Table 4-10)

Emission Factors by Vessel

Vessel Category	Vessel Type	Engine Category	Engine Type ¹	Fuel ²	GRT/DWT/PAX Sub-group ³	Engine Power (kW) ⁴	Baseline Specific Fuel Consumption (g/kWh) ⁵	NOx Emission Factors (g/kWh) ⁶	SO ₂ Emission Factors (g/kWh) ⁷	RSP Emission Factors (g/kWh) ₈	FSP Emission Factor (g/kWh) ⁹
RTV	Dry Bulk Carrier	Main Engine	Diesel Engine	Fuel with sulphur content not exceeding 0.5%	GRT >= 1000	744.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01
RTV	Dry Bulk Carrier	Auxiliary Engine	-	-	GRT >= 1000	448.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01

Remarks

1. The main engine type of RTV refers to S4.2.6 of MVEIS.
2. According to the Air Pollution Control (Fuel for Vessels) Regulation stipulates the use of fuel with sulphur content of 0.5% for all vessels within Hong Kong waters.
3. The GRT sub-group refers to Table 4-5 of MVEIS; the highest GRT for each vessel type is adopted as a conservative approach.
4. Average engine power main engine power of RTV makes reference to Table 4-5 of MVEIS, while auxiliary engine power of RTV is given by Engineer.
5. BSFC of RTV makes reference to Table 4-16 of MVEIS.
6. The NOx emission factor refers to MVEIS and IMO Fourth Greenhouse Gas Study 2020:- NOx emission of RTV (Table 4-16, MVEIS)
7. The SO2 emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:SO2 EF = BSFC x 2 x 0.97753 x Fuel Sulphur Fraction
8. The RSP emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:PM10 EF = 0.23 + BSFC x 7 x 0.02247 x (Fuel Sulphur Fraction - 0.0024)
9. RSP to FSP conversion factor of 0.97 is used, with reference to paragraph 4.2.32 of MVEIS.

Emission Factors by Engine Category by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Engine Category	Load Factor	NOx Emission Factors (g/hr) ^{1,2}	SO ₂ Emission Factors (g/hr) ^{1,2}	RSP Emission Factors (g/hr) ^{1,2}	FSP Emission Factor (g/hr) ^{1,2}
RTV	Dry Bulk Carrier	3	Maneuvering	Main Engine	0.300	2.2320E+03	4.6473E+02	3.7128E+01	3.6014E+01
RTV	Dry Bulk Carrier	3	Maneuvering	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01
RTV	Dry Bulk Carrier	3	Hotelling	Main Engine	0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
RTV	Dry Bulk Carrier	3	Hotelling	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remarks

1. The load factor makes reference to the table 'Load Factor by Vessel'.
2. The calculations of the emission factor of each engine type refer to the following equation: Emission Factor of an Engine Type (g/hr) = Engine Power (kW) * Emission Factor (g/kWh) * Engine Load Factor.

Composite Emission Factors by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Composite NOx Emission Factors (g/hr) ¹	Composite SO2 Emission Factors (g/hr) ¹	Composite RSP Emission Factors (g/hr) ¹	Composite FSP Emission Factor (g/hr) ¹
RTV	Dry Bulk Carrier	3	Maneuvering	4.1584E+03	8.6584E+02	6.9173E+01	6.7098E+01
RTV	Dry Bulk Carrier	3	Hotelling	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remark

1. Total Emission Rate is determined by this equation : Main Engine Emission Rate + Auxiliary Engine Emission Rate + Auxiliary Boiler Emission Rate (if applicable).

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 3)

Vessel Parameters by Vessel

Vessel Category	Vessel Type	Parameter Group	Source Type	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	Remarks
RTV	Dry Bulk Carrier	Group 3 of RTV	POINT	1.30	6	503.15	25.00	0.80	1, 2, 3

Remarks

- The release height of the vessels are determined by on-site observations.
- The exhaust temperature refer to the journal article: Dong, Thi Minh Hao & Xuan Phuong Nguyen. (2019). Exhaust Gas Recovery from Marine Diesel Engine in Order to Reduce the Toxic Emission and Save Energy: A Mini Review. Journal of Mechanical Engineering Research & Developments, 42(5):143-147. <https://doi.org/10.26480/jmerd.05.2019.143.147>. Given that other emission sources identified in this study (i.e., industrial/vehicular emission sources) mostly affect the air quality at a lower level, the lowest temperature of documented in this article was adopted as a conservative approach.
- The stack parameters, except release height and exit temperature, refer to approved EIA - "Route 11 (Section between Yuen Long and North Lantau)" (EIA-297/2023).

Total Emission Rate of the Marine Emission

Route #
3

Total Emission Rate

Vessel ID	Vessel Category	Vessel Type	Route Code ¹	Average Speed (Knot) ²	Operation Mode	Distance (nautical miles) ₃	Time-in-mode (hr)	NOx Emission Rate (g/s-vessel) ⁴	SO ₂ Emission Rate (g/s-vessel) ⁴	RSP Emission Rate (g/s- vessel) ⁴	FSP Emission Rate (g/s-vessel) ₄
R3_RTV03M	RTV	Dry Bulk Carrier	3	1	Maneuvering	3.11E-01	3.11E-01	3.5907E-01	7.4762E-02	5.9729E-03	5.7937E-03
R3_RTV03H	RTV	Dry Bulk Carrier	3	0	Hotelling	0.00E+00	1.00E+00	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03

Remark

- Despite the actual routes, all general marine vessels are considered travelling in the water at the nearest and safe distance from the project site / nearby shipyards.
- The average speed is calculated from the speed distribution for each vessel on each route.
- The distance is measured for each route.
- The calculations of emission factors refer to the following equation: Emission Factor (g/s-vessel) = Composite Emission Factor (g/hr) * Time-in-mode (hr) / 3600.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 3)

Emission Inventory

Source ID	Vessel ID	Vessel Category	Vessel Type	Source Type	X	Y	Number of Point Sources	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	NOx Emission Rate (g/s/vessel)	SO ₂ Emission Rate (g/s/vessel)	RSP Emission Rate (g/s/vessel)	FSP Emission Rate (g/s/vessel)
R3_RTV03H_01	R3_RTV03H	RTV	Dry Bulk Carrier	POINT	826326.8587	824116.1911	1	1.30	6.00	503.15	25.00	0.80	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03
R3_RTV03M_01	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826308.7185	824124.6126	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_02	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826290.7421	824133.3782	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_03	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826272.9461	824142.5044	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_04	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826255.3491	824152.0087	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_05	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826237.9722	824161.9094	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_06	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826220.8391	824172.2262	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_07	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826203.9767	824182.9796	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_08	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826187.4152	824194.1908	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_09	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826171.1894	824205.8823	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_10	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826155.3383	824218.0769	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_11	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826139.9065	824230.7977	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_12	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826124.9448	824244.0681	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_13	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826110.5109	824257.9103	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_14	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826096.6702	824272.3454	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_15	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826083.4969	824287.3916	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_16	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826071.0746	824303.0633	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_17	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826059.4973	824319.3687	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_18	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826048.8693	824336.3077	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_19	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826039.306	824353.8691	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_20	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826030.9325	824372.0275	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_21	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826023.8833	824390.7391	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_22	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826018.2999	824409.9383	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_23	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826014.3286	824429.5338	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_24	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826012.1181	824449.4041	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_25	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826011.8174	824469.3936	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_26	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826013.576	824489.3066	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_27	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826017.5467	824508.8968	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_28	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826023.8919	824527.8488	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_29	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826032.7144	824545.7825	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_30	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826042.8566	824563.0173	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_31	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826054.0694	824579.5731	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_32	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826066.6288	824595.1282	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_33	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826080.7641	824609.2612	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_34	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826096.5183	824621.5606	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_35	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826113.6553	824631.8503	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_36	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826131.7618	824640.3291	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_37	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826150.4469	824647.4532	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_38	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826169.4406	824653.7144	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_39	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826188.5814	824659.5127	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_40	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826207.7757	824665.1321	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_41	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826226.977	824670.7275	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_42	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826246.2016	824676.2424	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_43	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826265.4841	824681.5506	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_44	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826284.8622	824686.4977	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_45	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826304.3639	824690.9308	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_46	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826323.996	824694.7445	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_47	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826343.7431	824697.9097	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 3)

Emission Inventory

Source ID	Vessel ID	Vessel Category	Vessel Type	Source Type	X	Y	Number of Point Sources	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	NOx Emission Rate (g/s/vessel)	SO ₂ Emission Rate (g/s/vessel)	RSP Emission Rate (g/s/vessel)	FSP Emission Rate (g/s/vessel)
R3_RTV03M_48	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826363.5781	824700.468	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 3)

Emission Inventory

Source ID	Vessel ID	Vessel Category	Vessel Type	Source Type	X	Y	Number of Point Sources	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	NOx Emission Rate (g/s/vessel)	SO ₂ Emission Rate (g/s/vessel)	RSP Emission Rate (g/s/vessel)	FSP Emission Rate (g/s/vessel)
R3_RTV03M_49	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826383.474	824702.5012	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_50	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826403.4096	824704.1015	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_51	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826423.3701	824705.3537	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_52	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826443.3462	824706.3286	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_53	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826463.3319	824707.0828	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_54	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826483.3235	824707.6608	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_55	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826503.3197	824708.0377	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_56	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826523.3195	824708.0825	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_57	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826543.3173	824707.8003	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_58	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826563.3082	824707.2026	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_59	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826583.2875	824706.2991	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_60	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826603.2512	824705.0979	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_61	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826623.1953	824703.6053	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_62	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826643.1158	824701.8255	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_63	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826663.0087	824699.76	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_64	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826682.8695	824697.4067	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_65	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826702.6932	824694.7581	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_66	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826722.4724	824691.7963	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_67	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826742.1949	824688.4777	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04
R3_RTV03M_68	R3_RTV03M	RTV	Dry Bulk Carrier	POINT	826754.79	824686.0919	68	1.30	6.00	503.15	25.00	0.80	1.2408E-02	2.5836E-03	2.0641E-04	2.0021E-04

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic to Wok Tai Wan (Route 4)

Speed Distribution																										
Speed distribution by vessel type (Route 4)																										
	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20	20 - 22	22 - 24	24 - 26	26 - 28	28 - 30	30 - 32	32 - 34	34 - 36	36 - 38	38 - 40	40 - 42	42 - 44	44 - 46	46 - 48	48 - 50	
Speed Range (knots)																										
Speed Median (knots)	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	Total
RTV	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00%

Operation Mode by Vessel Speed	
Vessel Speed	Operation Mode
0	Hotelling
1	Maneuvering
8	Slow Cruise
12	Fairway Cruise

Hourly Traffic Volume of Marine Traffic

Route #
4

Hourly Traffic Volume																										
Vessel ID	Vessel Category	Vessel Type	0000 - 0100	0100 - 0200	0200 - 0300	0300 - 0400	0400 - 0500	0500 - 0600	0600 - 0700	0700 - 0800	0800 - 0900	0900 - 1000	1000 - 1100	1100 - 1200	1200 - 1300	1300 - 1400	1400 - 1500	1500 - 1600	1600 - 1700	1700 - 1800	1800 - 1900	1900 - 2000	2000 - 2100	2100 - 2200	2200 - 2300	2300 - 2400
R4_RTV03M	RTV	Dry Bulk Carrier	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
R4_RTV03H	RTV	Dry Bulk Carrier	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

- Remark
1. The speed distribution and hourly traffic volume are provided from Project Engineer, based on project design
 2. The hourly traffic volume for each vessel ID is used as their hourly profile in air dispersion modelling.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 4)

Load Factor by Vessel

Vessel Category	Vessel Type	Engine Category	GRT/DWT/PAX Sub-group	Fairway Cruise	Slow Cruise	Maneuvering	Hotelling
RTV	Dry Bulk Carrier	Main Engine	GRT >= 1000	0.45	0.45	0.3	0
RTV	Dry Bulk Carrier	Main Engine	GRT >= 1000	0.43	0.43	0.43	0.43

Remark

1. The load factors refers to Study on Marine Vessels Emission Inventory (MVEIS):

- Load factors of main engine of RTV (Table 4-7)
- Load factors of auxiliary engine of RTV (Table 4-10)

Emission Factors by Vessel

Vessel Category	Vessel Type	Engine Category	Engine Type ¹	Fuel ²	GRT/DWT/PAX Sub-group ³	Engine Power (kW) ⁴	Baseline Specific Fuel Consumption (g/kWh) ⁵	NOx Emission Factors (g/kWh) ⁶	SO ₂ Emission Factors (g/kWh) ⁷	RSP Emission Factors (g/kWh) ₈	FSP Emission Factor (g/kWh) ⁹
RTV	Dry Bulk Carrier	Main Engine	Diesel Engine	Fuel with sulphur content not exceeding 0.5%	GRT >= 1000	744.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01
RTV	Dry Bulk Carrier	Auxiliary Engine	-	-	GRT >= 1000	448.00	213.00	1.0000E+01	2.0821E+00	1.6634E-01	1.6135E-01

Remarks

1. The main engine type of RTV refers to S4.2.6 of MVEIS.
2. According to the Air Pollution Control (Fuel for Vessels) Regulation stipulates the use of fuel with sulphur content of 0.5% for all vessels within Hong Kong waters.
3. The GRT sub-group refers to Table 4-5 of MVEIS; the highest GRT for each vessel type is adopted as a conservative approach.
4. Average engine power main engine power of RTV makes reference to Table 4-5 of MVEIS, while auxiliary engine power of RTV is given by Engineer.
5. BSFC of RTV makes reference to Table 4-16 of MVEIS.
6. The NOx emission factor refers to MVEIS and IMO Fourth Greenhouse Gas Study 2020:- NOx emission of RTV (Table 4-16, MVEIS)
7. The SO2 emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:SO2 EF = BSFC x 2 x 0.97753 x Fuel Sulphur Fraction
8. The RSP emission factor is calculated based on the formula stated in Paragraph 4.2.31 of MVEIS:PM10 EF = 0.23 + BSFC x 7 x 0.02247 x (Fuel Sulphur Fraction - 0.0024)
9. RSP to FSP conversion factor of 0.97 is used, with reference to paragraph 4.2.32 of MVEIS.

Emission Factors by Engine Category by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Engine Category	Load Factor	NOx Emission Factors (g/hr) ^{1,2}	SO ₂ Emission Factors (g/hr) ^{1,2}	RSP Emission Factors (g/hr) ^{1,2}	FSP Emission Factor (g/hr) ^{1,2}
RTV	Dry Bulk Carrier	4	Maneuvering	Main Engine	0.300	2.2320E+03	4.6473E+02	3.7128E+01	3.6014E+01
RTV	Dry Bulk Carrier	4	Maneuvering	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01
RTV	Dry Bulk Carrier	4	Hotelling	Main Engine	0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
RTV	Dry Bulk Carrier	4	Hotelling	Auxiliary Engine	0.430	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remarks

1. The load factor makes reference to the table 'Load Factor by Vessel'.
2. The calculations of the emission factor of each engine type refer to the following equation: Emission Factor of an Engine Type (g/hr) = Engine Power (kW) * Emission Factor (g/kWh) * Engine Load Factor.

Composite Emission Factors by Vessel

Vessel Category	Vessel Type	Route Code	Operation Mode	Composite NOx Emission Factors (g/hr) ¹	Composite SO2 Emission Factors (g/hr) ¹	Composite RSP Emission Factors (g/hr) ¹	Composite FSP Emission Factor (g/hr) ¹
RTV	Dry Bulk Carrier	4	Maneuvering	4.1584E+03	8.6584E+02	6.9173E+01	6.7098E+01
RTV	Dry Bulk Carrier	4	Hotelling	1.9264E+03	4.0110E+02	3.2045E+01	3.1083E+01

Remark

1. Total Emission Rate is determined by this equation : Main Engine Emission Rate + Auxiliary Engine Emission Rate + Auxiliary Boiler Emission Rate (if applicable).

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 4)

Vessel Parameters by Vessel

Vessel Category	Vessel Type	Parameter Group	Source Type	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	Remarks
RTV	Dry Bulk Carrier	Group 3 of RTV	POINT	1.30	6	503.15	25.00	0.80	1, 2, 3

Remarks

- The release height of the vessels are determined by on-site observations.
- The exhaust temperature refer to the journal article: Dong, Thi Minh Hao & Xuan Phuong Nguyen. (2019). Exhaust Gas Recovery from Marine Diesel Engine in Order to Reduce the Toxic Emission and Save Energy: A Mini Review. Journal of Mechanical Engineering Research & Developments, 42(5):143-147. <https://doi.org/10.26480/jmerd.05.2019.143.147>. Given that other emission sources identified in this study (i.e., industrial/vehicular emission sources) mostly affect the air quality at a lower level, the lowest temperature of documented in this article was adopted as a conservative approach.
- The stack parameters, except release height and exit temperature, refer to approved EIA - "Route 11 (Section between Yuen Long and North Lantau)" (EIA-297/2023).

Total Emission Rate of the Marine Emission

Route #
4

Total Emission Rate

Vessel ID	Vessel Category	Vessel Type	Route Code ¹	Average Speed (Knot) ²	Operation Mode	Distance (nautical miles) ₃	Time-in-mode (hr)	NOx Emission Rate (g/s-vessel) ⁴	SO ₂ Emission Rate (g/s-vessel) ⁴	RSP Emission Rate (g/s- vessel) ⁴	FSP Emission Rate (g/s-vessel) ₄
R4_RTVO3M	RTV	Dry Bulk Carrier	4	1	Maneuvering	3.11E-01	3.11E-01	3.5907E-01	7.4762E-02	5.9729E-03	5.7937E-03
R4_RTVO3H	RTV	Dry Bulk Carrier	4	0	Hotelling	0.00E+00	1.00E+00	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03

Remark

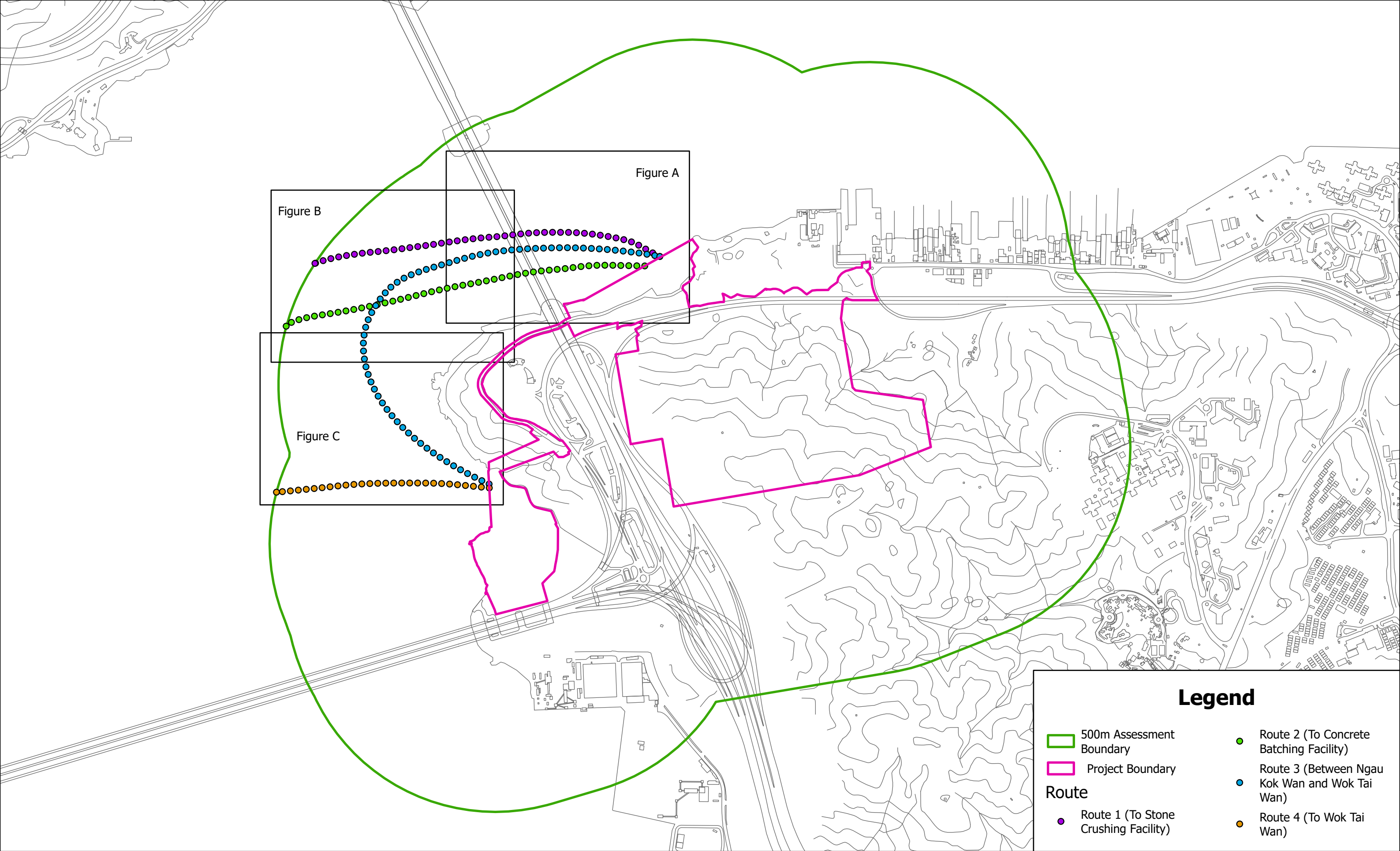
- Despite the actual routes, all general marine vessels are considered travelling in the water at the nearest and safe distance from the project site / nearby shipyards.
- The average speed is calculated from the speed distribution for each vessel on each route.
- The distance is measured for each route.
- The calculations of emission factors refer to the following equation: Emission Factor (g/s-vessel) = Composite Emission Factor (g/hr) * Time-in-mode (hr) / 3600.

Appendix 4.4 Calculation of Project Induced Marine Emission Source

Marine Traffic (Route 4)

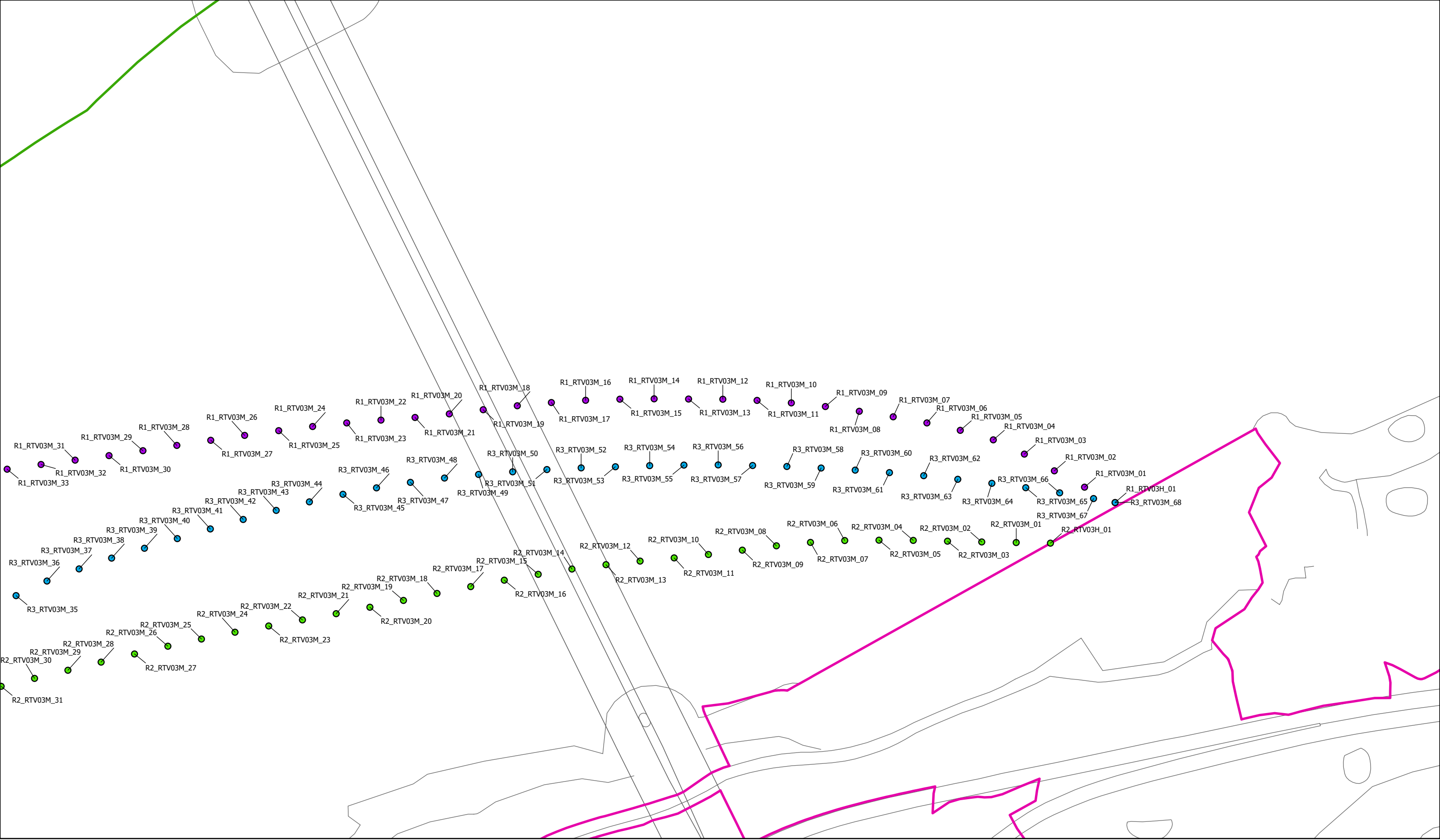
Emission Inventory

Source ID	Vessel ID	Vessel Category	Vessel Type	Source Type	X	Y	Number of Point Sources	Base Elevation (m)	Release Height (mAG)	Exit Temperature (K)	Exit Velocity (m/s)	Diameter (m)	NOx Emission Rate (g/s/vessel)	SO ₂ Emission Rate (g/s/vessel)	RSP Emission Rate (g/s/vessel)	FSP Emission Rate (g/s/vessel)
R4_RTV03H_01	R4_RTV03H	RTV	Dry Bulk Carrier	POINT	826327.3881	824106.5433	1	1.30	6.00	503.15	25.00	0.80	5.3511E-01	1.1142E-01	8.9013E-03	8.6343E-03
R4_RTV03M_01	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826307.4901	824108.5603	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_02	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826287.5924	824110.5806	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_03	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826267.6924	824112.5788	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_04	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826247.7847	824114.4974	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_05	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826227.8588	824116.2146	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_06	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826207.9027	824117.5312	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_07	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826187.9184	824118.3101	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_08	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826167.9216	824118.6566	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_09	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826147.9221	824118.776	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_10	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826127.9221	824118.8043	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_11	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826107.9221	824118.8044	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_12	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826087.9223	824118.7244	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_13	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826067.9235	824118.5045	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_14	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826047.9276	824118.1037	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_15	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826027.9379	824117.468	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_16	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	826007.96	824116.5315	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_17	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825988.0028	824115.2302	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_18	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825968.0746	824113.54	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_19	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825948.1764	824111.526	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_20	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825928.2962	824109.3401	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_21	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825908.4162	824107.1534	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_22	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825888.5265	824105.0556	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_23	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825868.6297	824103.0263	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_24	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825848.7275	824101.0507	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_25	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825828.8209	824099.1201	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_26	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825808.9104	824097.2306	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04
R4_RTV03M_27	R4_RTV03M	RTV	Dry Bulk Carrier	POINT	825793.9233	824095.8387	27	1.30	6.00	503.15	25.00	0.80	1.2360E-02	2.5735E-03	2.0560E-04	1.9943E-04

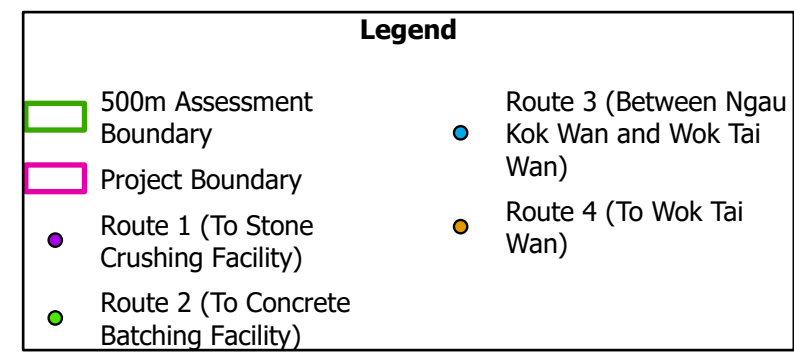
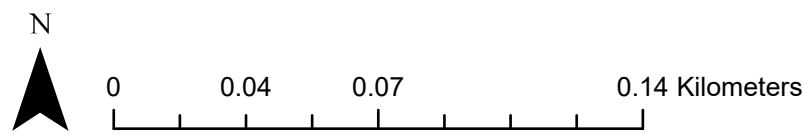


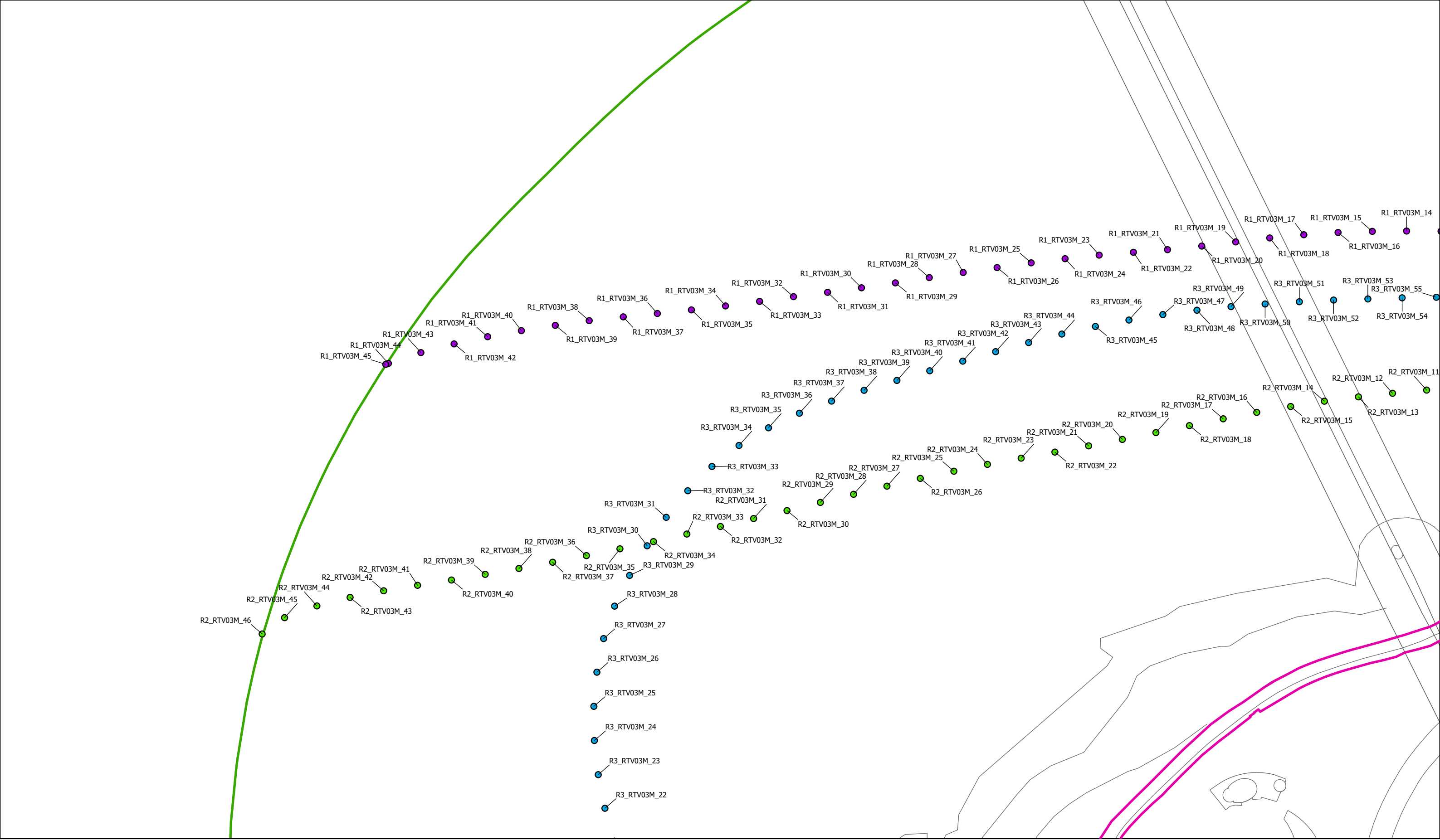
**Location of Project-Induced Marine Emission Sources
(Key Plan)**



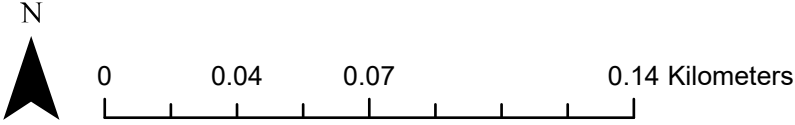


Location of Project-Induced Marine Emission Sources (Figure A)





Location of Project-Induced Marine Emission Sources (Figure B)



Legend

500m Assessment Boundary

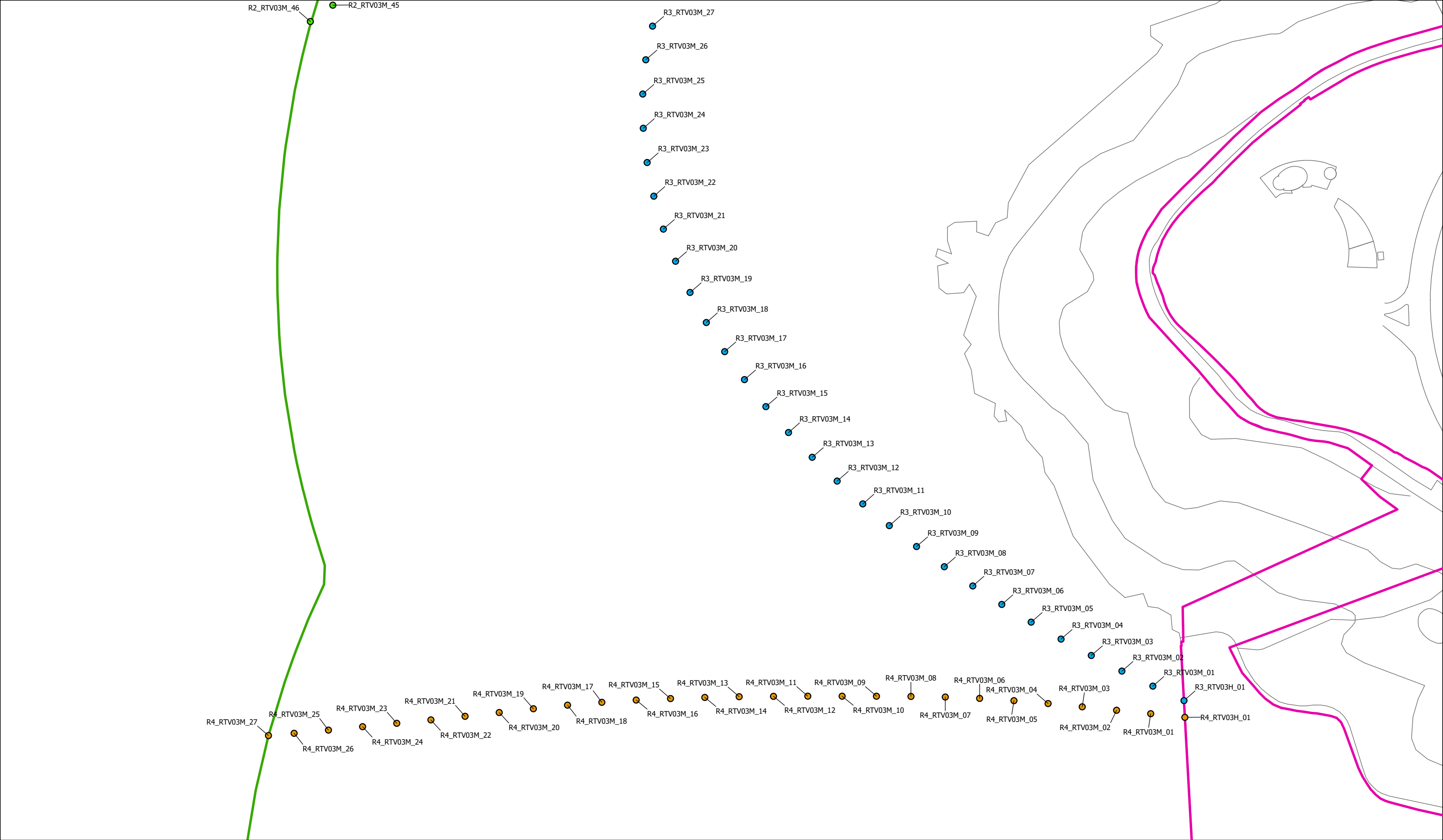
Project Boundary

Route 1 (To Stone Crushing Facility)

Route 2 (To Concrete Batching Facility)

Route 3 (Between Ngau Kok Wan and Wok Tai Wan)

Route 4 (To Wok Tai Wan)



Location of Project-Induced Marine Emission Sources (Figure C)

