

Proposed Shooting Range at Kau Wa Keng

Project Profile

Hong Kong, China Shooting Association

Reference: P524495

27-December-2024



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1 Basic Information

1.1 Project Title

- 1.1.1 The title of the Project is “Proposed Shooting Range at Kau Wa Keng”.

1.2 Purpose and Background of the Project

- 1.2.1 The sport of shooting has been part of the Olympic Games since the first modern era Summer Olympics in 1896. Hong Kong shooting athletes participate in various international shooting competitions, including the Olympics, Asian Games, East Asian Games, World Cup Series and World Shooting Championships.
- 1.2.2 A shooting range is an essential venue for holding shooting events and is also critical for athletes’ training and for the promotion of shooting in Hong Kong. The Hong Kong, China Shooting Association (“HKCSA” or “Project Proponent”) is in the process of taking over a vacated ex-shooting range at Kau Wa Keng in Lai Chi Kok, Kowloon (“the Site”) and re-operating it as a shooting range for HKCSA.
- 1.2.3 The ex-shooting range at the Site was previously used by the Hong Kong Rifle Association (“HKRA”) starting from 1964, but was vacated in 2013 and Lands Department (“LandsD”) repossessed the Site in 2014. HKCSA is interested in acquiring the Site to operate once again as a shooting range (“the Project”) via an application of a Short Term Tenancy (“STT”). The buildings of the Project will be the same ones previously constructed by HKRA, while the shooting range layout of the Project will be modified to meet the latest requirements of the Olympics. No skeet shooting and no clay target /pigeon will be allowed.
- 1.2.4 *The Firearms and Ammunition Ordinance (Cap. 238) and Firearms and Ammunition Regulations (Cap. 238A)* are the legislation governing the handling and storage of arms and ammunition at the Site. The range operator is responsible for obtaining a Shooting Range Order (“SRO”) from the Commissioner of Police under this regulation and for strictly following the conditions of the SRO during operation of the shooting range.
- 1.2.5 The Site area is around 8,797m² and it will be subject to change when applying for the STT in the future. The existing one-storey structures including Clubhouse, Reception Room, Record House, Armoury Store and Covered walkway, and some other elements, have not been maintained since the HKRA returned the Site to LandsD in 2014, so some refurbishment will be required.
- 1.2.6 An assessment of the potential environmental impacts associated with the Project has been provided in this Project Profile (“PP”). All structures and facilities at the Site were constructed by the previous operator. Only minor reinstatement and refurbishment works will be undertaken by HKCSA during Project construction stage. No additional building structures will be required. The photos of proposed site are provided below in **Photo 1.1** and **Photo 1.2**:
- **Photo 1.1** shows the outlook of covered walkway (at one end of the outdoor shooting ranges for firearm loading and shooting single storey), 10m Indoor Air Pistol Range and Clubhouse.
 - **Photo 1.2** shows the damaged barrier and bullet catchers to be replaced.

- 1.2.7 During the detailed design stage for the STT application, the Project Proponent will appoint qualified professionals, such as structural engineer or building surveyor, to carry out a condition survey of the existing building structures and materials at the Site and to evaluate whether these can be reused, refurbished, or need to be replaced. All existing structures and materials will be reused where practicable. A registered asbestos consultant and a registered asbestos laboratory shall be engaged to investigate for the presence of asbestos-containing materials (ACM) prior to demolition work.
- 1.2.8 The reinstatement and refurbishment works will mainly comprise replacement of roof and wall panels, replacement of topsoil at the outdoor shooting range, repair or reinstatement of the damaged building structures, indoor renovation, provision of noise barriers, bullet catchers and baffles at the ranges.
- 1.2.9 The Project was discussed at the Kwai Tsing District Council, Planning and District Facilities Management Committee meeting on 18 December 2018. The Committee unanimously endorsed the proposed STT for Shooting Range – atop Kau Wa Keng Fresh Water Service Reservoir.

Photo 1.1 Existing Covered Walkway at the Outdoor Shooting Ranges, 10m Indoor Air Pistol Range and Clubhouse



Photo 1.2 Barriers between Ranges and Bullet Catchers



- 1.2.10 Aurecon Hong Kong Limited ("Aurecon") has been appointed as the Consultant to prepare this PP.

1.3 Details of Project Proponent

Hong Kong, China Shooting Association

Room 2011, Olympic House
No.1 Stadium Path
Causeway Bay, Hong Kong

1.4 Location and Scale of Project

Location of Project

- 1.4.1 The Site of the Project is located at the ex-Kau Wa Keng Shooting Range, Cheung Hang Village, Cheung Hang Road, Lai Chi Kok, Kowloon as shown in **Figure 1.1**. The Site is located atop the Kau Wa Keng Fresh Water Service Reservoir. The only access to the Site is via Cheung Yuen Road and Cheung Hang Road to a WSD access road located south of the Site. There is no access to public transportation in the vicinity of the Site.
- 1.4.2 The Site is roughly rectangular in shape with a total area of approx. 8,797m². It is levelled ground with elevation of 136.1mPD to 136.3mPD. To the north of the Site is the mountain slope of Shek Lei Tau, with top elevation of 183.7mPD. To the northeast and southeast of the Site are village houses of Cheung Hang Village, situated at a lower elevation. This creates a semi enclosed topographic characteristic for the Site.
- 1.4.3 The Site falls within an area zoned “Government, Institution or Community” (“G/IC”) on the approved Kwai Chung Outline Zoning Plan No. S/KC/32 (the OZP), which is subject to a building height restriction of 1-storey as stipulated on the OZP (**Figure 1.3**). Surrounding land uses are predominately areas zoned “Green Belt” (“GB”) and other “G/IC” uses for service reservoir, pumping station, etc.

History of the Site

- 1.4.4 The Site is located at the southern slope of Shek Lei Tau and Kau Wa Keng Fresh Water Service Reservoir, which was constructed in the 1950s or 1960s. After construction of the reservoir, HKRA utilised the flat ground atop the reservoir to develop the shooting range in 1964 and operated under a STT until 2013.

1.5 Project Details

- 1.5.1 The Project will utilise all structures previously constructed by the HKRA and no additional building structures will be required. According to the General Building Plan approved in 1994 for the Site, the shooting range comprises the following facilities:
- Two 25m outdoor shooting ranges
 - Two 50m outdoor shooting ranges
 - An indoor 10m air pistol range
 - A one-storey Clubhouse, Reception Room, Record House, and Armoury Store
 - Covered walkways connecting the outdoor shooting ranges
- 1.5.2 The shooting range layout of the Project will be modified to meet the latest requirements of the Olympics. No skeet shooting and no clay target /pigeon will be allowed. The layout plan of the Site is provided in **Figure 1.2**. As all structures within the Site are already constructed, no site formation work, foundation work or substantial construction work is required for the Project. The reinstatement and refurbishment works will mainly include replacement of roof and wall panels, replacement of topsoil by hydrophobic filling material for erecting baffles and noise barrier at the outdoor shooting range, repair or reinstatement of the damaged building structures, indoor renovation, provision of noise barriers and bullet catchers at the ranges.
- 1.5.3 The types of firearms that can be used at the shooting range are restricted to:

Air pistol

- .177 calibre

Pistol

- .22, .32, 9mm, .38 revolver, .40, .41, .45, and .50 calibres

Rifle

- .22 / .223 / 7.62mm calibres

- 1.5.4 Only air pistols will be used in the 10m indoor shooting range, whereas air pistols, pistols and rifles can be used in the 25m and 50m outdoor shooting ranges. The Project will operate from 7am to 10pm but firing hours at outdoor shooting ranges will be restricted to 9:30am to 6:30pm. Nighttime operations (until 10pm) at the indoor shooting range involve only 10m air pistol shooting. Shooting activities shall strictly follow the Range Order to be issued by the Hong Kong Police Force to ensure that all necessary precautions are taken to prevent accidents either to those people using the range, or outside the range, and by implementing the instructions set out in the shooting club by-laws. Some safety precautions include the control of access to the range, drawing or presenting, loading and unloading of firearms, arc of fire, type of arms/ammunition approved, etc.
- 1.5.5 Since there is no public transportation in the vicinity of the Site, shuttle bus service will be provided by HKCSA for visitors to commute between the Site and the nearby MTR station. The shuttle bus service will be provided during three periods, comprising morning session (08:00-09:00), afternoon session (12:00-13:00), and evening session (17:00-18:00). During major competition, the maximum number of visitors to the shooting range is anticipated to be about 100 per day. With about 9 parking spaces available for staff and visitor, it is anticipated that only limited traffic would be generated with a maximum of one 19-seated shuttle bus and 20 passenger cars/taxis per hour.

1.6 Designated Projects to be covered by the Project Profile

- 1.6.1 The project is classified as Designated Project ("DP") under the Environmental Impact Assessment Ordinance ("EIAO") as specified below:
- **Schedule 2 (Part I), O5.** This refers to an open firing range, which the proposed shooting range will include two 25m shooting ranges, two 50m shooting ranges, and one 10m shooting range.
- 1.6.2 Under the EIAO, an Environmental Permit ("EP") will be required for the construction and operation of the proposed shooting range. This Project Profile is prepared for application for approval to apply directly for an EP for the Project under the EIAO. It describes the scope of the Project, assesses the potential environmental impacts associated with the Project and recommends mitigation measures to minimise the potential environmental impacts. It demonstrates that the potential environmental impacts of the Project and the mitigation measures described in this PP meets the requirements of the Technical Memorandum on EIA Process ("EIAO-TM").

1.7 Name and Telephone Number of Contact Person

- 1.7.1 The detail of name and telephone number of contact person are shown in **Table 1.1**. All queries may be addressed to the Consultant.

Table 1.1 Name and Telephone Number of Contact Person

For the Project Proponent:	For the Consultant:
Mr Wyman LI	Mr. Keith Chau
Chairman	Associate Director

Hong Kong, China Shooting Association	Aurecon Hong Kong Limited
Tel : +852 2504 8138	Tel : +852 3664 6788

1.7.2

The public may lodge an inquiry/complaint to HKCSA by phone, email, or post:

- Tel: (852) 2504 8138
- Email: hkairegun@yahoo.com.hk
- Address: Room 2011, Olympic House, No.1 Stadium Path, Causeway Bay, Hong Kong

2 Outline of Planning and Implementation Programme

2.1 Project Planning and Implementation

2.1.1 The Project is to be led, planned, and managed by HKCSA. To assist in project planning and implementation, HKCSA has engaged:

- Environmental Consultant to assist in obtaining an Environmental Permit ("EP") under the EIAO for construction and operation of the Project.
- Construction Consultant to prepare design for the reinstatement and refurbishment works.
- Contractors to carry out the reinstatement and refurbishment works.
- A registered asbestos consultant and a registered asbestos laboratory to investigate for the presence of asbestos-containing materials (ACM) prior to demolition work.

2.2 Project Programme

2.2.1 The Project is targeted to commence construction and operation as soon as possible, upon approval of required permit applications and STT arrangements, expected by 1st quarter of 2025.

2.2.2 It is estimated that the minor reinstatement and refurbishment work at the Site will take about 29 to 34 weeks to complete.

2.2.3 It is expected that the Project could therefore start to operate after obtaining all statutory approval requirements in the 4th quarter of 2025.

2.3 Interactions with Other Projects

2.3.1 According to the best information available at the time of preparation of this Project Profile, there are no existing, committed or planned projects within 500m of the Project site, which may potentially interface with this Project. As such, no cumulative environmental impacts are therefore expected.

3 Major Elements of the Surrounding Environment

3.1 General

- 3.1.1 To the north of the Site is the mountain slope of Shek Lei Tau, with a top elevation of 183.7mPD. To the northeast and southeast of the Site are village houses of Cheung Hang Village, situated at a lower elevation. This creates a semi enclosed topographic characteristic for the Site.
- 3.1.2 According to Kwai Chung Outline Zoning Plan S/KC/32, the Site is generally surrounded by land zoned GB with two pieces of land zoned G/IC located to the south and southwest for WSD's facilities, namely, the Kau Wa Keng No. 2 Fresh Water Service Reservoir and Kau Wa Keng Water Pumping Station. Further south is another G/IC site used by the Neighbourhood Advice-Action Council Fairyland, which is a multifunction rehabilitation centre. Cheung Hang Village is located to the immediate northeast and southeast of the Site at a lower elevation. The village is thus shielded from the Project by the natural topography. The approved Kwai Chung OZP (No. S/KC/32) is presented in **Figure 1.3**.
- 3.1.3 There is a natural stream located around 30m to the east of the Site, flowing from north to south through Cheung Hang Village. About 160m to the northeast of the Site is the closest boundary of Kam Shan Country Park.
- 3.1.4 The Site location and the environs were shown in **Figure 1.1**.

3.2 Air Sensitive Receivers ("ASRs")

- 3.2.1 Annex 12 of the Technical Memorandum on EIA Process ("EIAO-TM") defines ASRs to include any domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping centre, place of public worship, library, court of law, sports stadium or performing arts centre.
- 3.2.2 The dwellings in Cheung Hang Village are the nearest domestic premises to the Site. The horizontal separation of the nearest residential buildings from the Site is around 30m. The nearest institutional use to the Site is the Neighbourhood Advice-Action Council Fairyland, with a horizontal separation of about 180m from the Site.
- 3.2.3 **Table 3.1** lists the identified representative ASRs surrounding the Site and **Figure 3.1** shows their locations.

Table 3.1 Summary of Identified Representative ASRs

ID	Description	Use	Planned/ Existing	Distance From Site (m)	Assessment Height (mAG)
A1	Temporary Structure near 1A Cheung Hang Village	Residential	Existing	30	1.5 – 10
A2	1 Cheung Hang Village cum Cheung Hang Village Residents Welfare Association	Residential	Existing	40	1.5 – 5
A3	Former Cheung Hang Public School	Permanently Closed*	Existing	72	1.5 – 10
A4	Temporary Structure near 22A Cheung Hang Village	Residential	Existing	120	1.5 – 5
A5	Kau Wa Keng Pumping Station Upper Village	Residential	Existing	135	1.5 – 5

ID	Description	Use	Planned/ Existing	Distance From Site (m)	Assessment Height (mAG)
A6	Kau Wa Keng Fresh Water Pumping Station Staff Quarters	Residential	Existing	172	1.5 – 10
A7	Neighbourhood Advice-Action Council Fairyland	Care and Attention Home for Severely Disabled Persons	Existing	180	1.5 – 15
A8	Temporary structure near 28 Cheung Hang Village	Residential	Existing	84	1.5 – 5

Note: *This school is permanently closed and included for reference only.

3.3 Noise Sensitive Receivers (“NSRs”)

- 3.3.1 Annex 13 of the EIAO-TM defines NSRs to include any domestic premises, temporary housing accommodation, hostels, convalescent homes, homes for the aged, education institutions (including kindergarten and nurseries), places of public worship, courts, hospitals, medical clinics, and any other premises or places that are considered by the Director to have similar sensitivity to noise as the above.
- 3.3.2 The dwellings in Cheung Hang Village are the nearest residential use to the Site. The horizontal separation of the nearest residential building from the Site is around 30m. These are one- or two-storey buildings scattered along the course of the natural stream to the east of the Site. The elevation of the village houses ranges from about 110mPD to 190mPD and none are visible from the Site (136 mPD) due to the topography of the natural terrain.
- 3.3.3 The nearest institutional use to the Site is the Neighbourhood Advice-Action Council Fairyland(at an elevation of around 120.9mPD), with a horizontal separation of about 180m from the Site.
- 3.3.4 It is considered that Cheung Hang Village, which is the nearest residential premises from the Site, will be the representative NSR. **Table 3.2** lists the identified representative NSRs in the vicinity of the Site and **Figure 3.2** shows their locations.

Table 3.2 Summary of Identified Representative NSRs

Description	Use	Planned/ Existing	Distance From Site (m)
Temporary Structure near 1A Cheung Hang Village	Residential	Existing	30
1 Cheung Hang Village cum Cheung Hang Village Residents Welfare Association	Residential	Existing	40
Former Cheung Hang Public School	Permanently Closed*	Existing	72
Temporary Structure near 28 Cheung Hang Village	Residential	Existing	84
Temporary Structure near 22A Cheung Hang Village	Residential	Existing	120
Kau Wa Keng Pumping Station Upper Village	Residential	Existing	135
Kau Wa Keng Fresh Water Pumping Station Staff Quarters	Residential	Existing	172

Neighbourhood Fairyland	Advice-Action	Council	Care and Attention Home for Severely Disabled Persons	Existing	180
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Note: *This school is permanently closed and included for reference only.

3.4 Water Quality Sensitive Receivers (“WQSRs”)

3.4.1 Annex 14 of the EIAO-TM defines WQSRs to include areas of ecological or conservation values including existing or gazetted proposed marine parks and marine reserves, aquatic systems of the sites of special scientific interest (SSSI), and existing or gazetted proposed country parks and special areas, wetlands, conservation area, mangroves and important freshwater habitats; areas for abstraction of water for potable water supply, aquaculture and irrigation, fish spawning and nursery grounds, fish culture zones, mariculture subzones including shellfish culture site and brackish/freshwater fish ponds; gazetted beaches and other secondary contact recreation areas; water abstraction for cooling, flushing and other industrial purposes; and enclosed or sheltered water bodies including typhoon shelters, marinas and boat parks.

3.4.2 The Project is situated atop the Kau Wa Keng Fresh Water Service Reservoir. The water service reservoir beneath the Site is most immediate WQSR. In addition, the natural stream running through Cheung Hang Village and Kowloon Reception Reservoir are also identified as WQSRs within 500m from the Site.

3.4.3 **Table 3.3**, below, lists the WQSRs surrounding the Site and **Figure 3.3** shows their locations.

Table 3.3 Summary of Identified WQSRs

Description	Use	Distance From Site (m)
Kau Wa Keng Fresh Water Service Reservoir	Artificial Fresh Water Service Reservoir	-
Natural stream running through Cheung Hang Village	Natural Watercourse	30
Kowloon Reception Reservoir	Artificial Fresh Water Reservoir	410

3.5 Ecological Sensitive Receivers (“ESRs”)

3.5.1 The Site is a former shooting range constructed in 1964 and has been in operation until 2013. The Site itself located atop the Kau Wa Keng Fresh Water Service Reservoir is covered with shooting range structures or paved with grass. No valuable species or habitats with high ecological importance are located within the Site. The natural stream running through Cheung Hang Village located at about 30m to the east of the Site and Kam Shan Country Park located at about 160m to the northeast of Site are considered as the nearest ESRs.

3.5.2 **Figure 3.4** shows the locations of the ESRs.

3.6 Cultural Heritage

3.6.1 Built heritage, including declared monuments, proposed monuments, graded historic sites/buildings and government historic sites, in the vicinity of the Site were identified. **Table 3.4** lists the identified built heritage and **Figure 3.5** shows their locations.

Table 3.4 Summary of Identified Historic Site/Buildings

Name	Description	Distance From Site (m)
Two Buildings of Shek Lei Pui Treatment Works	Grade 2 Historic Building	394
Shek Lei Pui Treatment Works, Valve House	Grade 2 Historic Building	345
Kowloon Reception Reservoir, Dam	Grade 1 Historic Building	424
Kowloon Reception Reservoir, Valve House	Grade 1 Historic Building	456
Yiu Kung Ancestral Hall	Grade 3 Historic Building	469
Yeung Ching Study Hall	Grade 3 Historic Building	402
No.10 Kau Wa Keng	Grade 3 Historic Building	381
No.14 Kau Wa Keng	Grade 3 Historic Building	409
No.15 Kau Wa Keng	Grade 3 Historic Building	413
No.30 Kau Wa Keng	Grade 3 Historic Building	379
No.32 Kau Wa Keng	Grade 3 Historic Building	381
No.39 Kau Wa Keng	Grade 3 Historic Building	433
No.42 Kau Wa Keng	Grade 3 Historic Building	437
No.42A Kau Wa Keng	Grade 3 Historic Building	440
No.43 Kau Wa Keng	Grade 3 Historic Building	444
Nos. 4-5 Kau Wa Keng	Grade 3 Historic Building	387

3.7 Visual

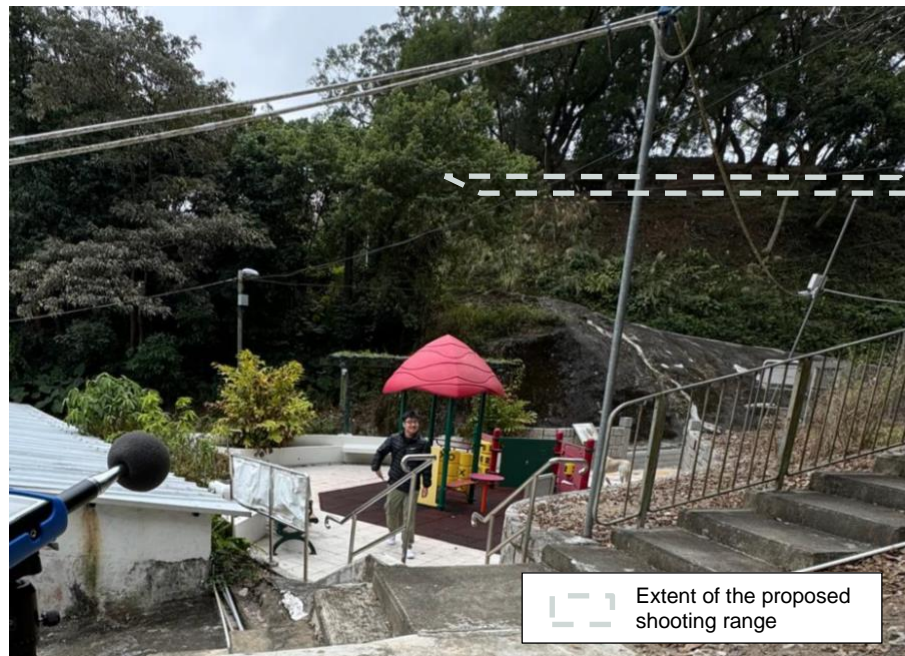
3.7.1

The Site is located atop the Kau Wa Keng Fresh Water Service Reservoir at about 136mPD. The location of proposed shooting Range at Kau Wa Keng is the ex-Kau Wa Keng Shooting Range. There are only several VSRs with a higher elevation than the subject site. The view from the identified VPs to the Site are either screened by the natural terrain or the boundary wall with height of at least 2m. Site visit conducted around the Site on 2 August 2023 confirmed that local villagers and visitors at Cheung Hang Village can only see the boundary barrier wall from the pedestrian path / communal area of the village. The single storey structures and shooting ranges cannot be seen or with limited view from surrounding. **Figure 3.6** shows the locations of the identified VPs.

Photo 3.1: View from pedestrian path near 1A Cheung Hang Village



Photo 3.2: View from communal area near 1 Cheung Hang Village cum Cheung Hang Village Residents Welfare Association



3.8 Potentially Hazardous Installation (“PHI”)

- 3.8.1 There is no potentially hazardous installation (PHI) near the project area and hence the project would not fall into any consultation zone of the PHIs.

4 Possible Impacts on the Environment

4.1 Outline of Process involved

- 4.1.1 As mentioned in **Section 1.2**, the shooting range layout of the Project will be modified to meet the latest requirements of the Olympics. No skeet shooting and no clay target /pigeon will be allowed. All structures and facilities at the Site were constructed by the previous operator and only minor reinstatement and refurbishment works will be undertaken by HKCSA during the Project construction stage. The reinstatement and refurbishment works will mainly include replacement of roof and wall panels, replacement of topsoil by hydrophobic filling material for erecting baffles to stop bullets from travelling out of the range and barrier at the outdoor shooting range, repair or reinstatement of the damaged building structures, indoor renovation, provision of noise barriers and bullet catchers at the ranges. No site formation works, and superstructure construction will be required.
- 4.1.2 During the operation of the Project, shooting activities will be carried out within the Site. Air pistols will be used in the 10m indoor shooting range, whereas all firearms including air pistols can be used in the 25m and 50m outdoor shooting ranges. The Project will operate from 7am to 10pm but firing hours at outdoor shooting ranges will be restricted to 9:30am to 6:30pm. Nighttime operations (until 10pm) at the indoor shooting range involve only 10m air pistol shooting. The general operation of the Project is described as follows:
- All the shooters will register at the Reception Room before conducting any shooting activities at the Site. The number of bullets issued to the shooters by the range operator and brought along by the shooters will be recorded.
 - The shooters will conduct shooting activities at the assigned shooting lanes and ranges.
 - After completion of daily shooting activities, all the bullet heads and cartridge casings used will be collected by the range operator with the aid of metal detectors and other instruments.
 - The collected bullet heads and cartridge casings will be temporarily stored in the Armoury Store for further collection by registered collectors for proper disposal in accordance with the Firearms and Ammunition Ordinance.
 - Inspection will be conducted by the range operator daily to check the conditions of the bullet catcher and will arrange for repair when needed before daily operation of the Project.

4.2 Summary of Potential Environmental Impacts

- 4.2.1 The potential environmental impacts associated with the proposed Project are summarised **Table 4.1** and likely impacts are assessed in the following sections.

Table 4.1 Potential Sources of Environmental Impacts

Potential Environmental Impacts	Construction	Operation	Remarks
Cultural Heritage	x	x	
Disposal of Spoil Material, Including Potentially Contaminated Material	x	x	
Disruption of Water Movement or Bottom Sediment	x	x	

Ecological Impacts	✓	✓	Potential ecological impact on natural stream running through Cheung Hang Village and Kam Shan Country Park
Particulate Matter (PM) and Gaseous Emissions	✓	✓	Potential dust and exhaust emission from Project construction Potential heavy metal emission during gun shooting activities Potential vehicular emission from construction and operation of the Project.
Generation of Waste or By- products	✓	✓	Refurbishment waste and waste from operation
Liquid Effluents, Discharges, or Contaminated Runoff	✓	✓	Site runoff and sewage from Project
Manufacturing, Storage, Use, Handling, Transport, or Disposal of Dangerous Goods, Hazardous Materials or Wastes	✗	✓	Ammunition is classified as DG
Night-time (23:00 to 07:00) Operations	✗	✗	
Noisy Operations	✗	✓	Potential noise generation during gun shooting activities
Odour	✗	✓	Potential odour arising from firearm shooting
Risk of Accidents Which Result in Pollution or Hazard	✗	✗	
Traffic Generation	✗	✗	
Unightly Visual Appearance	✗	✗	

Key

✓ = Potential to result in adverse impacts.

✗ = Not expected to result in adverse impacts.

4.3 Air Quality Impact Assessment

4.3.1 An air quality impact assessment has been carried out to identify potential air quality impacts arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 4 and Annex 12 of the EIAO-TM are referred to.

Environmental Legislation and Standards

Air Quality Objectives ("AQOs")

- 4.3.2 The AQOs have been established under the Air Pollution Control Ordinance (“APCO”) (Cap.311). The AQOs covers seven pollutants, including Sulphur Dioxide (“SO₂”), Respirable Suspended Particulates (“RSP” or “PM₁₀”), Fine Suspended Particulates (“FSP” or “PM_{2.5}”), Nitrogen Dioxide (“NO₂”), Ozone (“O₃”), Carbon Monoxide (“CO”) and Lead (“Pb”). The AQOs of relevance for this Project are summarised in **Table 4.2**, below.

Table 4.2 Relevant Hong Kong Air Quality Objectives

Pollutant	Average Time	Concentration Limit, µg/m ³	No. of Exceedances Allowed
RSP or PM ₁₀ [Note 1]	24-hour	100	9
	Annual	50	Not Applicable
FSP or PM _{2.5} [Note 2]	24-hour	50	35
	Annual	25	Not Applicable
Lead (Pb)	Annual	0.5	Not Applicable

Note:

1. RSP are suspended particles in air with a nominal aerodynamic diameter of 10µm or less.
2. FSP are suspended particles in air with a nominal aerodynamic diameter of 2.5µm or less.

- 4.3.3 The criteria of Toxic Air Pollutants (TAPs) such as copper, iron, lead, and zinc are referenced other external sources. The criteria are summarized in **Table 4.3** below.

Table 4.3 Criteria of Concerned Toxic Air Pollutants (TAPs)

Pollutant	Average Time	Concentration Limit, µg/m ³	Reference [1][2][3][4]
Copper (Cu)	1-hour	100	OEHHA
	24-hour	3.6	NHDES
	Annual	2.4	NHDES
Iron (Fe)	1-hour	-	NHDES
	24-hour	25	NHDES
	Annual	17	NHDES
Lead (Pb)	1-hour	-	N/A
	24-hour	0.15	NHDES
	Annual	0.5	HKAQO
Zinc (Zn)	1-hour	-	N/A
	24-hour	10	NHDES
	Annual	6.7	NHDES

Note:

[1] N/A: Not available

[2] HKAQO: Hong Kong Air Quality Objectives

[3] NHDES: New Hampshire Code of Administrative Rules, Table of All Regulated Toxic Air Pollutants

[4] OEHHA: Office of Environmental Health Hazards Assessment, California

Technical Memorandum on EIA Process (“EIAO-TM”)

- 4.3.4 The criteria for evaluating air quality impact include the following:
- meet the Air Quality Objectives and other standards established under the Air Pollution Control Ordinance (Cap. 311);
 - meet 5 odour units based on an averaging time of 5 seconds for odour prediction assessment;
 - for air pollutants not established under the Air Pollution Control Ordinance nor above: meet the standards or criteria adopted by recognized international organizations such as the World Health Organization or the United States Environmental Protection Agency as to be agreed with the Director.

Air Pollution Control (Construction Dust) Regulation

- 4.3.5 Construction dust is controlled by the Air Pollution Control (Construction Dust) Regulation, which is enacted under the Section 43 of the Air Pollution Control Ordinance (APCO). This Regulation stipulates that for any notifiable works, notice shall be given to EPD before the proposed notifiable work commences to be carried out. For both notifiable and regulatory works, the contractor responsible for the construction site shall ensure that the work is carried out in accordance with the Schedule which provides the control requirement of construction dust.

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

- 4.3.6 Regulation requires Non-road Mobile Machinery ("NRMM"), other than those exempted, to comply with the prescribed emission standards. 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. Only approved or exempted NRMMs with a proper label are allowed to be used in specified activities and locations including construction sites, containers terminals and back up facilities, restricted areas of the airport, designated waste disposal facilities and specified processes.

Air Pollution Control (Fuel Restriction) Regulation

- 4.3.7 The Air Pollution Control (Fuel Restriction) Regulation was enacted in 1990 and amended in 2022. The regulation imposes legal control on the type of fuels allowed for use and their sulphur contents in commercial and industrial processes. Gaseous fuel, conventional solid fuel with a sulphur content not exceeding 1% by weight or liquid fuel with a sulphur content not exceeding 0.005% by weight and a viscosity not more than 6 centistokes at 40°C, such as Ultra Low Sulphur Diesel (ULSD) are permitted to be used in commercial and industrial processes.

Potential Sources of Pollution

- 4.3.8 Construction dust (such as the replacement works of topsoil) is considered to be the major source of air pollution during the construction phase of the Project. Non-road mobile machinery and electricity generator will be required for the minor reinstatement and refurbishment works carried out during the construction phase. The use of dump trucks and non-road mobile machinery over the construction sites will also be a source of air pollution. As confirmed by the engineer, only limited traffic will be generated during the construction phase, and it is anticipated that there will be a maximum of 2 trucks per hour. Since there is no concurrent project within 500 m assessment area, there is no cumulative air quality impact from concurrent project.
- 4.3.9 As the Project involves open firing of ammunition, which contains lead or lead compounds and other heavy metals, such as copper, iron, and zinc. Lead dust, lead fume and other heavy metal emissions are the potential pollutions source during operation of the Project. Odour arising from firearm shooting is a potential odour source during operation of the Project.

Construction Phase Assessment

- 4.3.10 As no site formation work, foundation work or other construction work is required for the Project, the major source of air pollution will be dust that may be generated during the minor reinstatement, refurbishment works and movement of the 3,100 tonnes of topsoil.
- 4.3.11 With the implementation of mitigation measures that are recommended in the *Air Pollution Control (Construction Dust) Regulation*, fugitive dust and gaseous emissions can be controlled and adverse air quality impact is therefore not anticipated.
- 4.3.12 Relevant good site practice and mitigation measures to be implemented during the construction phase for air quality control are as follows:
- Regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather.
 - Frequent watering for particularly dusty areas and areas close to ASRs.
 - Tarpaulin covering of all dusty vehicle loads transported to and from the Site.
 - Imposition of speed controls for vehicles within the Site.
 - Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from off-site ASRs.
- 4.3.13 Limited number of non-road mobile machinery (as presented in Table 4.6) and electricity generator will be required for the minor reinstatement and refurbishment works. All the non-road mobile machinery adopted will comply with the requirements as stipulated in the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation and Air Pollution Control (Fuel Restriction) Regulations (i.e., use of ultra-low sulphur diesel) to minimize the gaseous and PM emissions. As confirmed by the engineer, there will be a maximum of two dump truck trips per hour and hence the traffic generated during the construction phase will be limited. No adverse air quality impact due to exhaust emissions from the construction plants and dump trucks is anticipated.

Operation Phase Assessment

Power Supply and Mechanical Ventilation Facilities

- 4.3.14 Mains electricity supply is available at the Site, therefore no stand-alone power generation will be needed (e.g. diesel generator) and so there will be no emissions due to fuel combustion.
- 4.3.15 Air pistols used in the indoor shooting range is powered by CO₂ and no criteria pollutant emissions are anticipated from the indoor shooting range.

Heavy Metal Emission

- 4.3.16 A firearm ammunition (i.e., bullet) is composed of a bullet head, which is a projectile expelled from a gun barrel during shooting, and bullet cartridge case that is a metal case packing the bullet head and other components of the ammunition, such as propellant, rim and primer, together. Lead is the major component in lead bullets, which make up about 90% of the total mass of the bullets^[1]. Pollutants resulting from shooting activities would be primarily lead but also others such as copper, iron, zinc etc., in which lead usually has the greatest potential to harm human health and the environment ^[2].
- 4.3.17 Firing a bullet from a gun involves the ignition of a primer. The ignition itself will not result in any gaseous lead emission. However, lead fumes might be generated when hot gases act on the lead bullet as it is fired. Additionally, lead dust might also be generated if a lead bullet becomes deformed or broken upon hitting the target.
- 4.3.18 Copper and zinc are components of the metal jackets of the bullet cartridge case, while iron is used as the tip of the bullet^[3]. The bullet cartridge case interacts with the bore (i.e., the inner surface of the barrel) as it travels down the barrel. The surface of the cartridge case undergoes both some degree of elastic-plastic deformation and some degree of abrasion. Therefore, low concentration of copper and zinc will be released due to the deformation of bullet cartridge case surface during firing while low concentration of iron will be released when the bullet hits the target, along with soot arising from incomplete combustion
- 4.3.19 In view of the typical composition of a bullet and the mass composition of fume emitted from firearms, it is proposed to assess copper, iron, lead, and zinc. Other heavy metals either exhibit low toxicity or are present in concentrations low enough that they are not assessed in this project^{4,5,6}.
- 4.3.20 In order to minimise fine particulates generation from a bullet head while hitting the target^[7], a bullet catcher with rubber curtain target backing (made with rubber sheets that can be penetrated by bullet heads and self-sealed instantly, such as "Linatex") and steel plate backstop with containers placed underneath will be constructed behind the target plate to stop and collect bullet heads. The bullet heads would penetrate the soft rubber target backing material, and therefore would not be deformed and broken, hence avoiding release of heavy metals.
- 4.3.21 The indoor 10m firing range is designed for air pistol (.177 calibre) guns only. No pollution will be generated during the operational period. Therefore, the indoor shooting range will not cause any air quality problems during the operational phase.
- 4.3.22 Based on the discussion above, emissions of copper, iron, lead, and zinc at outdoor shooting ranges released from shooting activities during operation phase are the primary concerns. The emission factors of copper, lead, and zinc for various types of ammunition, such as .22 Caliber, 7.62-mm Ball Cartridge, 9mm Ball Cartridge, .38 Caliber Special Ball Cartridge, and .45 Caliber Ball Cartridge were referenced to United States Environmental Protection Agency (US EPA) AP-42: Compilation of Air Emissions Factors from Stationary Sources. Since the emission factor of iron is not available in US EPA AP-42: Compilation of Air Emissions Factors from Stationary Sources, the emission factor for TSP is assigned to iron as a conservative approach.
- 4.3.23 With reference to the 'Guidelines on Choice of Models and Model Parameters' published by EPD, AERMOD, was used to evaluate the impacts of project-induced heavy metal emissions on nearby air-sensitive receivers.
- 4.3.24 Surface characteristic parameters such as albedo, Bowen ratio and surface roughness are required in the AERMET. The land use characteristics of the surrounding were classified, and these parameters of each land use were determined by AERMET by default according to its land use characteristics. Smart Air Modelling Platform v2.0 (SAMP v2.0) was adopted in generating the AERMET. The determination of the surface characteristics parameters is presented in **Appendix A** Elevated terrain in AERMOD was adopted for this assessment.

¹ Elsevier B.V., 2020, Shooting Ranges: Environmental Contamination, Encyclopedia of Environmental Health Volume I

² Environmental Protection Authority Victoria, January 2019, Guide for Managing Contamination at Shooting Ranges

- 4.3.25 The firing details listed in below will be included in the future SRO, which will only be ready after the police inspection conducted against the final completion of the ranges. The highest heavy metal emission factor for the types of ammunition used at the shooting range (i.e., emission factor of 7.62-mm ball cartridge⁸), along with the maximum allowable shots per hour at each range were adopted for desktop calculation as the worst-case scenario. There are 28 designated shooting locations in the firing range (Range 1: 6 locations, Range 2: 8 locations, Range 3: 8 locations and Range 4: 6 locations). In the modelling, there shall be 28 volume sources to represent the potential shooting activities at the 28 designated shooting locations. Maximum allowable shots shall be adopted for each designated shooting location as a conservative approach. The locations and the emission inventory of heavy metal emissions are shown in **Figure 4.1** and **Appendix B**.
- 4.3.26 The air quality impact due to heavy metal emissions from the operation of shooting range at the ASRs were predicted and summarized in **Table 4.4**. The detailed assessment results are shown in **Appendix C**. According to **Table 4.4**, the hourly averaged, daily averaged, and annual averaged copper, iron, lead, and zinc concentrations at all ASRs would comply with relevant criteria. No adverse air quality impact due to heavy metals is anticipated.

³ Interstate Technology and Regulatory Council Small Arms Firing Range Team, January 2003, Characterization and Remediation of Soils at Closed Small Arms Firing Range

⁴ Copper, lead, zinc are the most abundant heavy metals found: Figure 1B of Kim et al. (2022) (<https://www.nature.com/articles/s41598-022-24856-5>).

⁵ Barium is considered less toxic than lead, copper: New Hampshire Code of Administrative Rules, Table of All Regulated Toxic Air Pollutants.

⁶ Trace amount of other heavy metals: Kim et al. (2022).

⁷ USEPA, June 2005, Best Management Practices for Lead at Outdoor Shooting Ranges

⁸ Section 15.1 of the United States Environmental Protection Agency (US EPA) AP-42: Compilation of Air Emissions Factors from Stationary Sources

Table 4.4 Summary of Predicted Heavy Metal Concentrations at Representative ASRs

Heavy Metals	Averaging time (Background Concentration, $\mu\text{g}/\text{m}^3$) ^[1]	Criteria ($\mu\text{g}/\text{m}^3$)	Heavy metal concentrations at representative air sensitive receivers ($\mu\text{g}/\text{m}^3$)							
			A1	A2	A3	A4	A5	A6	A7	A8
Copper (Cu)	1-hour (0.15)	100	0.5802-0.6794	0.4011-0.4117	0.4484-0.5955	0.2665-0.2692	0.2589-0.2644	0.5816-0.6307	0.1687-0.1773	0.3687-0.3718
	Daily (0.15)	3.6	0.11383-0.12427	0.08488-0.08579	0.10061-0.1243	0.07108-0.07128	0.07878-0.07947	0.08903-0.08936	0.06267-0.06275	0.08057-0.08093
	Annual (0.046)	2.4	0.04062-0.04389	0.02612-0.02642	0.02371-0.0264	0.02058-0.02065	0.02369-0.02386	0.02181-0.02194	0.01958-0.01962	0.02475-0.02501
Iron (Fe)	1-hour (2.4)	-	3.4316-3.7208	2.9093-2.9402	3.0472-3.4762	2.5168-2.5248	2.4946-2.5105	3.4356-3.5789	2.2316-2.2566	2.8147-2.8239
	Daily (2.4)	25	2.07156-2.102	1.98713-1.98978	2.033-2.10208	1.94691-1.94747	1.96934-1.97135	1.99924-2.0002	1.92237-1.9226	1.97458-1.97561
	Annual (0.607)	17	0.62496-0.63451	0.58268-0.58356	0.57566-0.58349	0.56654-0.56672	0.57559-0.57608	0.5701-0.57049	0.56362-0.56372	0.57869-0.57943
Lead (Pb)	1-hour (0.089)	-	0.5-0.5776	0.36-0.3683	0.3969-0.512	0.2545-0.2567	0.2487-0.253	0.5013-0.5398	0.178-0.1848	0.3346-0.3371
	Daily (0.089)	0.15	0.13503-0.1432	0.11239-0.1131	0.12469-0.14323	0.10159-0.10174	0.10762-0.10816	0.11565-0.11591	0.095-0.09506	0.10903-0.1093
	Annual (0.013)	0.5	0.0287-0.03126	0.01735-0.01759	0.01547-0.01757	0.01302-0.01307	0.01546-0.01559	0.01398-0.01409	0.01224-0.01227	0.01629-0.01649
Zinc (Zn)	1-hour (1.7)	-	1.7685-1.7814	1.7451-1.7465	1.7513-1.7705	1.7276-1.7279	1.7266-1.7273	1.7687-1.7751	1.7148-1.716	1.7409-1.7413
	Daily (1.7)	10	1.70767-1.70903	1.7039-1.70401	1.70595-1.70904	1.7021-1.70212	1.7031-1.70319	1.70444-1.70448	1.701-1.70101	1.70334-1.70338
	Annual (0.098)	6.7	0.10095-0.10138	0.09906-0.0991	0.09874-0.09909	0.09834-0.09835	0.09874-0.09876	0.0985-0.09851	0.09821-0.09821	0.09888-0.09891

Note:

[1] For the hourly and daily data, the maximum daily concentrations of the relevant metals at Kwai Chung AQMS from the latest five years (i.e. 2019-2023) are adopted as the background concentrations. For the annual data, the maximum annual concentrations of the relevant metals at Kwai Chung AQMS from 2019 to 2023 are adopted as the background concentrations.

- The predicted concentration has included the background heavy metal concentrations (Year 2019 to 2023).

Odour Impact

- 4.3.27 Reference is made to the approved EIA report for the "Police Facilities in Kong Nga Po" (Application No. EIA-239/2016). Odour samplings were conducted near the firing training locations within the San Uk Ling Firing Range during active firing training sessions. The odour testing results were below the detection limit and the odour criterion. Considering the similar scale of shooting activities (i.e. 500 shots per hour) for the proposed Project and the existing San Uk Ling Firing Range, no adverse odour impact from the proposed Project is anticipated.
- 4.3.28 Furthermore, a review of the historical odour complaint record shows that no complaints regarding odour issues from the operation of the open firing range at the Site were received during its operation in the past 50 years.
- 4.3.29 No other odour emission source is found within the assessment area during the site visit on 2 August 2023, 23 January 2024 and 19 April 2024. Therefore, it is concluded that odour impact of the proposed Project on surrounding ASRs shall be minor and no odour control measure is required.

Vehicular emission Impact

- 4.3.30 It is estimated that there will be potential traffic generation during construction and operation phases of the Project. As all structures within the Site are already constructed, no site formation work, foundation work or substantial construction work is required for the Project. As confirmed by the engineer, there will be a maximum of two dump truck trips per hour and hence the traffic generated during the construction phase will be limited. No adverse air quality impact due to exhaust emissions from the dump trucks during the construction phase is anticipated
- 4.3.31 Air quality impact may arise from the extra vehicular access to the proposed shooting range through Cheung Hang Road and the internal access road during the operational phase. But shuttle bus service will be provided by HKCSA for visitors to commute between the Site and the nearby MTR station. The shuttle bus service will be provided during three periods, comprising the morning session (08:00-09:00), afternoon session (12:00-13:00), and evening session (17:00-18:00) by appointment only. Given that the maximum number of visitors to the shooting range is 100 per day during major competitions (i.e., with peak traffic generation), with the limited parking spaces (i.e., about 9 parking spaces) for staff and visitors, it is anticipated that the maximum traffic generation is one 19-seated shuttle bus and 20 passenger cars/taxi per hour. Given the limited traffic, no adverse air quality impact from vehicular emissions induced by the Project is anticipated during its operation.

4.4 Noise Impact Assessment

- 4.4.1 This assessment of noise impact has been carried out to identify, qualify and quantify noise impact arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 5 and Annex 13 of the EIAO-TM are referred to.

Environmental Legislation and Standards

Environmental Impact Assessment Ordinance ("EIAO", Cap.499) and Noise Control Ordinance ("NCO", Cap.400)

- 4.4.2 The main piece of legislation controlling environmental noise impact is the NCO. The NCO enables regulations and Technical Memoranda ("TMs") to be enacted, which introduce detailed control criteria, measurement procedures and other technical matters:
- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and EIAO-TM
 - TM on Noise from Construction Work other than Percussive Piling ("GW-TM")
 - TM on Noise from Percussive Piling ("PP-TM")
 - TM on Noise from Construction Work in Designated Areas ("DA-TM")
 - TM for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites ("IND-TM")

- 4.4.3 The Site is completely outside Designated Area (“DA”) with reference to Plan No. EPD/AN/K&NT-01 entitled Designated Areas – Kowloon West, Kwai Chung, Tsuen Wan and Tsing Yi. Therefore, DA-TM does not apply to the Project.

Potential Sources of Pollution

- 4.4.4 Minor reinstatement and refurbishment works will be carried out during the construction phase. The use of Powered Mechanical Equipment (“PME”) and vehicles within the Site will be potential noise sources. Adverse noise impact arising from the reinstatement and refurbishment works can be avoided by implementation of good site practice and appropriate mitigation measures. Construction work during Restricted Hours will not be required and there will be no percussive piling.
- 4.4.5 Noise generated from outdoor shooting activities will be the major pollution source during operation of the Project. The single storey Clubhouse will be provided with mechanical ventilation, such as window-type/split-type air conditioning units and/or exhaust fans. The window-type/split-type air conditioning units and/or exhaust fans will be facing inside the site and away from the nearby noise sensitive receivers and windows with proper insulation, such as gasketed windows.

Construction Phase Assessment

- 4.4.6 Minor reinstatement and refurbishment works will be carried out during the construction phase. The use of PME and vehicle movement within the Site will be the potential noise sources.
- 4.4.7 For general construction works other than percussive piling, although GW-TM does not provide control over daytime (0700 to 1900 hours on any day not being a Sunday or general holiday) construction activities, noise limits are set out in Table 1B of Annex 5 of the EIAO-TM for Designated Projects. The relevant noise standards are summarised in **Table 4.5**.

Table 4.5 Noise Standards for Daytime Construction Activities

Use	0700 to 1900 on any day not being a Sunday or general holiday, Leq(30 mins), dB(A)	1900 to 0700 or any time on Sundays or general holidays
All domestic premises, temporary housing accommodation, hostels, convalescent homes, and homes for the aged	75	The criteria laid down in the relevant technical memoranda under the NCO for designated areas and construction works other than percussive piling may be used for planning purposes. A Construction Noise Permit (“CNP”) shall be required for carrying out of the construction work during these periods
Places of public worship, courts of law, and hospitals and medical clinics	70	
Educational institutions (including kindergartens and nurseries)	70 65 (During Examination)	

Note:

- The above standards apply to uses which rely on opened windows for ventilation and are assessed at 1m from the external façade.

- 4.4.8 Noise impacts arising from construction of the Project are mainly due to the use of PME for various construction activities. As the scale of the works is small, the types and quantities of PME to be used are limited. An inventory of the PME used in the construction work of the Proposed Project is given in **Table 4.6**, together with the associated Sound Power Level (“SWL”).

Table 4.6 Tentative Inventory of the PMEs

PME	Reference ID	SWL per unit, dB(A)	Quantity	SWL of the work activity, dB(A)
Breaker, hand-held, mass > 10kg and < 20kg	CNP 024	108	1	117

PME	Reference ID	SWL per unit, dB(A)	Quantity	SWL of the work activity, dB(A)
Generator, silenced, 75 dB(A) at 7 m	CNP 102	100	1	
Crane, mobile/barge mounted (diesel)	CNP 048	112	1	
Excavator/loader, wheeled/tracked	CNP 081	112	1	
Dump truck, 5.5 tonne < gross vehicle weight \leq 38 tonne	EPD*	105	2	

Note:

* The SWL is referenced to the Sound Power Levels of Other Commonly Used PME available in EPD's website: https://www.epd.gov.hk/epd/sites/default/files/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf

The project engineer has confirmed that the PME list has been reviewed and that the PME inventory is realistic, practical and practicable in completing the works within the construction works schedule.

- 4.4.9 The Site is located at high elevation on flat ground and no NSR has direct line-of-sight of the outdoor shooting ranges. Barrier correction of -10 dB(A) was applied to the predicated noise level for screening effect of topography and perimeter barrier.
- 4.4.10 A positive 3dB(A) correction was applied to the predicted noise level to account for the façade effect at each assessment point.
- 4.4.11 The NSR with the shortest horizontal distance from the Site is Temporary Structure near 1A Cheung Hang Village. Therefore, Temporary Structure near 1A Cheung Hang Village is the worst affected NSR and so is selected as the representative NSR, namely NSR1, for construction noise impact assessment. The distance between the NSR1 and the corresponding notional source of the construction is measured as 60m. The location of NSR1 and notional source are shown in **Figure 4.2**.
- 4.4.12 The assessment of construction noise impact was carried out quantitatively based on the guidelines given in GW-TM issued under the NCO where appropriate. Sound Power Levels (SWLs) of PME refer to Table 3 of the GW-TM and the Sound Power Levels of Other Commonly Used PME available in EPD's website.
- 4.4.13 Predicted noise level at the NSR is calculated as follows:
- $$SPL = SWL - DC + FC + BC$$
- where
- SPL = Sound Pressure Level at NSR in dB(A)
- SWL = Sound Power Level in dB(A)
- DC = Distance attenuation for point source in far field, $20 \log r + 8$ dB(A), with r being the distance between the noise source and NSR
- FC = Façade correction, +3dB(A)
- BC = Barrier correction, -10dB(A)
- 4.4.14 The construction noise calculation was conducted at the representative NSR based on the worst-case scenario considering the potential changes in the construction programme and construction activities. The tentative construction programme and the assessment results are shown in **Table 4.7** and **Table 4.8** below.

Table 4.7 Tentative Construction Programmes

Activities	Duration
Design development and tendering	Week 1 to Week 24
Clearance works and dismantling of obsolete components	Week 25 to Week 27
- Maintenance and minor works -Installation of a vent pipe to connect the existing ventilators -Erection of additional noise barrier	Week 28 to Week 57
Assembling/fixing, rewiring of electrical installation, AC and ventilation installation, interior finishing works	Week 56 to Week 59

Table 4.8 Predicted Noise Levels at Representative NSR

NSR ID	Max. Predicted Construction Noise Level Leq (30min), dB(A)	EIAO-TM Noise Criterion Leq (30 min), dB(A)	Exceedance
NSR 1	66	75dB(A) during 0700 to 1900 hours in any day not being Sunday or general holiday	No

4.4.15 The results of the construction noise assessment indicated that there would be no exceedance at the representative NSR, the predicted noise level is well below the relevant noise criterion and it represented that all NSRs at further distance also comply with the relevant noise criterion.

4.4.16 Although the assessment has demonstrated that there will be no adverse impact to all NSRs, the mitigation measures recommended in EIAO GN No. 9/2023 shall be implemented where applicable. In addition, the following measures and relevant good on-site practice are recommended to minimise the potential noise impacts during construction stage:

- Quiet PME and construction method should be adopted if possible. For example:
 - Hand-held Percussive Breaker – (QPME ID: EPD-15022)
 - Generator – (QPME ID: EPD-15025)
 - Crane, mobile – (QPME ID: EPD-14912)
 - Excavator, wheeled/tracked – (QPME ID: EPD-14971)
- The contractor shall devise and execute working methods to minimise the noise impacts on the surrounding sensitive uses, and provide experienced personnel with suitable training to ensure that those methods are implemented.
- Switch off idling equipment.
- Regular maintenance of equipment.
- Fit muffler or silencer for equipment.
- Noisy equipment and noisy activities should be located as far away from the NSRs as is practical.
- PME should be kept to a minimum and the parallel use of noisy equipment/machinery shall be avoided.
- Erect noise barriers or noise enclosure for the PME if appropriate.

- Implement good housekeeping and provide regular maintenance to the PME.
- Spot check resultant noise levels at nearby NSRs.

- 4.4.17 The “Recommended Pollution Control Clauses for Construction Contracts” published by the EPD should be adopted in the Contract Specification for the Contractor to follow and implement relevant measures and good site practices in minimising noise impact.
- 4.4.18 If any reinstatement and refurbishment work involving use of PME is required during restricted hours, a CNP shall be applied for under the NCO. The noise criteria and assessment procedures for obtaining a CNP are specified in GW-TM.
- 4.4.19 With the implementation of the abovementioned mitigation measures, adverse noise impact during the construction stage is not anticipated.

Operation Phase Assessment

Project Noise Source

- 4.4.20 Noise will be generated during shooting and this will be the only noisy activity during operation phase.
- 4.4.21 Air pistols, which will be used only in the indoor shooting range, use CO2 instead of a primer and therefore do not generate significant noise. The indoor range will be equipped with mechanical ventilation, such as window-type/split-type air conditioning units and/or exhaust fans, and will have windows with proper insulation, such as gasketed windows. The window-type/split-type air conditioning units and/or exhaust fans will be facing inside the site and away from the nearby noise sensitive receivers. Therefore, no significant external noise impact is anticipated from activities in the indoor shooting range and the split-type air conditioning units and/or exhaust fans.
- 4.4.22 Firing of pistols and rifles in the outdoor shooting range will be the major noise source from the Project. However, since the outdoor shooting range will not operate during night time (2300-0700 hours), no night time noise impact is anticipated.

Representative Noise Sensitive Receivers and its Noise Criteria

- 4.4.23 The operation of the Project shall comply with the requirements of the EIAO-TM.
- 4.4.24 Table 2 of IND-TM stipulates the day, evening and night time Acceptable Noise Levels (“ANLs”) for NSRs according to the corresponding Area Sensitivity Rating (“ASR”), which is determined by Influencing Factors (“IFs”) in accordance with IND-TM. These are summarised in **Table 4.9**.

Table 4.9 Acceptable Noise Levels for NSRs in different ASR and Time Periods

Time Period	ANL, dB(A)		
	ASR “A”	ASR “B”	ASR “C”
Day (0700 to 1900 hours)	60	65	70
Evening (1900 to 2300 hours)			
Night (2300 to 0700 hours)	50	55	60

- 4.4.25 The noise criteria for planned fixed noise source shall follow the standards for planning purposes in Table 1A of Annex 5 of EIAO-TM:
- 5dB(A) below the appropriate ANLs shown in Table 2 of IND-TM, or
 - the prevailing background noise levels (For quiet areas with level 5dB(A) below the ANL), whichever is lower.

- 4.4.26 The Site is located at high elevation on flat ground and no NSR has direct line-of-sight of the outdoor shooting ranges. The NSR with the shortest horizontal distance from the Site is Temporary Structure near 1A Cheung Hang Village. Therefore, Temporary Structure near 1A Cheung Hang Village is the worst affected NSR and so is selected as the representative NSR, namely NSR1, for operational noise impact assessment. The location of NSR1 is shown in **Figure 4.4**.
- 4.4.27 1 Cheung Hang Village cum Cheung Hang Village Residents Welfare Association located southeast of the Site has a greater separation distance from the shooting range and is shielded by the structure of the indoor shooting range. However, it also is a potentially affected NSR and so is selected as another representative NSR, namely NSR2, for operational noise impact assessment. The location of NSR2 is shown in **Figure 4.4**.
- 4.4.28 There are no IFs in the vicinity of both NSRs and as NSRs are located in a rural area, an area sensitivity rating of “A” is considered appropriate. The ANL of both NSRs shall be 60 dB(A) during day and evening time period.
- 4.4.29 A site visit was conducted and background noise level was measured outside NSR1 and NSR2 during the daytime on 23 January 2024 and 19 April 2024. The background noise level remained steady during entire measurement period. It was observed that the background noise at NSR1 was dominated by the sound of water flowing in a channel near to NSR1 and background noise at NSR2 was dominated by the sound of neighbourhood. The Background Noise Level of Representative NSRs and the Applicable Noise Criteria are presented in **Table 4.10**.

Table 4.10 Background Noise Level of NSRs and the Applicable Noise Criteria

NSR ID	Description	Measured Background Noise Level , L _{eq} (30 mins)	5 dB(A) below ANL	Applicable Noise Criteria
NSR1	Temporary Structure near 1A Cheung Hang Village	55 dB(A)	55 dB(A)	55 dB(A)
NSR2	1 Cheung Hang Village cum Cheung Hang Village Residents Welfare Association	57 dB(A)	55 dB(A)	55 dB(A)

Noise Impact Assessment

- 4.4.30 As mentioned in S4.1.1, the site layout would be modified to meet the latest requirements of the Olympics whilst the firing activities of the proposed shooting range would not adhere to that in the Olympic Games. In the approved Project Profile for Proposed Shooting Range at Pillar Point Valley Landfill (PP- 347/2008), the sound exposure levels (“SEL”) of various types of firearms were measured at the Hong Kong Gun Club in Tai Mo Shan and at the ex-HKRA (the Site). The type of firearm to be used at the Project will include those used at the Pillar Point Valley Landfill shooting range. The inventory of firearms is listed below:

Air pistol

- .177 calibre

Pistol

- .22, .32, 9mm, .38 revolver, .40, .41, .45, and .50 calibres

Rifle

- .22 / .223 / 7.62mm calibres

- 4.4.31 The noise measurement data presented in the approved Project Profile (PP-347/2008) is considered applicable to this Project. The maximum noise level was adopted to represent the worst-case scenario. As confirmed by firearm expert and arms licensee, .45 calibre pistol generates highest noise level amongst the firearms listed above. Hence, the SEL of .45 pistol would be used for .40, .41, and .50 calibres pistol.
- 4.4.32 A summary of sound exposure level of various types of firearms are provided in **Table 4.11**.

Table 4.11 Summary of Noise Measurement Result of Firearms Test

Type of Firearm	Measurement Distance	Sound Exposure Level per Shot, dB(A) ^[1]	Reference ^[2] ^[4]
.177 air pistol	2m	91.7	PP-347/2008
.22 rifle		105.0	PP-347/2008
.223 rifle		106.4	Measurement result on 19 May 2024 ^[4]
7.62mm rifle		107.1	Measurement result on 19 May 2024 ^[4]
9mm pistol		113.7	PP-347/2008
.40 pistol ^[3]		114.4	PP-347/2008
.41 pistol ^[3]		114.4	PP-347/2008
.45 pistol		114.4	PP-347/2008
.22 pistol		105.4	PP-347/2008
.32 pistol		106.3	PP-347/2008
.38 revolver		110.5	PP-347/2008
.50 pistol ^[3]		114.4	PP-347/2008

Note:

[1] Noise measurements were conducted at different directions from the firearm. The maximum noise levels were adopted as a worst-case scenario.

[2] Table 3 of Approved Project Profile for Proposed Shooting Range at Pillar Point Valley Landfill (PP-347/2008), March 2008.

[3] As confirmed by firearm expert and arms licensee, .45 calibre pistol generates highest noise level amongst the firearms listed above. Hence, the SEL for .45 pistol would be used for .40, .41 and .50 calibres pistol.

[4] Detailed result of noise measurement is shown in **Appendix D**

- 4.4.33 As shown on the layout plan in **Figure 4.3**, the Project will have two 50m outdoor shooting ranges and two 25m outdoor shooting ranges.
- 4.4.34 There are two kinds of shooting practices within the Site, namely “shooting at the standing location” and “shooting on move”. For “shooting at the standing location”, a number of shooters fire at targets simultaneously at the firing lines under the covered walkway and this form of shooting is considered to have the highest total number of shots fired within 30 minutes.
- 4.4.35 “Shooting on move” is a form of shooting that requires the shooter to move around the shooting range and shoot from several positions, fire under or over obstacles and in various positions. Only one shooter is allowed to use the shooting range at a single time, for obvious safety reasons.
- 4.4.36 Noise generated from a gunshot is regarded as point source and distance attenuation for point source is adopted in the assessment. A correction of +3 dB(A) is applied for impulsiveness due to the nature of gunshot noise and another correction of +3 dB(A) is applied due to façade reflection at the NSR.
- 4.4.37 Different fixed noise source locations for each range were used for different shooting activities; for “shooting at the standing location”, the shooters will all shoot from the shooting position under the covered walkway; whereas for “shooting on move”, the shooter will be inside the range. A plan showing different fixed noise source positions adopted for different shooting activities is provided on **Figure 4.4**. The slant distance between the noise source and the NSRs has been adopted for calculating the distance correction factor. Distances of each noise source to the NSRs are tabulated in **Table 4.12**, below.

Table 4.12 Distances of Fixed Noise Sources to the NSR1 and NSR 2

Fixed Noise Sources ID	Slant Distance Between Sources and NSR1
N1-R1 (Shooting on move at Range 1)	107m
N1-R2 (Shooting at the standing location at Range 2)	91m
N1-R3 (Shooting at the standing location at Range 3)	72m
N1-R4 (Shooting at the standing location at Range 4)	61m
N1-R5 (Shooting at the standing location at Range 1)	110m
Fixed Noise Sources ID	Slant Distance Between Sources and NSR1
N2-R1 (Shooting on move at Range 1)	134m
N2-R2 (Shooting at the standing location at Range 2)	106m
N2-R3 (Shooting at the standing location at Range 3)	89m
N2-R4 (Shooting at the standing location at Range 4)	77m
N2-R5 (Shooting at the standing location at Range 1)	124m

- 4.4.38 No NSR has direct line-of-sight to any of the fixed noise source locations. In considering the difference in ground levels between the source and the NSRs and topography shielding, barrier correction of all fixed sources towards all NSRs was anticipated to be more than 10 dB(A). As a conservative approach, the screening effect caused by topography shielding will be capped at 10dB(A).
- 4.4.39 Predicted noise level at the NSR is calculated as follows:
- $$\text{SPL} = \text{SEL} + 10 \log(S) + \text{DC} + \text{TC} + \text{FC} + \text{IC} + \text{SC}$$
- where
- SPL = Sound Pressure Level at NSR in dB(A)
- SEL = Sound Exposure Level of gun shot at a Reference Distance
- S = Number of gunshots in 30 minutes
- DC = Distance correction factor, $-20 \log (\text{distance between source and NSR} \div \text{reference distance})$
- TC = Time correction factor, $10 \log (1/1800)$
- FC = Façade correction, +3dB(A)
- IC = Impulsiveness correction, +3dB(A)
- SC = Screening correction, calculated by ISO-9613-2
- 4.4.40 The firing details listed in below will be included in the future SRO, which will only be ready after the police inspection conducted against the final completion of the ranges. The type of firearm is restricted in each Range and the Project will operate under the nine scenarios shown below based on the best available information. Nonetheless, if there are any changes deviating from the nine shooting operation scenarios listed in the Project Profile, HKCSA will submit the Fixed Noise Performance Review Report to EPD for approval before the implementation of any changes in the operation scenario.
- 4.4.41 The unmitigated noise level for each shooting practice at different shooting locations on NSRs are calculated and summarised in Table A.1 and Table A.2 in **Appendix E**. Based on the noise calculation results for individual ranges and activities presented in **Appendix E**, of the three shooting activities, pistol shooting at the standing location is the noisiest shooting activity; shooting on move is the second noisiest activity; and rifle shooting at the standing location is the least noisy activity. The noise measurement data adopted in the assessment represents the "worst-case scenario". The noisiest shooting pattern and the noisiest allowable firearms under the future SRO will be selected to calculate noise impact at each range.
- 4.4.42 A full-time Duty Range Officer (DRO) is required to be appointed under the Firearms and Ammunition Regulations. In order to ensure the above operation restrictions stipulated in the future SRO will be executed properly, the DRO will be responsible to arrange and manage uses of the shooting ranges. A daily log recording the shooting activities at each range shall be prepared and certified by the DRO and kept at Site for inspection.

Table 4.13 Unmitigated Noise Level from Each Range in Each Operation Scenario of the Project and its Predicted Noise Level at NSRs

	Range 1*	Range 2	Range 3	Range 4	Cumulative Noise Level, dB(A)	Noise Criteria, dB(A)	Compliance (Y/N)	Noise Exceedances at the NSRs, dB(A)
Scenario 1								
Types of Firearms (Note 1, 2)	All Firearms	-	-	Rifle only	-	-	-	-
Number of shots in 30 minutes	45	-	-	15	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	60	-	-	53	60	55	N	5
Predicted Noise Level at NSR 2, dB(A)	59	-	-	51	60	55	N	5
Scenario 2								
Types of Firearms (Note 1, 2)	-	.22 ammunition only		-	-	-	-	-
Number of shots in 30 minutes	-	15	15	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	48	50	-	52	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	46	48	-	50	55	Y	-

Remark: * The number of shots in 30 minutes at Range 1 for Scenario 1: 45 shots for 'shooting at the standing location' (SSL) or 15 shots for 'shooting on the move' (SOM).

Scenario 3								
Types of Firearms (Note 1)	-	All Firearms between .32 to .45 ammunition		-	-	-	-	-
Number of shots in 30 minutes	-	10	10	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	55	57	-	59	55	N	4
Predicted Noise Level at NSR 2, dB(A)	-	53	55	-	57	55	N	2
Scenario 4 (General Competition)								
Types of Firearms (Note 1, 2)	-	.22 ammunition only		-	-	-	-	-
Number of shots in 30 minutes	-	105	105	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	56	58	-	60	55	N	5
Predicted Noise Level at NSR 2, dB(A)	-	55	56	-	58	55	N	3

Scenario 5 (General Competition)								
Types of Firearms (Note 1, 2)	-	All Firearms	All Firearms except .45, 9mm Pistol, and .38 Revolver	-	-	-	-	-
Number of shots in 30 minutes	-	30	30	-	-	-	-	--
Predicted Noise Level at NSR 1, dB(A)	-	60	62	-	64	55	N	9
Predicted Noise Level at NSR 2, dB(A)	-	58	60	-	62	55	N	7
Scenario 6								
Types of Firearms (Note 1)	-	.22 and .32 Pistol		-	-	-	-	-
Number of shots in 30 minutes	-	125	85	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	58	58	-	61	55	N	6
Predicted Noise Level at NSR 2, dB(A)	-	56	56	-	59	55	N	4

Scenario 7								
Types of Firearms (Note 1)	-	-	-	Rifle only	-	-	-	-
Number of shots in 30 minutes	-	-	-	15	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	-	-	53	53	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	-	-	51	51	55	Y	-
Scenario 8								
Types of Firearms (Note 1,2)	All Firearms	All firearms except .40, .41, .45, .50 and 9mm Pistol	.22 and .32 Pistol	Rifle only	-	-	-	-
Number of shots in 30 minutes	50	40	40	40	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	60	57	55	57	64	55	N	9
Predicted Noise Level at NSR 2, dB(A)	59	55	53	55	62	55	N	7

Scenario 9								
Types of Firearms (Note 1)	22 and .32 Pistol			Rifle only	-	-	-	-
Number of shots in 30 minutes	100	75	60	15	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	55	56	57	53	61	55	N	6
Predicted Noise Level at NSR 2, dB(A)	54	54	55	51	60	55	N	5

Notes :

1. Types of firearms refer to Table 4.10. All firearms included .22/.223/7.62mm rifle, 9mm pistol, .22/.32/.38 revolver.40/.41/.45/.50 pistol.
2. As advised by Arms Licensee and expert on firearms, .45 ammunition produces the highest noise level amongst all firearms of .22/.32/.38 revolver.40/.41/.45/.50 pistol, 9mm and rifles of .22/.223/7.62mm calibres. Thus, the SEL of .45 pistol was adopted for assessment as a worst-case for "All firearms" scenario.

Noise Mitigation Measures

- 4.4.43 The above noise calculations revealed that there shall be noise exceedance when the Project is operating at the worst-case scenario.

Barrier Effect of Existing 2m Boundary Wall and 1-storey Building

- 4.4.44 Solid boundary walls which are 2m high located to the east and west of the Site will be repaired to ensure there is no sound leakage from the wall. A 1- storey building structure which is 3m high located to the south-east of the Site. The boundary walls and the building structure can provide barrier effect for the NSR. The locations of the aforementioned features are indicated in **Figure 4.5**.

Proposed Additional Noise Barriers within Shooting Range

- 4.4.45 Additional noise barrier with a height of at least 2m will be erected in between Range 1 and Range 2, and between Range 2 and Range 3 as additional noise mitigation to alleviate the noise impact. The barrier will be gap-free and constructed with timber and acoustic mat, with total surface density of no less than 8kg/m², or any material with equivalent surface density, which could achieve the target sound attenuation as stated in **Appendix E**, could be used. Examples of acoustic mat are shown in **Appendix F**. The locations of the barriers are indicated in **Figure 4.5**.

Cumulative Barrier Attenuation

- 4.4.46 The cumulative barrier attenuation of boundary walls, existing building and noise barriers has been calculated in accordance with basic acoustic principles such as ISO 9613 – 2 Acoustics – attenuation of sound during propagation outdoors – Part 2: General method of calculation. Detail calculation of barrier correction is appended in **Appendix E**. In considering the topography of the Site and surrounding area, the overall noise screening effect will be conservatively capped at 20dB (A) for each noise source.
- 4.4.47 The predicted noise level for each shooting practice at different shooting locations on NSRs are calculated and summarized in Table A.5 and Table A.6 in **Appendix E**. Based on the noise calculation results for individual ranges and activities presented in **Appendix E**, of the three shooting activities, pistol shooting at the standing location is the noisiest shooting activity; shooting on move is the second noisiest activity; and rifle shooting at the standing location is the least noisy activity. The noisiest shooting pattern and the noisiest allowable firearms under the future SRO will be selected to calculate noise impact at each range.
- 4.4.48 Mitigated noise levels at each range in each scenario are identified and summarised in **Table 4.14**. Cumulative noise levels of all operation scenarios at both NSRs will comply with the noise criteria. Therefore, it is concluded that no adverse noise impact will be anticipated at nearby NSRs with implementation of above noise mitigation measures.

Noise Commissioning Tests

- 4.4.49 Prior to the operation of the Project, the Project Proponent should conduct noise commissioning tests at / near the representative NSRs (i.e. Temporary Structure near 1A Cheung Hang Village and 1 Cheung Hang Village cum Cheung Hang Village Residents Welfare Association) to verify the operation noise from fixed noise sources under the worst-case scenarios (i.e., Scenario 5 and Scenario 8) within the criteria determined in this Project Profile. The noise commissioning tests should be conducted before the commencement of the Project's operation. The Leq (30 minutes) shall be used as the monitoring parameter. The test should be carried out by a qualified person possessing at least 7 years of noise control experience and a corporate membership of Hong Kong Institute of Acoustics or equivalent.
- 4.4.50 Nevertheless, the public may lodge an inquiry/complaint to HKCSA by phone, email, or post :
- Tel: (852) 2504 8138
 - Email: hkaigun@yahoo.com.hk
 - Address: Room 2011, Olympic House, No.1 Stadium Path, Causeway Bay, Hong Kong

Table 4.14 Mitigated Noise Level from Each Range in Each Operation Scenario of the Project and its Predicted Noise Level at NSRs

	Range 1*	Range 2	Range 3	Range 4	Cumulative Noise Level, dB(A)	Noise Criteria, dB(A)	Compliance (Y/N)	Noise Exceedances at the NSRs, dB(A)
Scenario 1								
Types of Firearms (Note 1, 2)	All Firearms	-	-	Rifle only	-	-	-	-
Number of shots in 30 minutes	45	-	-	15	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	50	-	-	45	51	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	49	-	-	45	50	55	Y	-
Scenario 2								
Types of Firearms (Note 1, 2)	-	.22 ammunition only		-	-	-	-	-
Number of shots in 30 minutes	-	15	15	-	-	-	-	--
Predicted Noise Level at NSR 1, dB(A)	-	38	40	-	42	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	36	38	-	40	55	Y	-

Remark: * The number of shots in 30 minutes at Range 1 for Scenario 1: 45 shots for 'shooting at the standing location' (SSL) or 15 shots for 'shooting on the move' (SOM).

Scenario 3								
Types of Firearms (Note 1)	-	All Firearms between .32 to .45 ammunition		-	-	-	-	-
Number of shots in 30 minutes	-	10	10	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	45	47	-	49	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	43	45	-	47	55	Y	-
Scenario 4 (General Competition)								
Types of Firearms (Note 1, 2)	-	.22 ammunition only		-	-	-	-	-
Number of shots in 30 minutes	-	105	105	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	46	48	-	50	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	45	46	-	48	55	Y	-

Scenario 5 (General Competition)								
Types of Firearms (Note 1, 2)	-	All Firearms	All Firearms except .45, 9mm Pistol, and .38 Revolver	-	-	-	-	-
Number of shots in 30 minutes	-	30	30	-	-	-	-	--
Predicted Noise Level at NSR 1, dB(A)	-	50	52	-	54	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	48	50	-	52	55	Y	-
Scenario 6								
Types of Firearms (Note 1)	-	.22 and .32 Pistol		-	-	-	-	-
Number of shots in 30 minutes	-	125	85	-	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	48	48	-	51	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	46	46	-	49	55	Y	-

Scenario 7								
Types of Firearms (Note 1)	-	-	-	Rifle only	-	-	-	-
Number of shots in 30 minutes	-	-	-	15	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	-	-	-	45	45	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	-	-	-	45	45	55	Y	-
Scenario 8								
Types of Firearms (Note 1, 2)	All Firearms	All firearms except .40, .41, .45, .50 and 9mm Pistol	.22 and .32 Pistol	Rifle only	-	-	-	-
Number of shots in 30 minutes	50	40	40	40	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	50	47	45	49	54	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	49	45	43	49	53	55	Y	-

Scenario 9								
Types of Firearms (Note 1)	22 and .32 Pistol			Rifle only	-	-	-	-
Number of shots in 30 minutes	100	75	60	15	-	-	-	-
Predicted Noise Level at NSR 1, dB(A)	45	46	47	45	52	55	Y	-
Predicted Noise Level at NSR 2, dB(A)	44	44	45	45	50	55	Y	-

Notes:

1. Types of firearms refer to Table 4.10. All firearms included .22/.223/7.62mm rifle, 9mm pistol, .22/.32/.38 revolver/.40/.41/.45/.50 pistol.
2. As advised by Arms Licensee and expert on firearms, .45 ammunition produces the highest noise level amongst all firearms of .22/.32/.38 revolver/.40/.41/.45/.50 pistol, 9mm and rifles of .22/.223/7.62mm calibres. Thus, the SEL of .45 pistol was adopted for assessment as a worst-case for "All firearms" scenario.

4.5 Water Quality Impact Assessment

Environmental Legislation and Standards

Water Pollution Control Ordinance (Cap .358)

- 4.5.1 An amendment to the Water Pollution Control Ordinance (WPCO) was enacted in 1990 and provides a mechanism for setting effluent standards. These are included in the Technical Memorandum Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (WPCO Cap 358, S.21). All discharges into government sewerage systems, marine and inland waters are required to comply with standards stipulated in the Technical Memorandum (TM).

Construction Site Drainage, ProPECC PN2/23

- 4.5.2 Under ProPECC Practice Note PN2/23 Construction Site Drainage (ProPECC PN2/23), various guidelines for the handling and disposal of construction site discharges are included. The guidelines include the use of sediment traps, wheel washing facilities for vehicles leaving the Site, adequate maintenance of drainage systems to prevent flooding and overflow, sewage collection and treatment, and comprehensive waste management (collection, handling, transportation, and disposal) procedures.

Potential Sources of Pollution

- 4.5.3 Although muddy runoff from the Site is unlikely to be generated during the minor reinstatement and refurbishment works, appropriate mitigation measure and standard good site practice shall be implemented.
- 4.5.4 Fired bullets will be left on the shooting range after being shot. Metal bullets left on open ground will be a potential pollution source to surface runoff.
- 4.5.5 Sewage will be generated from toilets use by staff and visitors of the Project. There will be no other facilities and activities with sewage or wastewater generation, such as catering services. Surface runoff from the Site is collected by existing peripheral surface channels and there will be no change in the future.

Construction Phase Assessment

- 4.5.6 Muddy runoff from the Site is unlikely to be generated during the minor reinstatement and refurbishment works. As no new construction work will be carried out, mitigation measures specified in *ProPECC PN 2/23* and standard good site practice for construction site drainage will be followed where appropriate during the minor reinstatement and refurbishment works.
- 4.5.7 The Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any waste matter (or refuse) which is not part of the final product from waste processing plants to be deposited anywhere within the Site (or onto any adjoining land). He shall arrange removal of such matter from the Site (or any building erected or to be erected thereon) in a proper manner to the satisfaction of the Engineer in consultation with the Director of Environmental Protection.
- 4.5.8 During construction reinstatement and refurbishment works, it is recommended that portable toilets should be provided for handling sewage generated by the construction workers. These will be supplied, maintained, and emptied for offsite disposal by a specialist contractor. Therefore, no adverse water quality impacts are anticipated from the construction of the Project with the recommended mitigation measures and standard good site practice in place.

Operation Phase Assessment

- 4.5.9 Surface runoff will be collected by the existing drainage system and discharge to public drainage facility by gravity.
- 4.5.10 When a bullet is fired, the bullet will be split into bullet head and cartridge casings. The bullet head is usually made of lead and cartridge casing is usually made of steel, copper, or plastic. Bullet head will be fired toward the target and collected by the bullet catcher. Empty cartridge casing will be ejected from the firearm when the shooter fired a shot.
- 4.5.11 A bullet catcher with rubber curtain target backing (made with Linatex®) and steel plate backstop with containers placed underneath will be used as it is an internationally accepted, environmental, economical, and safe device to avoid fragmentation and for easy collection of bullet heads at live fire ranges. Cartridge casing after firing will drop onto the ground and can be easily collected by floor sweeping. All fired bullet heads will only hit the designated bullet trap which will stop the bullet heads and they will fall into a container placed underneath the trap to avoid lead contamination. Daily inspection will be conducted by the range operator to check the conditions of the bullet catcher and will arrange for repair when needed.
- 4.5.12 In order to prevent contamination to the surface runoff, all cartridge casing will be cleared by the staff of the facility at the end of every working day, and the ammo cases left after being fired will be cleared daily. Metal detectors will be used to ensure all cartridge casings will be recovered. Bullet heads which are stopped by bullet catcher will stay in the water container underneath and will be removed monthly. Metal detectors with the equivalent specifications and detection ability will be used in the proposed shooting range. The collected bullet heads and cartridge casings will be temporarily stored in the Armoury Store for further collection by registered collectors for proper disposal in accordance with the Firearms and Ammunition Ordinance,
- 4.5.13 There is currently no public sewerage connection at the Site and there are no plans by the government to extend the nearby sewerage system to the Site in the near future. There are no permanent toilet facilities in the Clubhouse.
- 4.5.14 As such, it is proposed that sewage generated by HKCSA members and guests will be collected for off-site disposal. Chemical toilets will be provided, and sewage will be emptied into an above ground sewage storage tank of suitable volume, this is considered to be an appropriate and cost-effective method to handle the small amount of sewage generated from the Project. The proper housekeeping and proper disposal of sewage will be implemented to avoid any odour nuisance to the nearby ASRs.
- 4.5.15 Based on HKCSA's experience, two chemical toilets will be sufficient for the Proposed Shooting Range. Sewage from the holding tank will be emptied regularly by a licenced contractor for offsite disposal. No sewerage impact is therefore anticipated from the Project. These two chemical toilets will be placed at the western part of the Site, which is out of the top of the water service reservoir. The locations of the chemical toilets are illustrated on **Figure 4.6**.
- 4.5.16 There are existing surface channels installed along the periphery of the Site for collection of stormwater. No discharge of wastewater will be allowed into the surface channel. As such, no adverse water quality impact is anticipated during the operation of the Project.
- 4.5.17 The Kau Wa Keng Fresh Water Service Reservoir and natural stream running through Cheung Hang Village are the most immediate WQSR of this Project. During operation phase of the Project, it is anticipated that there is no contamination to the surface runoff, therefore no significant water quality impacts to the Kau Wa Keng Water Service Reservoir below and natural stream running through Cheung Hang Village are anticipated.
- 4.5.18 Nevertheless, the following precautionary measures are recommended to prevent fresh water in Kau Wa Keng Fresh Water Service Reservoir and the surrounding WQSR from contamination during operation of the shooting range:
- Portable toilets will be provided for handling sewage generated by the construction workers. These will be supplied, maintained, and emptied for offsite disposal by a specialist contractor.
 - Bullet with brass primer will be used.

- Bullet catchers with rubber curtain target backing (made with “Linatex”) and steel plate backstop with containers placed underneath will be constructed behind the target plate to stop and collect bullets.
- All cartridge casing will be collected daily by the staff of the shooting range with the aid of metal detectors.
- The collected bullet heads and cartridge casings will be temporarily stored in the Armoury Store for further collection by registered collectors for proper disposal in accordance with the Firearms and Ammunition Ordinance.
- Baffles above each range will be provided as shown on **Figure 4.7** to stop bullets from travelling out of the range.
- Paper targets and pepper popper targets will be used in the shooting range. No clay target will be used.
- The installation of a vent pipe to connect the existing ventilators (shown on **Figure 4.8**), ensuring that the exhaust point is located outside of the firing range area.
- Replacing the topsoil with hydrophobic filling material will form an impervious ground surface for easy collection of cartridge casings. Replacing the topsoil with hydrophobic filling material will form an impervious ground surface for easy collection of cartridge casings.

4.5.19 Therefore, it can be concluded that the operation of the Project would not cause any adverse water quality impact to the identified WQSR.

4.6 Ecological Impact Assessment

- 4.6.1 As the Site is a former shooting range developed in 1964 and in operation until 2013 and is located atop the Kau Wa Keng Fresh Water Service Reservoir, no valuable species or habitats with high ecological importance are anticipated within the Site. No significant habitat loss or other direct ecological impact was anticipated due to the minor reinstatement and refurbishment works and subsequent operation of the Project.
- 4.6.2 The Site has been used as a shooting range for 49 years, and other slope and water reservoir maintenance works also take place in the surrounding area. The nearby potential ecologically sensitive receivers include the natural stream running through Cheung Hang Village, which is disturbed by human activities from Cheung Hang Village. It is unlikely that the Site and its vicinity are an important habitat for noise-sensitive fauna. The potential disturbance to potential wild fauna is considered minor.
- 4.6.3 The natural stream running through Cheung Hang Village is located about 30m to the east of the Site. The elevation of the natural stream is about 110mPD to 120mPD while the elevation of the Site is about 136mPD. With the provision of the boundary wall at least of 2m along the Site, the natural stream is shielded and protected from the potential impact from the Site. Meanwhile, as mentioned in **Section 4.5.16**, no adverse water quality impact on the natural stream running is also anticipated with the implementation of the recommended water quality mitigation measures.
- 4.6.4 Kam Shan Country Park is located about 160m to the northeast of the Site. The Site itself is semi-enclosed by the mountain slope of Kam Shan and the surrounding topography provided a natural shielding to protect Kam Shan Country Park. Those Site feature substantially reduced and localised the potential noise impact to the fauna in the country park.
- 4.6.5 The potential disturbance to potential wild fauna is considered minor. Therefore, it is considered that the indirect ecological impact from operation of the Project is minor.
- 4.6.6 With implementation of the proposed noise and water quality mitigation measures, the Project are not therefore likely to have any significant off-site ecological impact on surrounding ESRs.

4.7 Waste Management Implication

- 4.7.1 This assessment of waste management implications has been carried out to identify, qualify and quantify solid waste arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 7 and Annex 15 of the EIAO-TM are referred to.

Construction Phase Assessment

- 4.7.2 The principal legislation governing waste management in Hong Kong is the Waste Disposal Ordinance (Cap. 354) (WDO), and its subsidiary regulations. The Ordinance, enacted in 1980, generally encompasses all stages of waste management, from place of arising to final disposal point of waste. The Waste Disposal (Chemical Waste) (General) Regulation, enacted under the WDO in 1992, provides controls on all aspects of chemical waste disposal, including storage, collection, transport, treatment, and final disposal.

Potential Source of Waste

- 4.7.3 The key potential waste sources during the construction phase are:
- Inert C&D Materials (e.g., concrete waste, waste from blockwork and brickwork)
 - Non-inert C&D Materials (e.g., wood and plastics) resulting minor reinstatement and refurbishment work.
 - General refuse generated by site workers.
 - Chemical Waste

- 4.7.4 As only minor reinstatement and refurbishment work will be carried out onsite, no site formation work, and construction work will be carried out. Inert C&D material generated from the construction activities and it should be reused on-site where practicable.
- 4.7.5 The construction contractor will first conduct a condition survey and inspection on the existing structure and material on the Site to evaluate if they can be re-used or need to be reinstated. All existing structure and material will be reused or recycled where practicable. The contractor will reinstate the damaged structure and carry out indoor refurbishment for all rooms and stores in the Project.
- 4.7.6 Asbestos, such as amosite, is a naturally occurring fibrous silicate which may be found in buildings constructed before the mid-1980s for the purpose of thermal insulation, electrical insulation, fireproofing, etc. Exposure to asbestos fibres may cause lung cancer, mesothelioma, or asbestosis. Removal and disposal of asbestos containing materials (ACM) is controlled by Cap. 311 Air Pollution Control Ordinance and Cap. 354C Waste Disposal (Chemical Waste) (General) Regulation.
- 4.7.7 During Project operation, the major type of waste will be general refuse arising from daily operation and activities within the proposed shooting range from staff, users, and guests. All general refuse should be recycled wherever possible and landfill disposal should be adopted as the last resort. General refuse from the Site will be collected and disposed of at landfill properly by appropriate waste collector.
- 4.7.8 The shooting waste (comprising of cartridge casings and bullet) will be generated during the operational phase.

Construction Phase Assessment

Inert C&D materials

- 4.7.9 Inert C&D materials are those which do not decompose, such as debris, rubble, earth and concrete, and which are suitable for land reclamation and site formation.
- 4.7.10 All existing structure and material will be reused or recycled where practicable, subject to inspection and evaluation by the contractor. The actual quantity of inert C&D materials to be generated is dependent on evaluation by the contractor prior to project construction stage. To estimate the maximum quantity of C&D materials to be generated for disposal, it is assumed that all existing structures need to be demolished and re-constructed, as worst-case scenario.
- 4.7.11 Building waste will be generated during works period. This includes inert C&D materials, such as concrete waste, waste from blockwork and brickwork, waste from screening and plastering; and non-inert C&D materials from timber formwork, packaging waste and other wastes.
- 4.7.12 Section 3.2 of A Guide for Managing and Minimizing Building and Demolition Waste^[9] provides a “waste index” for building waste generation in Hong Kong based on the GFA of three different building types:
- Private Housing Projects 0.250m³/m² GFA
 - Government Housing Projects 0.174m³/m² GFA
 - Commercial Office Projects 0.200m³/m² GFA

⁹ A Guide for Managing and Minimizing Building and Demolition Waste, C. S. Poon, T.W. Yu and L. H. Ng, Research Centre for Urban Environmental Technology and Management, Dept of Civil & Structural Engineering, Hong Kong Polytechnic University, May 2001

4.7.13 To provide a conservative estimate of building waste from the Proposed Project, the “waste index” for private housing projects is the most appropriate index to use. However, as noted above, in addition to inert C&D materials, this “waste index” also includes non-inert C&D materials, such as timber formwork, packaging waste and other wastes, and The Guide does not identify what proportion of building waste is inert C&D materials and what proportion is non-inert C&D materials.

4.7.14 However, making reference to EPD’s Monitoring of Solid Waste in Hong Kong – Waste Statistics for 2022 ^[10], 92% of construction waste shall be inert C&D materials. The proportion of inert C&D materials in the “waste index” can therefore be estimated by applying the Hong Kong-wide proportion of inert C&D materials in construction waste, i.e., 92%, to the “waste index” as follows:

$$\begin{aligned}\text{Waste Index}_{\text{INERT C\&D MATERIALS}} &= 0.92 \times \text{“waste index” for private housing projects} \\ &= 0.92 \times 0.250\text{m}^3/\text{m}^2 \text{ GFA} \\ &= 0.23 \text{ m}^3/\text{m}^2 \text{ GFA}\end{aligned}$$

4.7.15 The inert C&D materials component of building waste from the Proposed Development, which has a GFA of about 1,808m², can therefore be estimated as follows:

$$\begin{aligned}\text{Building Waste} &= \text{Waste Index}_{\text{INERT C\&D MATERIALS}} \times \text{GFA} \\ &= 0.23\text{m}^3/\text{m}^2 \text{ GFA} \times 1,808\text{m}^2 \\ &= 416\text{m}^3\end{aligned}$$

4.7.16 Assuming a density of 1.8 tonnes/m³, an estimated 416m³ (749 tonnes) of inert C&D materials may be generated throughout the 29-34 weeks works period.

4.7.17 Inert C&D materials should be reused on-site where practicable, and efforts should be made to optimise cut and fill requirements during the detailed design. Good site practice and mitigation measures should be implemented. Surplus inert C&D materials should be sent off-site to public fill reception facilities. The nearest disposal facility is Fill Bank in Tuen Mun Area 38, which is around 21km from the Site.

4.7.18 As the amount of inert C&D materials generated mentioned in **Section 4.7.16** during the works period of the Proposed Project and with the implementation of the mitigation measures mentioned in Sections 4.7.41 to 4.7.46, no adverse waste impact from the handling, transportation or disposal of inert C&D materials is anticipated.

Non-inert C&D materials

4.7.19 Non-inert C&D materials are those which can decompose or generate odour, such as bamboo, timber, vegetation, packaging waste and other organic material, and which are therefore unsuitable for land reclamation.

4.7.20 The major source of non-inert C&D materials during construction will be removal of topsoil and building waste.

4.7.21 As estimated by the Structural Engineer, about 3,100 tonnes topsoil will be removed and replaced by hydrophobic filling material for erecting baffles and noise barrier at the outdoor shooting range. A site visit was conducted on 2 August 2023. Based on the site observation, no debris of bullet heads and cartridge casings due to previous use of shooting range were observed on the ground surface of the shooting range between the shooting location under the covered walkway and the backstop. Therefore, debris of bullet should not likely be found on the topsoil to be removed.

¹⁰ Monitoring of Solid Waste in Hong Kong – Waste Statistics for 2022, EPD.

Photo 4.1: Site with no debris observed in August 2023



Photo 4.2: Shooting range with no debris observed in August 2023



Photo 4.3: Shooting range with no debris observed in August 2023



4.7.22 Non-inert C&D materials, such as timber formwork, packaging waste and other wastes, are included in the “waste index” provided in The Guide^[5], discussed above.

4.7.23 However, Plate 2.12 of Waste Statistics for 2022 identifies that in 2022, 8% of construction and demolition waste was disposed of in landfills, meaning it must non-inert C&D materials. The proportion of non-inert C&D materials in the “waste index” can therefore be estimated by applying the Hong Kong-wide proportion of non-inert C&D materials in construction waste, i.e., 8%, to the “waste index” as follows:

$$\begin{aligned}\text{Waste Index}_{\text{NON-INERT C\&D MATERIALS}} &= 0.08 \times \text{“waste index”} \\ &= 0.08 \times 0.250 \text{ m}^3/\text{m}^2 \text{ GFA} \\ &= 0.02 \text{ m}^3/\text{m}^2 \text{ GFA}\end{aligned}$$

4.7.24 The non-inert C&D materials components in building waste can therefore be estimated as follows:

$$\begin{aligned}\text{Building Waste} &= \text{Waste Index}_{\text{NON-INERT C\&D MATERIALS}} \times \text{GFA} \\ &= 0.02 \text{ m}^3/\text{m}^2 \text{ GFA} \times 1,808 \text{ m}^2 \\ &= 36.16 \text{ m}^3\end{aligned}$$

4.7.25 Assuming the density of non-inert building waste is 1.0 tonnes/m³, an estimated 36 tonnes of non-inert building waste plus 3,100 tonnes topsoil will be generated dominantly throughout the 29-34 weeks works period.

4.7.26 On-site sorting should be carried out for non-inert C&D materials generated from the works. Recyclable materials, such as metal, paper product, and plastic, should be collected by local recyclers for recycling. All non-inert C&D materials should be recycled wherever possible and landfill disposal should be adopted as the last resort. This nearest disposal facility is West New Territories Landfill (WENT) Landfill, which is around 23km from the Site.

4.7.27 With the implementation of the recommended mitigation measures in **Section 4.7.41 to 4.7.46**, no adverse waste impact from the handling, transportation or disposal of non-inert C&D materials is anticipated.

General Refuse

4.7.28 General refuse will be generated by workers during the minor reinstatement and refurbishment works. General refuse from construction workers is similar to domestic waste and includes packaging and organic material.

4.7.29 Quantity of general refuse will not be significant, and the general refuse will be collected by waste skip on-site. Assuming ten workers will be working for the Proposed Project over entire works period of 34 weeks excluding Sunday for general refuse quantity estimation.

4.7.30 Each worker will generate general refuse, which is similar to domestic waste. Plate 2.7 of Waste Statistics for 2022 identifies that the 5-year average (Year 2018 to 2022) per capita domestic waste disposal rate was 0.91kg/person/day, although the per worker generation rate of general refuse will likely be less than this. However, to be conservative, the per capita domestic waste disposal rate has been adopted for general refuse generation by construction workers. On this basis:

$$\begin{aligned}\text{General Refuse/day} &= \text{No. workers/day} \times \text{per capita generation rate} \\ &= 10 \text{ workers} \times 0.91 \text{ kg/worker/day} \\ &= 9.1 \text{ kg/day} \\ \text{Total General Refuse} &= \text{General Refuse/day} \times \text{duration of works period} \\ &= 9.1 \text{ kg/day} \times (6 \text{ days/week} \times 34 \text{ weeks}) \\ &= 1,856 \text{ kg} \\ &= 1.9 \text{ tonne assuming a density of } 1.0 \text{ tonnes/m}^3\end{aligned}$$

- 4.7.31 An estimated 1.9 tonne of general refuse may be generated throughout the entire 34 weeks workings period.
- 4.7.32 On-site sorting should be carried out for general refuse generated from the works. Recyclable materials, such as metal, paper, and plastic, should be collected by local recyclers for recycling. All general refuse should be recycled wherever possible and landfill disposal should be adopted as the last resort.
- 4.7.33 As the amount of general refuse generated from the works of the Proposed Project mentioned in Section 4.7.30 and with the implementation of the mitigation measures mentioned in Sections 4.7.41 to 4.7.46, no adverse waste impact from the handling, transportation or disposal of general refuse is anticipated.

Chemical Waste

- 4.7.34 Chemical waste, such as spent lubricants for equipment or waste batteries, may be generated during Project construction.
- 4.7.35 Majority of maintenance/repairing for construction equipment to be carried out off-site during construction stage. Chemical wastes including waste batteries, lubricating oil, and waste paints to be generated.
- 4.7.36 In addition, no vehicle and equipment for maintenance will be repaired/maintained on-site waste lubricating oil will be generated. Other chemical wastes include waste lamp and waste batteries will be generated. It is anticipated that the quantity of the aforementioned chemical waste in the order of few hundred litres per month.
- 4.7.37 No fuel, chemical and chemical waste is allowed to be stored within the Kau Wa Keng Fresh Water Service Reservoir. Any working fuel, chemical and chemical waste shall be immediately removed outside the Kau Wa Keng Fresh Water Service Reservoir after any construction works and be removed from the top of Kau Wa Keng Fresh Water Service Reservoir on a daily basis.
- 4.7.38 The contractor shall register as a Chemical Waste Producer under the Waste Disposal (Chemical Waste) (General) Regulation. All chemical waste shall be stored at a properly designed chemical waste storage area located within the construction site in accordance with EPD's Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. A licensed collector shall be employed to handle and dispose of all chemical wastes, e.g., at the Chemical Waste Treatment Centre (CWTC) at Tsing Yi, or other facility approved by EPD.
- 4.7.39 The site was in use by HKRA since 1964 and thus the buildings may contain ACM. It is recommended that a Registered Asbestos Consultant and a Registered Asbestos Laboratory shall be engaged to investigate for the presence of ACM prior to construction work. Should asbestos be found, the ACM should be removed in accordance with the requirements of the Air Pollution Control Ordinance and disposed of in accordance with the requirements stipulated in the Waste Disposal Ordinance.
- 4.7.40 Given the above and the implementation of the recommended mitigation measures in S.4.7.41 to S.4.7.46, no adverse waste impact from the handling, transportation, or disposal of each waste type during the construction of the Project is anticipated.

Mitigation Measures During Construction Phase

- 4.7.41 Waste management shall be controlled through contractual requirements as well as through statutory requirements.
- 4.7.42 The contractors should adopt good housekeeping practices such as waste segregation prior to disposal. Besides the provision of stockpiling and segregating areas at site, effective collection of site wastes is required to prevent waste materials being blown around by wind, flushed or leached into nearby waters, or creating odour nuisance or pest and vermin problems. Waste storage areas should be well maintained and cleaned regularly.
- 4.7.43 Whenever there are excess recyclable construction materials, including bricks, plastics and metals, reuse and recycling should be carried out where practicable to minimise the amount of waste disposal. Other inert non-recyclable materials such as concrete, asphalt, etc. should be treated as public fill. Non-inert and non-recyclable wastes should be disposed at designated landfill site.
- 4.7.44 General refuse should be stored in enclosed bins or compaction units separate from C&D material. A reputable waste collector should be employed by the construction contractor to remove general refuse from the Site, separately from C&D materials. Preferably an enclosed and covered area should be provided to reduce the occurrence of “wind-blown” materials.
- 4.7.45 For chemical waste, the Contractor should follow the ‘trip-ticket’ system of which the arrangement of production, collection, and disposal in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation*.
- 4.7.46 In addition, the EPD’s Recommended Pollution Control Clauses (*RPCC*) for Construction Contract in COP should be incorporated in the relevant works contract. The RPCC are generally good engineering practice to minimise inconvenience and environmental nuisance to nearby residents and other sensitive receivers. The general requirements as summarised as follows:
- A Waste Management Plan (“WMP”) shall be prepared in accordance with *ADV-19* and submitted to the Engineer for approval.
 - The Contractor shall observe and comply with the Waste Disposal Ordinance and its subsidiary regulations.
 - The Contractor shall submit to the Engineer for approval a WMP with appropriate mitigation measures including allocation of an area for waste segregation and shall ensure that the day-to-day site operations comply with the approved WMP.
 - The Contractor shall minimise the generation of waste from his work. Avoidance and minimisation of waste generation can be achieved through changing or improving design and practices, careful planning, and good site management.
 - The Contractor shall ensure that different types of wastes are segregated on-site and stored in different containers, skips or stockpiles to facilitate reuse/recycling of waste and, as the last resort, disposal at different outlets as appropriate.
 - The reuse/recycling of waste shall be practised wherever possible. The recycled materials shall include paper/cardboard, and metal etc.
 - The Contractor shall ensure that C&D materials are sorted into public fill (inert portion) and C&D materials (non-inert portion). Public fill shall be reused in earth filling, reclamation or site formation works, and C&D materials shall be reused and recycled and, as the last resort, disposal of at landfills.
 - The Contractor shall record the amount of waste generated, recycled, and disposed of (including the disposal sites).
 - The Contractor shall use a trip ticket system for the disposal of C&D materials to any designated public fill reception facilities and/or landfill as stipulated in the DevB TCW No. 6/2010.
 - Training shall be provided for workers about the concepts of site cleanliness and appropriate waste management procedure, including waste reduction, reuse, and recycling.

- The Contractor shall observe and comply with the *Waste Disposal (Chemical Waste) (General) Regulation* and shall apply for registration as chemical waste producer when chemical waste is produced. All chemical waste shall be properly stored, labelled, packaged, and collected in accordance with the Regulation.

Operation Phase Assessment

4.7.47 As estimated by the Applicant, the staff arrangement of the proposed shooting range shall be from 3 to 6, depending on the number of shooters to be engaged on the day. The number of staffs will be up to 10 while there is competition held during weekend or Sunday, to manage the hundred shooters. Hence, the total occupants of the shooting range will not more than 110 people per day. According to the EPD's Monitoring of Solid Waste in Hong Kong – Waste Statistic for 2022, the 5-year average (Year 2018 to 2022) per capita general refuse disposal rate is 1.50kg/person/day. Therefore, the quantity of general refuse disposed of it expected to be approximately 60.2 tonnes per years. All general refuse should be recycled wherever possible and landfill disposal should be adopted as the last resort. General refuse from the Site will be collected and disposal of at landfill properly by appropriate waste collector. On this basis:

$$\begin{aligned}
 &\text{5-year average (Year 2018 to 2022) per capita general refuse disposal rate} = 1.50 \text{ kg/person/day} \\
 &\text{General refuse /year} = 1.50 \text{ kg/person/day} \times \text{person} \times \text{day} \\
 &= 1.50 \text{ kg} \times 110 \text{ person} \times 365 \text{ day} \\
 &= 60,225 \text{ kg/year} / 1000 \text{ kg} \\
 &= 60.2 \text{ tonnes/year}
 \end{aligned}$$

4.7.48 Cartridge casings and bullet head will be generated during shooting activities and need to be disposed of. The quantity of shooting waste (comprising of bullets heads and bullet cartridge casings) generated from the Project is estimated as shown in **Table 4.15** below.

Table 4.15 Estimated Shooting Waste Generated from the Operation of the Project

BULLET TYPE	NUMBER OF BULLETS USED PER WEEK	MAXIMUM WEIGHT PER BULLET (G)	MAXIMUM WEIGHT OF SHOOTING WASTE GENERATED PER WEEK (KG)
0.22 / .223 / 7.62mm caliber Long Range (LR)	8,000	40	320
.22/ .32/ .38 caliber, .40/ .41/ .45, and .50 caliber and 9mm	10,000	230	2,300
ESTIMATED MAX. SHOOTING WASTE GENERATED (kg/WEEK)			2,620

Remark: As mentioned in S.4.7.7, the waste generated from .177 air pistols (i.e. BB pellets) is treated as general refuse.

- 4.7.49 As estimated above, a maximum of 2,620 kg shooting waste (comprising of bullet heads and bullet cartridge casings) will be generated each week from the shooting activities.
- 4.7.50 During operation, the number of bullets issued to each shooter and brought along by the shooters will be recorded. All bullets issued to and brought along by the shooters will be fired within the Site on the same day and no unfired bullets are allowed to be taken out of the Site. Therefore, the total number of bullets issued to the shooter plus the total number of bullets brought into the Site will be the total number of bullets fired on that day.
- 4.7.51 Cartridge casings and bullets heads will be collected from the shoot ranges by shooting range's staff on daily basis. The operators can then check whether all bullet heads and cartridge casings has been collected. The total weight of shooting waste collected will be recorded on the daily record sheet and all collected shooting waste will be temporarily stored in the Armoury Store for further collection by registered collector for proper disposal in accordance with the Firearms and Ammunition Ordinance and conditions under the shooting range licence issued under the Firearms and Ammunition Ordinance on a need basis, tentatively once per month.
- 4.7.52 The total quantity of shooting wastes for disposal will be checked by the operators against the daily record sheets during waste collection by the registered collectors to ensure that all shooting wastes are being collected by the licensed collector for proper disposal in accordance with the Firearms and Ammunition Ordinance and conditions under the shooting range licence issued under the Firearms and Ammunition Ordinance. A sample daily shooting record sheet is shown in **Appendix G**. No adverse waste impact from the handling, transportation, or disposal of waste during operation of the Project is therefore anticipated.
- 4.7.53 Nevertheless, the operation practices and precautionary measures recommended in Sections 4.7.50 to S.4.7.52 should be implemented for collection and disposal of the shooting wastes to prevent adverse impact arising from waste management implication.

4.8 Cultural Heritage

- 4.8.1 No sites of archaeological interest, declared Monuments, proposed Monuments, graded historic sites/buildings, or government historic sites were identified within or in the vicinity of the Site. The nearest historic building is Shek Lei Pui Treatment Works, Valve House, which is a grade 2 historic building and is 345m away from the Site.
- 4.8.2 In view of the large separation distance between the Site and the nearest graded historic buildings as well as the sites of archaeological interest (more than 300m), no adverse impact on those buildings and the sites of archaeological interest is anticipated during Project construction or operation and no mitigation measure shall be required.

4.9 Landscape and Visual

- 4.9.1 The Project will utilise or reinstate all existing structures at the Site and there will not be any new additional structure to be constructed, there will not be any change to the landscape characteristics. Therefore, no adverse landscape impact is anticipated.
- 4.9.2 The project only involves the utilization or reinstatement of existing structures at the subject site, with no additional structures, site formation work, or foundation work required. The project comprises single-storey structures located at a higher elevation than most of the nearby VSRs. There are only several VSRs with a higher elevation than the subject site. The view from the identified VPs to the Site are either screened by the natural terrain or the boundary wall with height of at least 2m. Site visit conducted around the Site on 2 August 2023 confirmed that local villagers and visitors at Cheung Hang Village can only see the boundary barrier wall from the pedestrian path / communal area of the village. The photos of the view from the pedestrian path near 1A Cheung Hang Village and the communal area near the Cheung Hang Village Residents Welfare Association are provided in **Photos 3.1** and **3.2**. The single storey structures and shooting ranges cannot be seen or with limited view from surrounding. It is concluded that no adverse visual impact is anticipated. **Figure 3.6** shows the locations of the identified VPs.

4.10 Hazard to life

- 4.10.1 There is no existing hazardous installation (PHI) near the project area. Potential hazard of life impact due to the project is not expected.

4.11 Manufacturing, Storage, Use, Handling, Transport, or Disposal of Dangerous Goods, Hazardous Materials or Wastes

- 4.11.1 As ammunition is classified as Dangerous Goods under Cap. 295 *Dangerous Goods Ordinance*, all ammunition to be used during operating phase of the Site will be handled in accordance with the requirements set out by Mines Division of CEDD, Hong Kong Police Force and Fires Services Department.
- 4.11.2 The storage of ammunition will be at the armoury store and in Mode B Stores located to the west of the shooting range as marked on **Figure 4.9**. All “Mode B Store” of the Project will be located outside the boundary of the Kau Wa Keng Fresh Water Service Reservoir. The 'Mode B Stores' at the site will not be used to store any other dangerous goods or flammable materials other than ammunition, and the storage amount is insignificant. Details of Mode B store construction will comply with the *Guidance Note No. GN4 – Licensing and Operation of Mode B Stores*.

4.12 Land Contamination

- 4.12.1 The land contamination assessment shall be based on the criteria and guidelines stated in Annex 19 “Guidelines for Assessment of Impact on Sites of Cultural Heritage and Other Impacts”, Section 3 (Potential Contaminated Land Issues) of the EIAO-TM. While the EIAO-TM contains no separate criteria for evaluating potential land contamination issues, Annex 19 Section 3 sets out the general approach and methodology for assessment of land contamination issues, predominantly historical land uses, associated with a project or proposal. Reference has also been made to the *Guidance Note for Contaminated Land Assessment and Remediation and Practice Guide for Investigation and Remediation of Contaminated Land*.
- 4.12.2 The Site was originally vacant before 1960s. It was located at the southern slope of Shek Lei Tau and Kau Wa Keng Fresh Water Service Reservoir, which was constructed in the 1960s. After construction of the reservoir, HKRA utilised the flat ground atop the reservoir to develop the shooting range in 1964 and operated until 2013. The shooting range is not classified as a land contaminating use.
- 4.12.3 Previous shooting activities at the Site by HKRA were similar to those to be included in the proposed shooting range. The previous shooting range has 3 nos. of 20m pistol shooting ranges and 2 nos. of 25m rifle shooting ranges. Only .22 calibre handgun and rifle were allowed to be used. Armour piercing ammunitions, tracer ammunitions, shot shells and any ammunition with a calibre greater than .22 calibre are not allowed to be used. Only paper targets were used at the previous shooting range and no skeet shooting was allowed and therefore no clay pigeon was used.
- 4.12.4 As observed at the Site, bullet backstops were provided behind targets for collection of bullet heads. As housekeeping measures, bullet heads and cartridge casings were collected from the ground and these shooting wastes are stored up for proper disposal by registered waste collector. Since no skeet shooting was practiced and no clay pigeons were used, no debris from clay pigeon was found at the Site. No sign of land contamination was observed due to previous shooting range operation at the Site. The photo of site condition are provided in **Photo 4.1** to **Photo 4.3**.
- 4.12.5 Given that only minor reinstatement and refurbishment work and no site formation work and construction work will be carried out, land contamination issue is therefore not anticipated at the Site.

5 Environmental Audit (EM&A) Requirements

5.1 Introduction

5.1.1 The potential environmental impacts due to the Project have been evaluated in Section 4 of this PP. With the implementation of the recommended mitigation measures, no adverse environmental impact is envisaged. It is recommended to have an environmental audit programme in place to track and assess the effectiveness of the recommended mitigation measures and compliance with legislative requirements by means of regular site inspections during construction and operation of the Project.

5.1.2 The required environmental audit is summarized in *Table 5.1* below.

Table 5.1 Summary of Environmental Audit Requirements

Aspects	Construction Phase	Post-Construction / Operation Phase
Air Quality	• Site inspection and audit	• Not required
Noise	• Site inspection and audit	• Site inspection and audit
Water Quality	• Site inspection and audit	• Site inspection and audit
Waste Management	• Site inspection and audit	• Site inspection and audit
Land Contamination	• Not required	• Not required
Ecology	• Not required	• Not required
Landscape and Visual	• Not required	• Not required
Cultural Heritage	• Not required	• Not required

5.2 Organization of Environmental Audit

5.2.1 The organization of Environmental Audit involves HKCSA, an Independent Environmental Checker (IEC), and Contractor(s). An IEC shall be employed before commencement of construction of the Project. The IEC, who possesses at least 7 years' experience in EM&A and/or environmental management, shall be an independent party from the Contractor. The IEC audit the overall environmental performance, including the implementation of all environmental mitigation measures, and any other submissions required by the Environmental Permit.

5.3 Environmental Audit Requirements

5.3.1 With the implementation of recommended mitigation measures, no adverse environmental impacts during the construction and operation phase would be anticipated. Environmental site audit shall be conducted by an IEC during the construction and operation phase to ensure that the recommended mitigation measures are implemented properly.

6 Summary of Project

6.1 Measures to Minimise Environmental Impacts

- 6.1.1 Relevant environmental mitigation measures are suggested to be implemented by the contractor during the minor reinstatement and refurbishment works. The contractor shall fully observe all relevant ordinances and regulations, TM, and practice notes, and carry out the works in a manner to comply with all relevant criteria. The potential environmental impacts and proposed mitigation measures to be incorporated during construction and operation stages of the Project are summarized in **Table 6.1**

Table 6.1 Summary of Potential Environmental Impacts and Mitigation Measures

<u>Potential Environmental Impact</u>	<u>Project Stage</u>	<u>Mitigation Measure</u>	<u>Implementation Agent</u>	<u>Text Ref.</u>
Air Quality	Construction Phase	<ul style="list-style-type: none"> • Mitigation measures that are recommended in the Air Pollution Control (Construction Dust) Regulation. • Adopt mitigation measures stipulated in EPD's "Recommended Pollution Control Clauses for Construction Contracts" and good site practices • Regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather. • Frequent watering for particularly dusty areas and areas close to ASRs. • Tarpaulin covering of all dusty vehicle loads transported to and from the Site. • Imposition of speed controls for vehicles within the Site. • Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from off-site ASRs. • All the non-road mobile machinery and electricity generator adopted will comply with the requirements as stipulated in the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation and Air Pollution Control (Fuel Restriction) Regulations. 	Contractor	4.3.11 to 4.3.13
Noise	Construction Phase	<ul style="list-style-type: none"> • Mitigation measures recommended in EIAO GN No. 9/2023 shall be implemented where applicable. • Adopt noise mitigation measures stipulated in EPD's "Recommended Pollution Control Clauses for Construction Contracts" and good site practices • Quiet PME and construction method should be adopted if possible. • The contractor shall devise and execute working methods to minimise the noise impacts on the surrounding sensitive uses, and provide experienced personnel with suitable training to ensure that those methods are implemented. • Switch off idling equipment. • Regular maintenance of equipment. • Fit muffler or silencer for equipment. • Noisy equipment and noisy activities should be located as far away from the NSRs as is practical. • PME should be kept to a minimum and the parallel use of noisy equipment/machinery shall be avoided. • Erect noise barriers or noise enclosure for the PME if appropriate. • Implement good housekeeping and provide regular maintenance to the PME. • Spot check resultant noise levels at nearby NSRs. 	Contractor	4.4.16 and 4.4.17

<u>Potential Environmental Impact</u>	<u>Project Stage</u>	<u>Mitigation Measure</u>	<u>Implementation Agent</u>	<u>Text Ref.</u>
	Operation Phase	<ul style="list-style-type: none"> • Additional noise barriers with a height of at least 2m will be erected in between Range 1 and Range 2, and between Range 2 and Range 3 as additional noise mitigation to alleviate the noise impact. The barriers will be gap-free and constructed with timber and acoustic mat, if necessary, with total surface density of no less than 8kg/m², or any material with equivalent surface density, which could achieve the target sound attenuation. • Solid boundary walls which are 2m high located to the east and west of the Site will be repaired to ensure there is no sound leakage from the wall. A 1- storey building structure which is 3m high located to the south-east of the Site. The boundary walls and the building structure can provide barrier effect for the NSR, 	Contractor / HKCSA	4.4.44 and 4.4.45
Water Quality	Construction Phase	<ul style="list-style-type: none"> • Mitigation measures specified in ProPECC PN 2/23 and standard good site practice for construction site drainage will be followed where appropriate during the minor reinstatement and refurbishment works. • The Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any waste matter (or refuse) which is not part of the final product from waste processing plants to be deposited anywhere within the Site (or onto any adjoining land). He shall arrange removal of such matter from the Site (or any building erected or to be erected thereon) in a proper manner to the satisfaction of the Engineer in consultation with the Director of Environmental Protection. • During construction reinstatement and refurbishment works, it is recommended that portable toilets should be provided for handling sewage generated by the construction workers. These will be supplied, maintained, and emptied for offsite disposal by a specialist contractor. 	Contractor	4.5.6 to 4.5.8

Potential Environmental Impact	Project Stage	Mitigation Measure	Implementation Agent	Text Ref.
	Operation Phase	<ul style="list-style-type: none"> • Portable toilets will be provided for handling sewage generated by the HKCSA members and guests and will be emptied into an above ground sewage storage tank of suitable volume. These will be supplied, maintained, and emptied for offsite disposal by a specialist contractor. • Bullet with brass primer will be used. • Bullet catchers with rubber curtain target backing (made with "Linatex") and steel plate backstop with containers placed underneath will be constructed behind the target plate to stop and collect bullets. • All cartridge casing will be collected daily by the staff of the shooting range with the aid of metal detectors. • Collected cartridge casing will be temporarily stored in the Armoury Store for further collection by registered collector for proper disposal in accordance with the Firearms and Ammunition Ordinance. • Baffles above each range will be provided to stop bullets from travelling out of the range. • Paper targets and pepper popper targets will be used in the shooting range. No clay target will be used. • The installation of a vent pipe to connect the existing ventilators, ensuring that the exhaust point is located outside of the firing range area. • Replacing the topsoil with hydrophobic filling material will form an impervious ground surface for easy collection of cartridge casings 	HKCSA	4.5.18
Ecological	Construction Phase / Operation Phase	Implementation of the proposed noise and water quality mitigation measures	Contractor / HKCSA	4.6.6

Waste Management	Construction Phase	<ul style="list-style-type: none"> • Waste management shall be controlled through contractual requirements as well as through statutory requirements. • The contractors should adopt good housekeeping practices such as waste segregation prior to disposal. Besides the provision of stockpiling and segregating areas at site, effective collection of site wastes is required to prevent waste materials being blown around by wind, flushed or leached into nearby waters, or creating odour nuisance or pest and vermin problems. Waste storage areas should be well maintained and cleaned regularly. • Whenever there are excess recyclable construction materials, including bricks, plastics and metals, reuse and recycling should be carried out where practicable to minimise the amount of waste disposal. Other inert non-recyclable materials such as concrete, asphalt, etc. should be treated as public fill. Non-inert and non-recyclable wastes should be disposed at designated landfill site. • General refuse should be stored in enclosed bins or compaction units separate from C&D material. A reputable waste collector should be employed by the construction contractor to remove general refuse from the Site, separately from C&D materials. Preferably an enclosed and covered area should be provided to reduce the occurrence of "wind-blown" materials. • For chemical waste, the Contractor should follow the 'trip-ticket' system of which the arrangement of production, collection, and disposal in accordance with the Waste Disposal (Chemical Waste) (General) Regulation. • In addition, the EPD's Recommended Pollution Control Clauses (RPCC) for Construction Contract in COP should be incorporated in the relevant works contract. The RPCC are generally good engineering practice to minimise inconvenience and environmental nuisance to nearby residents and other sensitive receivers. The general requirements as summarised as follows: <ul style="list-style-type: none"> • A Waste Management Plan ("WMP") shall be prepared in accordance with ADV-19 and submitted to the Engineer for approval. • The Contractor shall observe and comply with the Waste Disposal Ordinance and its subsidiary regulations. • The Contractor shall submit to the Engineer for approval a WMP with appropriate mitigation measures including allocation of an area for waste segregation and shall ensure that the day- to-day site operations comply with the approved WMP. • The Contractor shall minimise the generation of waste from his work. Avoidance and minimisation of waste generation can be achieved through changing or improving design and practices, careful planning, and good site management. • The Contractor shall ensure that different types of wastes are segregated on-site and stored in different containers, skips or stockpiles to facilitate reuse/recycling of waste and, as the last resort, disposal at different outlets as appropriate. 	Contractor / HKCSA	4.7.41 to 4.7.46
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<u>Potential Environmental Impact</u>	<u>Project Stage</u>	<u>Mitigation Measure</u>	<u>Implementation Agent</u>	<u>Text Ref.</u>
		<ul style="list-style-type: none"> • The reuse/recycling of waste shall be practised wherever possible as far as possible. The recycled materials shall include paper/cardboard and metal etc. • The Contractor shall ensure that C&D materials are sorted into public fill (inert portion) and C&D materials (non-inert portion). Public fill shall be reused in earth filling, reclamation or site formation works, and C&D materials shall be reused and recycled and, as the last resort, disposal of at landfills. • The Contractor shall record the amount of waste generated, recycled, and disposed of (including the disposal sites). • The Contractor shall use a trip ticket system for the disposal of C&D materials to any designated public fill reception facilities and/or landfill as stipulated in the DevB TCW No. 6/2010. • Training shall be provided for workers about the concepts of site cleanliness and appropriate waste management procedure, including waste reduction, reuse, and recycling. • The Contractor shall observe and comply with the Waste Disposal (Chemical Waste) (General) Regulation and shall apply for registration as chemical waste producer when chemical waste is produced. All chemical waste shall be properly stored, labelled, packaged, and collected in accordance with the Regulation. 		

<u>Potential Environmental Impact</u>	<u>Project Stage</u>	<u>Mitigation Measure</u>	<u>Implementation Agent</u>	<u>Text Ref.</u>
Waste Management	Operation Phase	<ul style="list-style-type: none"> During operation, the number of bullets issued to each shooter and brought along by the shooters will be recorded. All bullets issued to and brought along by the shooters will be fired within the Site on the same day and no unfired bullets are allowed to be taken out of the Site. Therefore, the total number of bullets issued to the shooter plus the total number of bullets brought into the Site will be the total number of bullets fired on that day. Cartridge casings and bullets heads will be collected from the shoot ranges by shooting range's staff on daily basis. The operators can then check whether all bullet heads and cartridge casings has been collected. The total weight of shooting waste collected will be recorded on the daily record sheet and all collected shooting waste will be temporarily stored in the Armoury Store for further collection by registered collector for proper disposal in accordance with the Firearms and Ammunition Ordinance and conditions under the shooting range licence issued under the Firearms and Ammunition Ordinance on a need basis, tentatively once per month. The total quantity of shooting wastes for disposal will be checked by the operators against the daily record sheets during waste collection by the registered collectors to ensure that all shooting wastes are being collected by the licensed collector for proper disposal in accordance with the Firearms and Ammunition Ordinance and conditions under the shooting range licence issued under the Firearms and Ammunition Ordinance. A sample daily shooting record sheet is shown in Appendix G. 	HKCSA	4.7.50 to 4.7.52

6.2 Possible Severity, Distribution and Duration of Environmental Effects and Any Further Implications

- 6.2.1 With implementation of above mitigation measure, no adverse environmental impacts are anticipated with the Project.
- 6.2.2 The Project was discussed in Kwai Tsing District Council, Planning and District Facilities Management Committee meeting on 18 December 2018. The Committee unanimously endorsed the plan of proposed STT for Shooting Range - atop Kau Wa Keng Fresh Water Service Reservoir.

7 Use of Previously approved EIA Reports

- 7.1.1 A similar shooting range was proposed at Pillar Point and obtained EP via obtaining permission to apply directly under Section 5(11) of the EIAO. Two previously approved EIA were also referenced in this Project Profile as those DPs comprise of development of open firing range. The reference of this project profile is summary in *Table 7.1*.

Table 7.1 Reference of this Project Profile

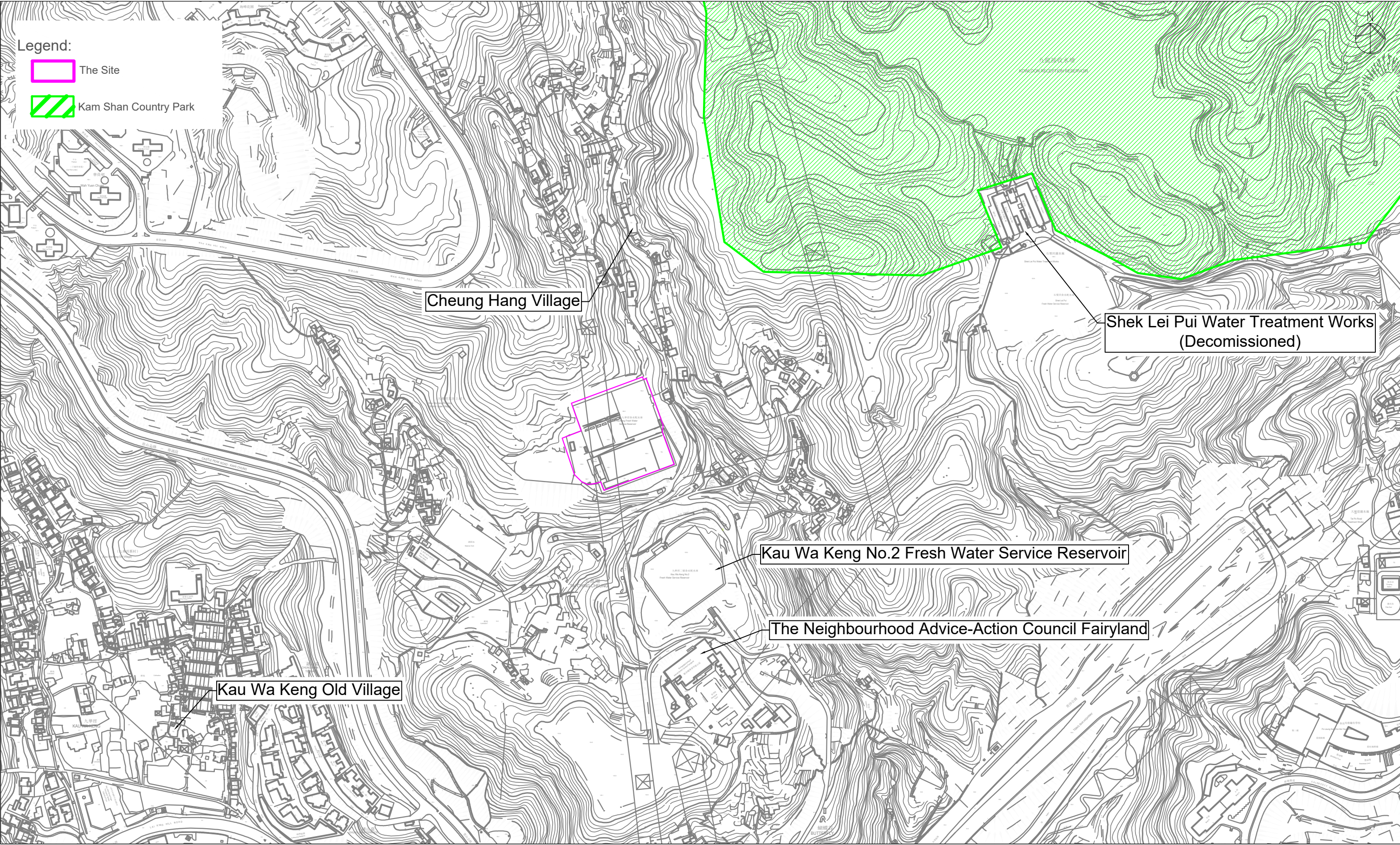
Project Reference	Submission Report (Ref. No.)	Structure of Project	Aspect of environmental impacts were addressed in the Project Profile/ approved EIA Report	Measures recommended in the Project Profile/ approved EIA Report	Conclusion of Study	Date of EIA Report Approval/ Permission to Apply Directly for EP	Issuance of EP (EP No.)
Police Facilities in Kong Nga Po	28 Jul 2016 (AEIAR-201/2016)	Comprising of two police firing ranges and other public facilities	Air Quality Impact (Odour)	N/A	The study concluded that there would be no adverse long-term or cumulative effects/ impacts to the environment.	20 Oct 2016	01 Nov 2016 (EP-510/2016)
North East New Territories New Development Areas ^	Apr 2013 (AEIAR-175/2013)	-	Noise Impact	N/A	The Project evaluated the noise impact induced by Lo Wu Classification Range. The study concluded that there would be no adverse long-term or cumulative effects/ impacts to the environment.	Oct 2013	N.A
Proposed Shooting Range at Pillar Point Valley Landfill	Mar 2008 (PP-347/2008)	The Project comprises one outdoor 25m pistol shooting range (60 lanes) and one outdoor 50m rifle shooting range (60 lanes).	Noise Impact	N/A	The study concluded that there would be no adverse long-term or cumulative effects/ impacts to the environment.	7 May 2008	11 Jun 2008 (EP-307/2008)

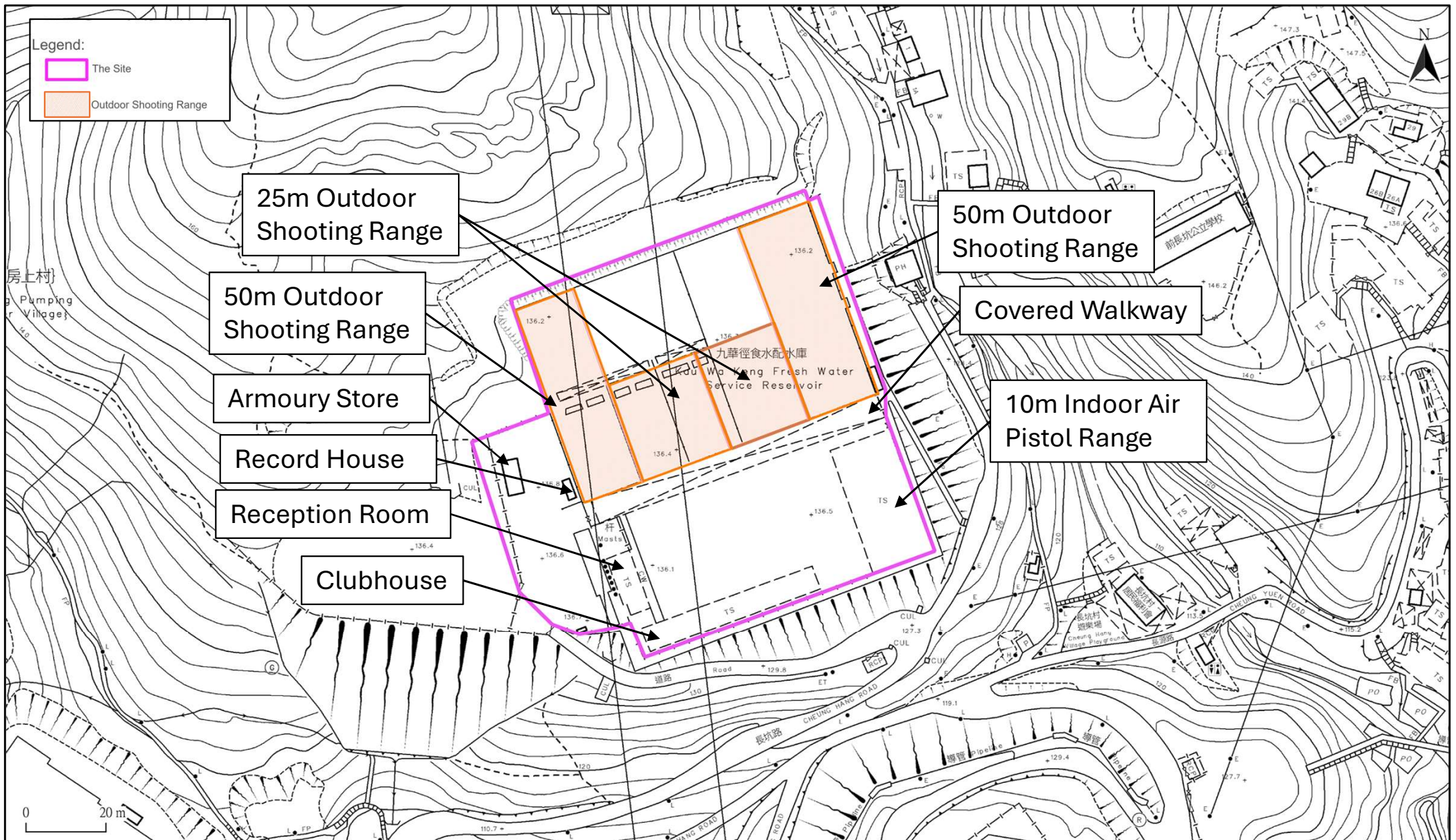
Remarks:

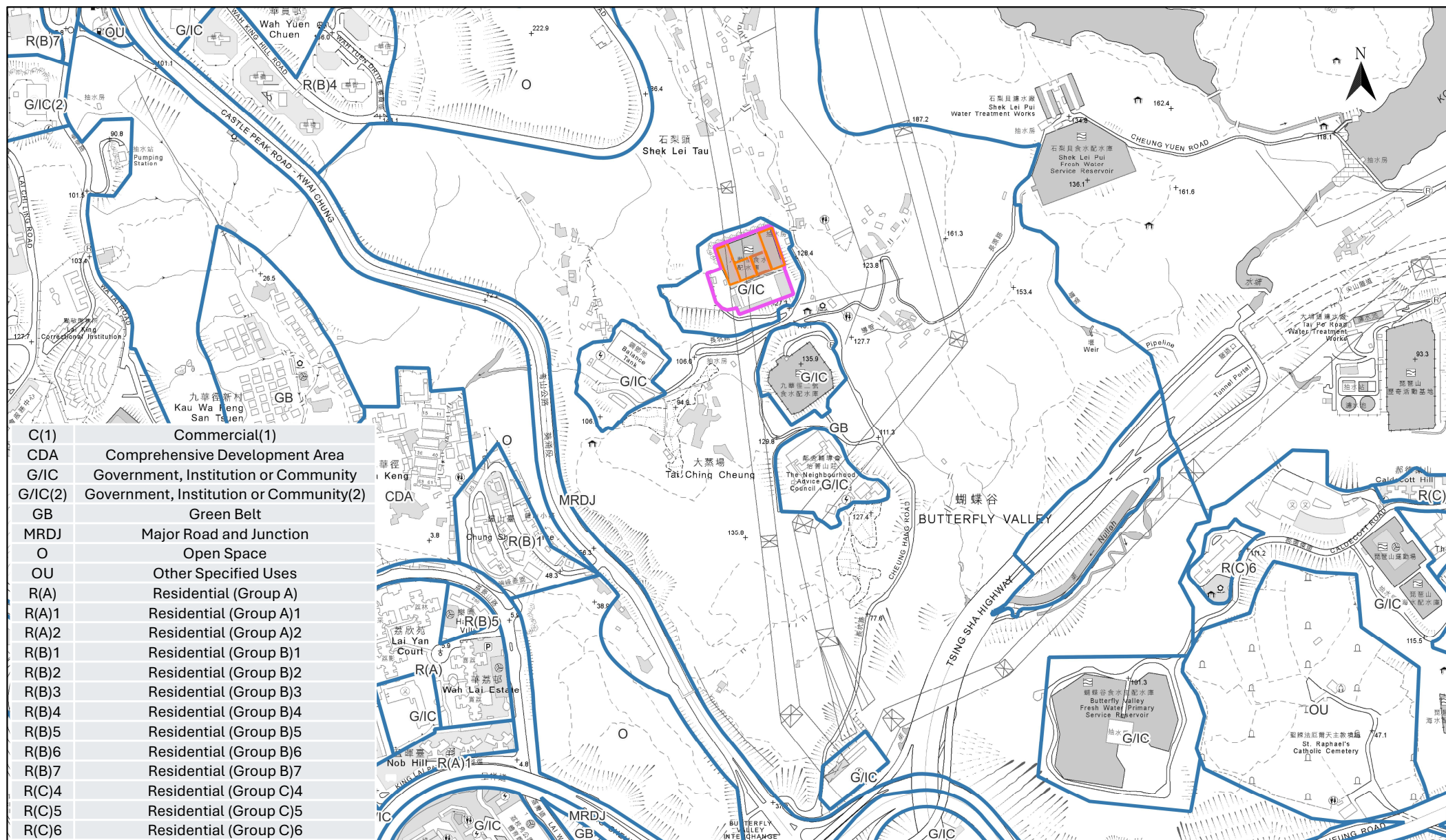
"N/A" denote to "Not Applicable".

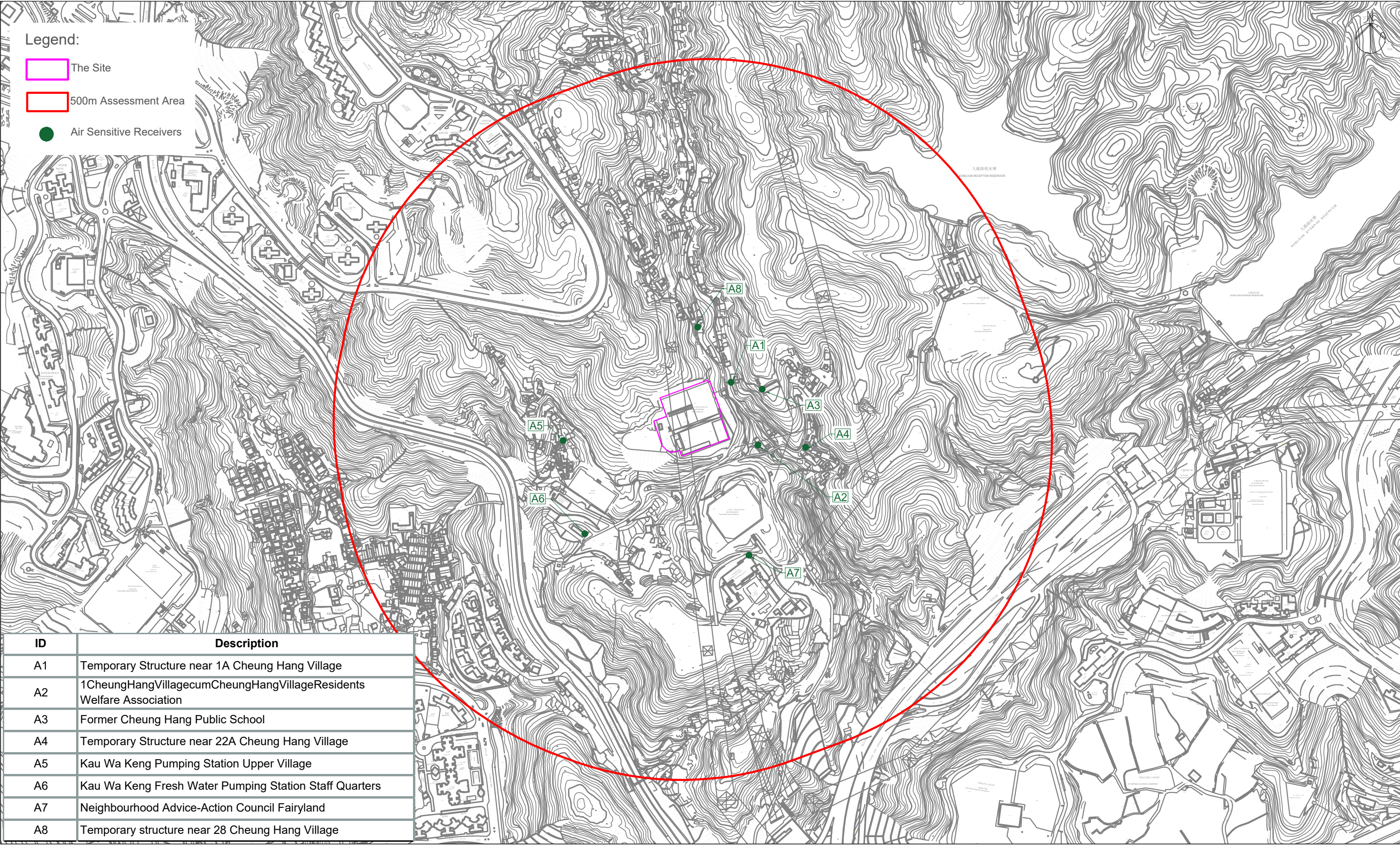
^ This Project is a Schedule 3 designated project.

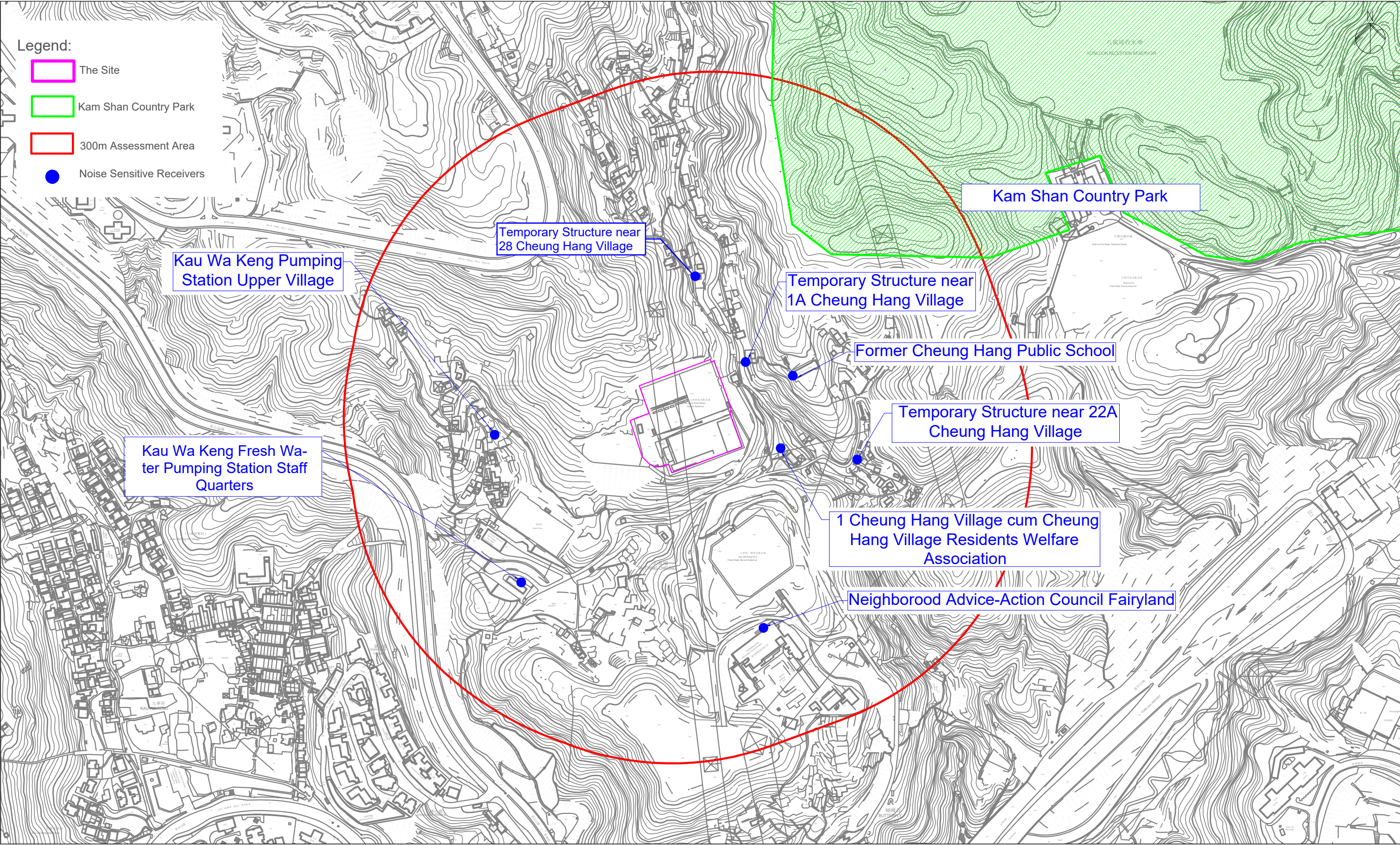
FIGURE



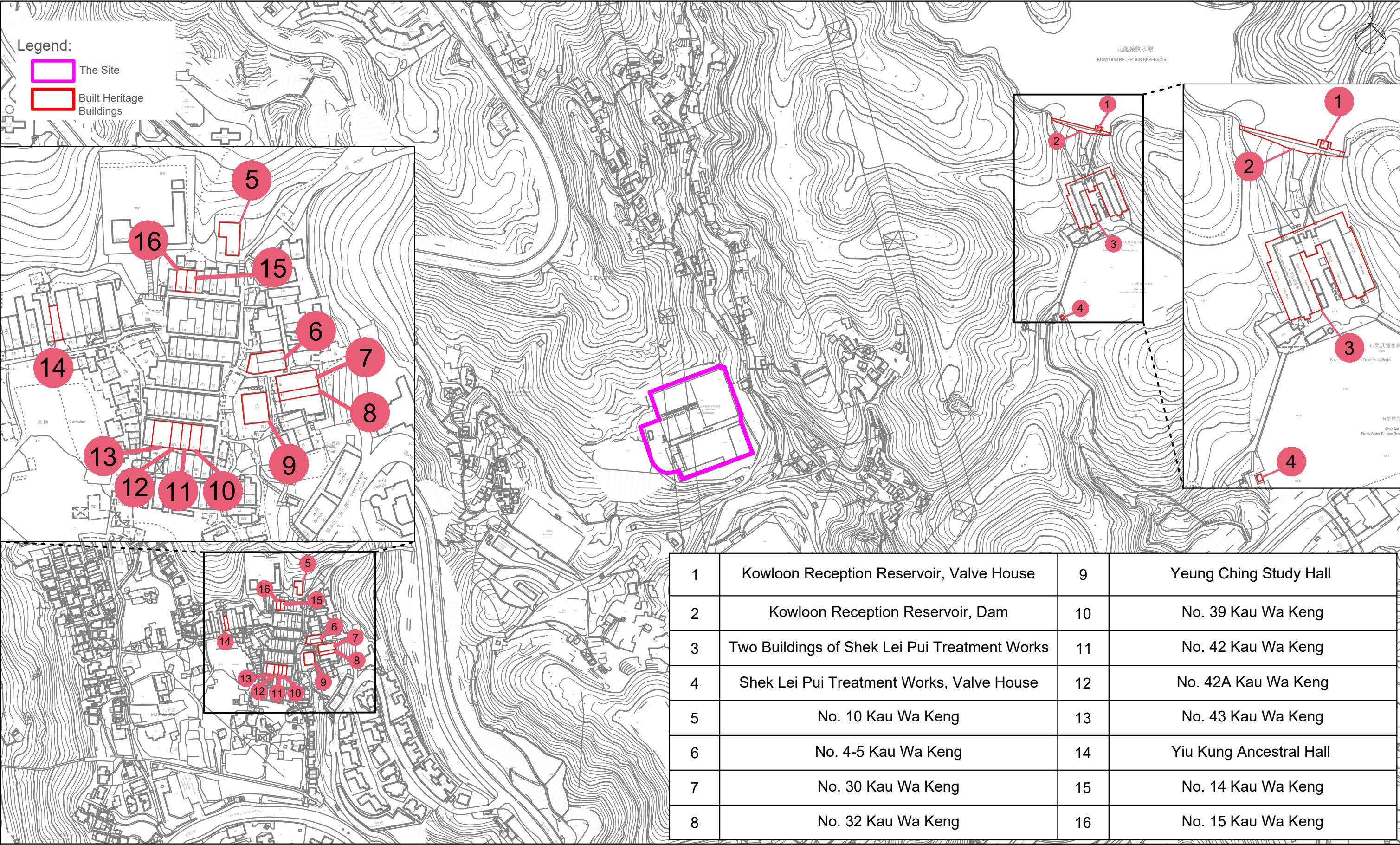


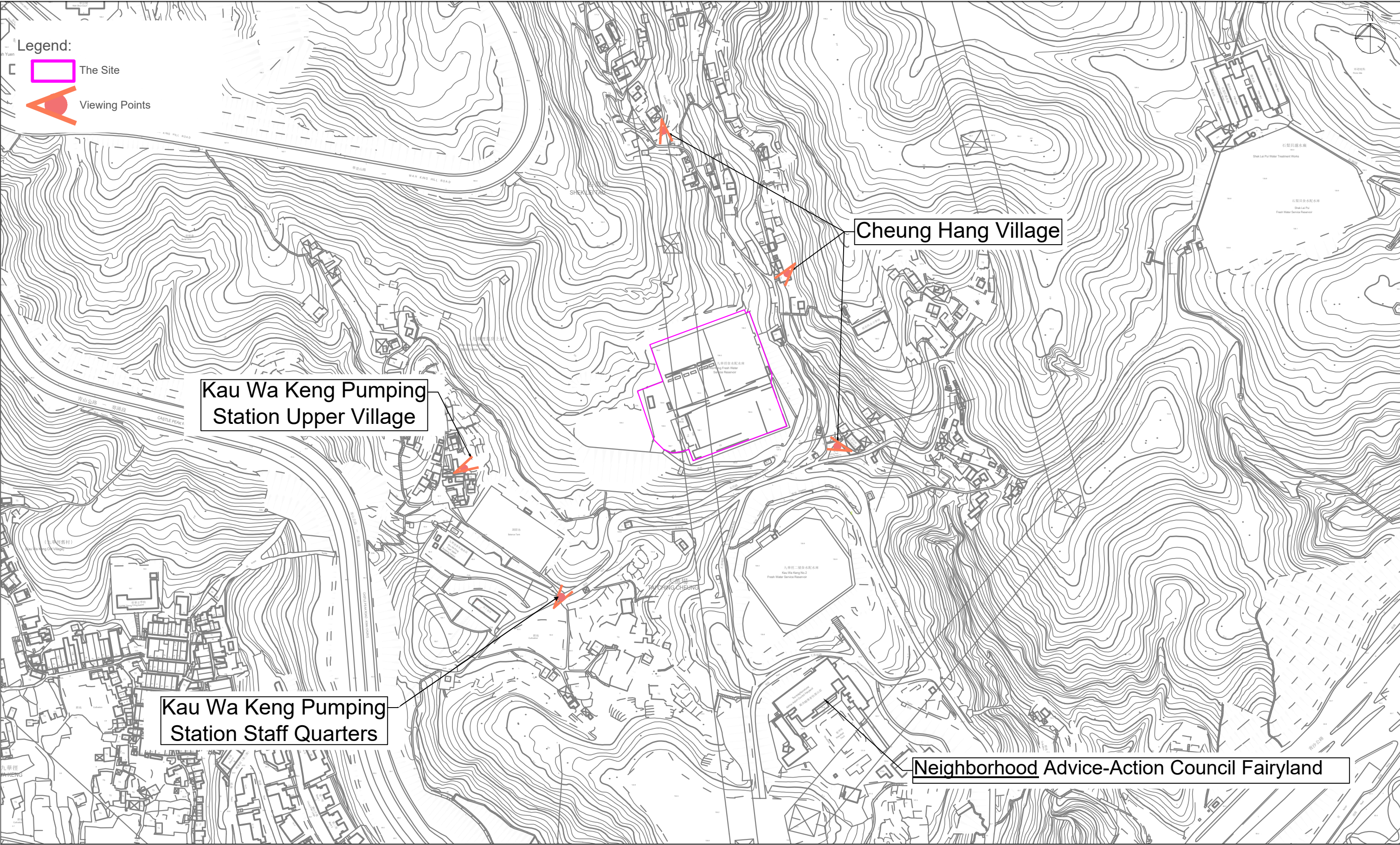


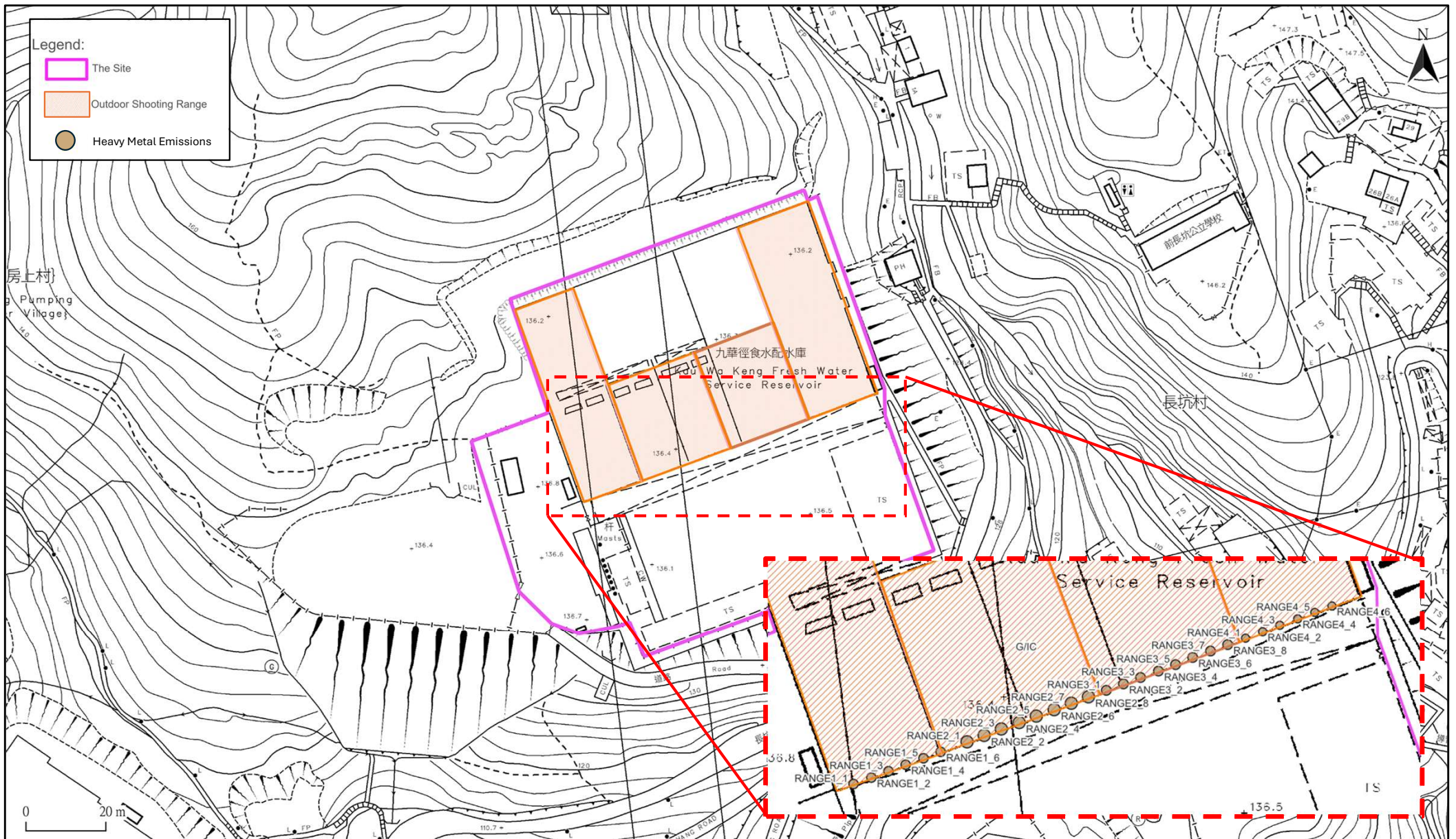


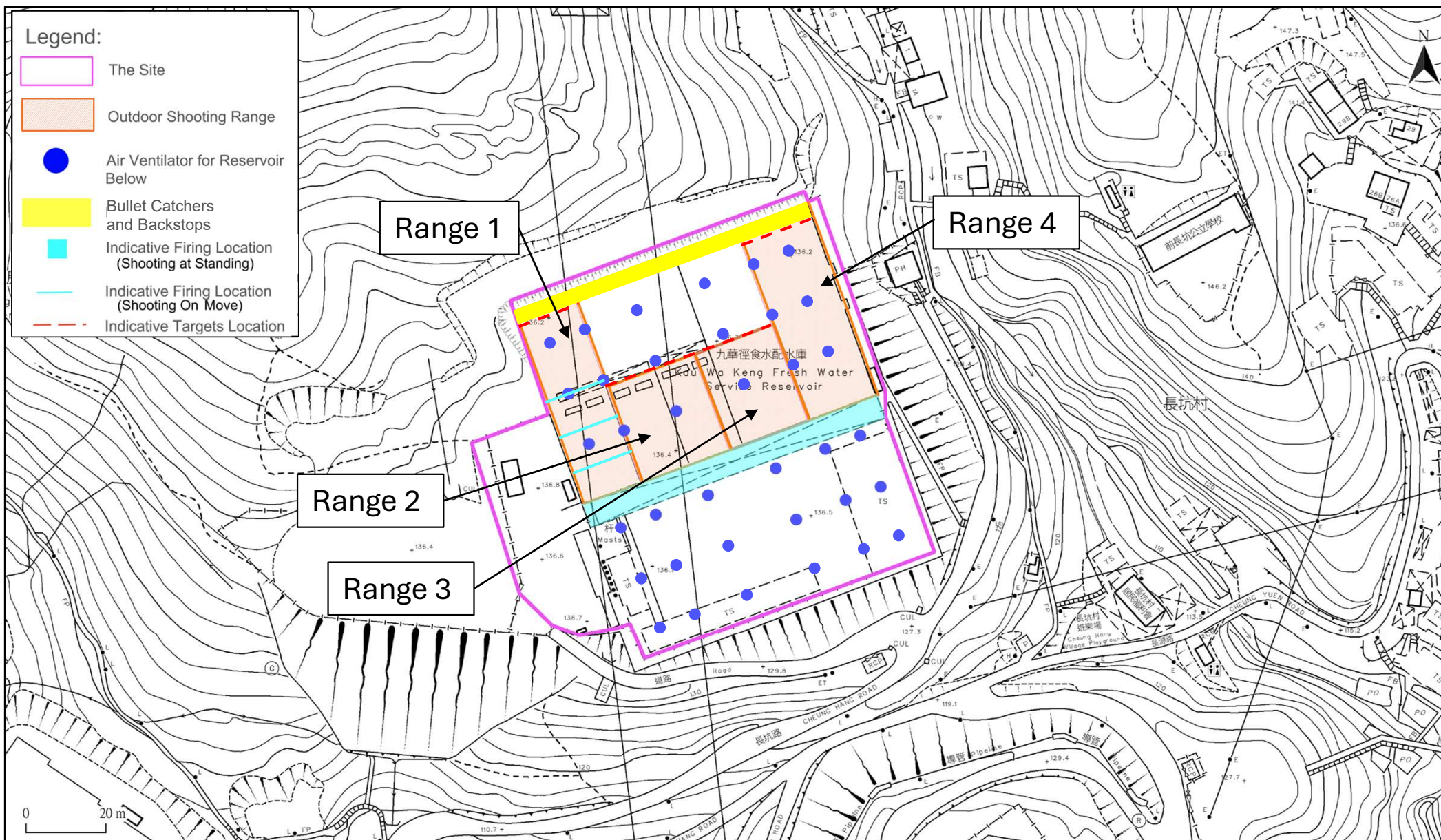


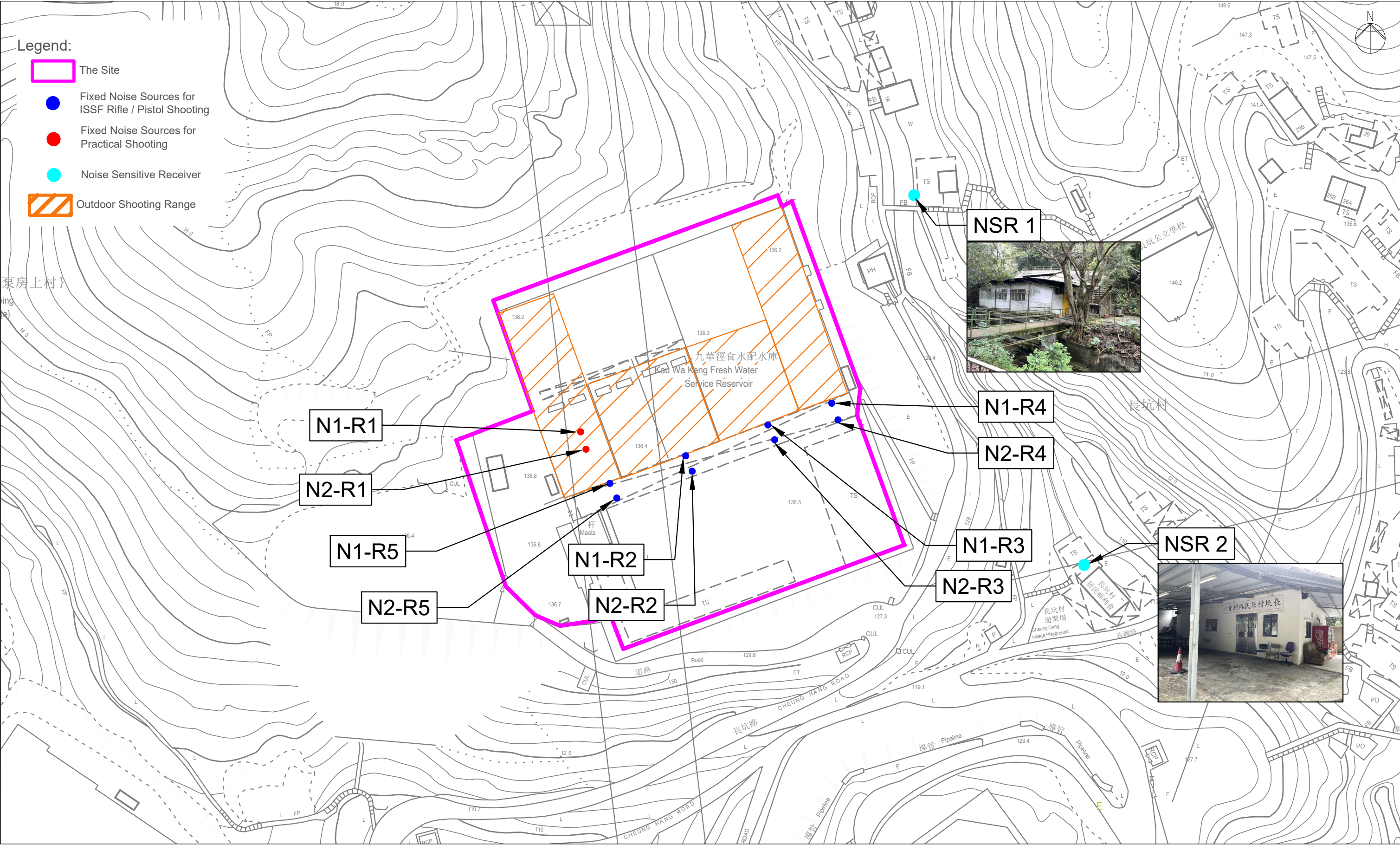






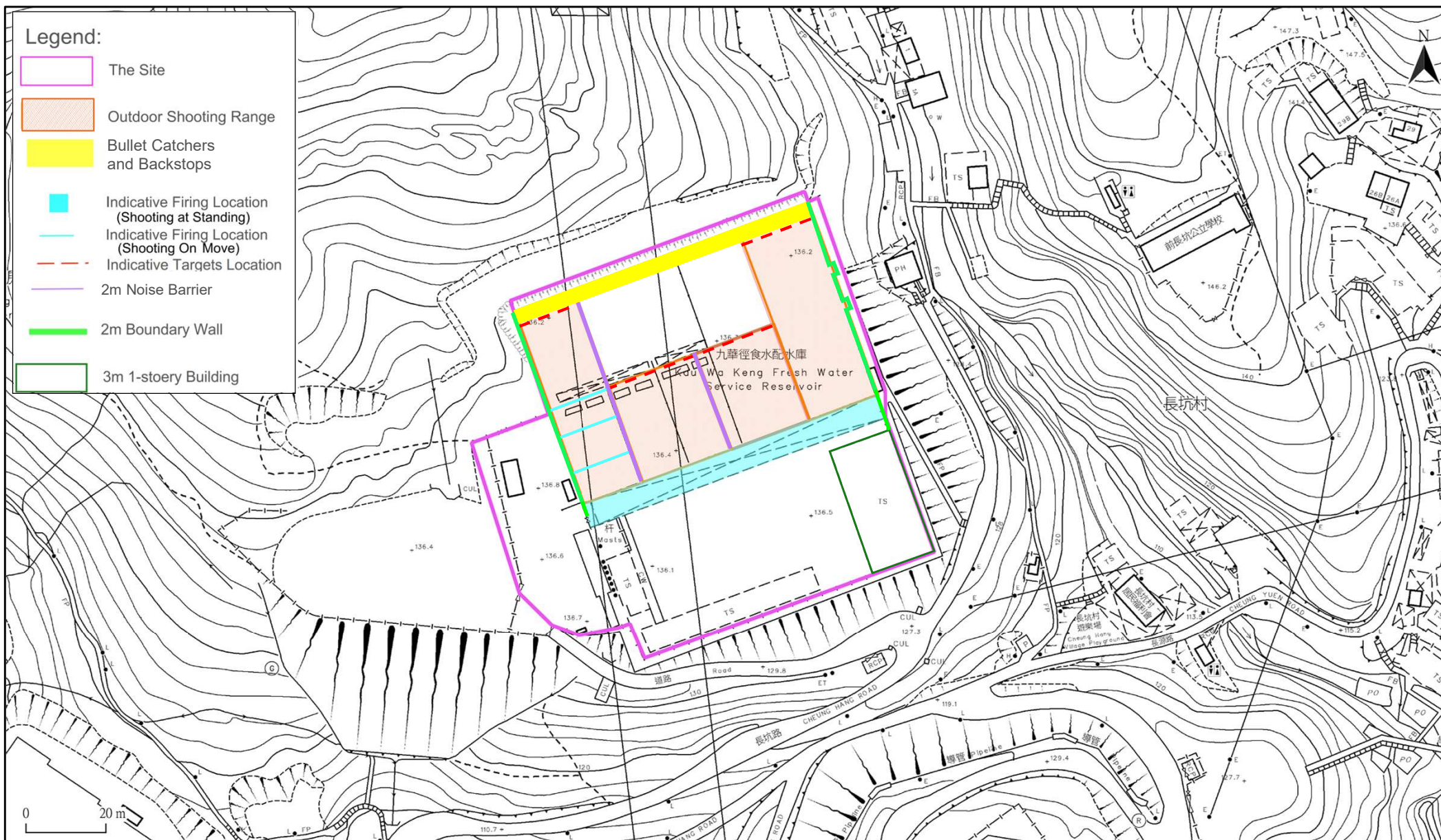


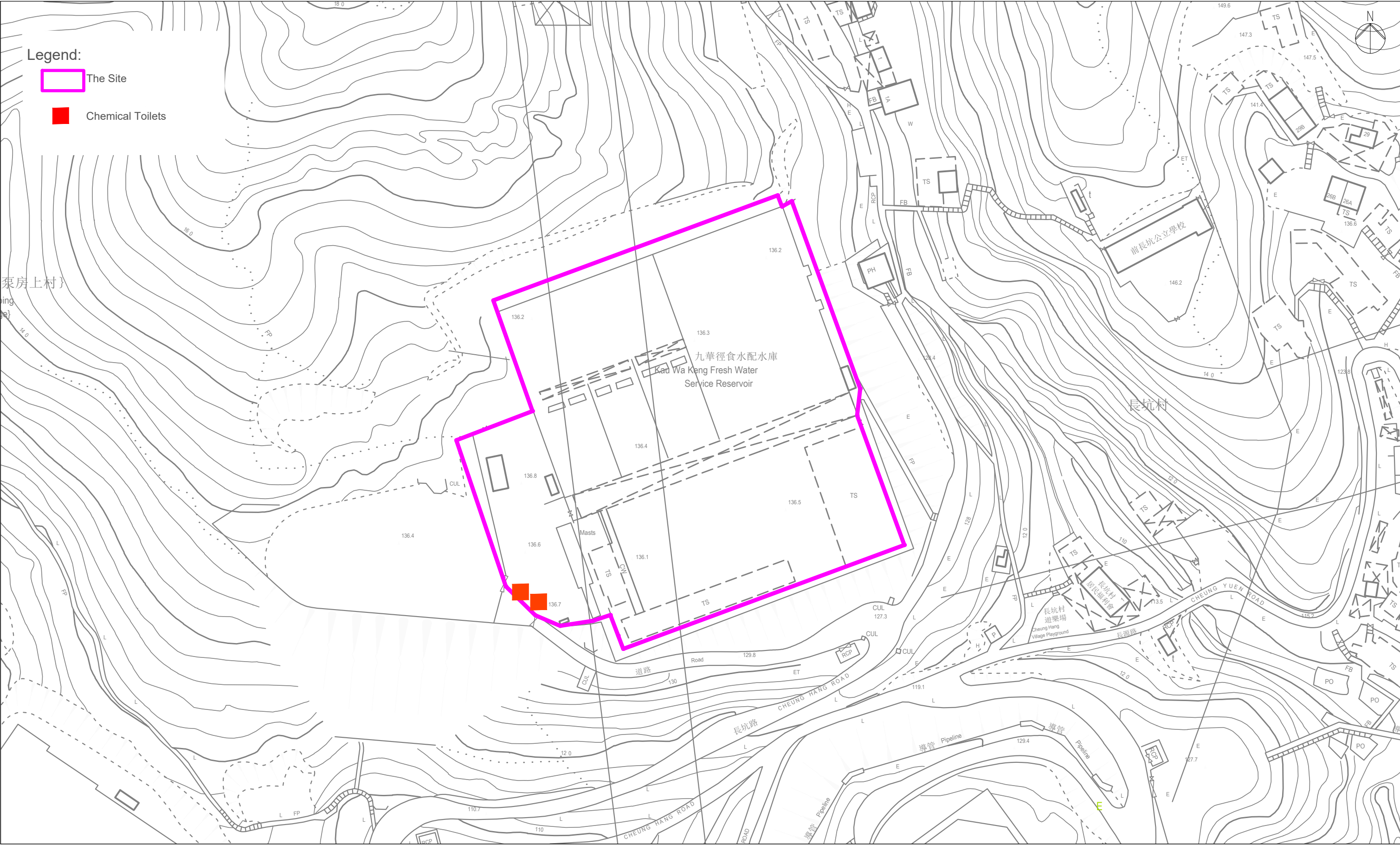




Proposed Shooting Range at Kau Wa Keng
Representative Noise Sensitive Receivers and
the Corresponding Fixed Noise Sources

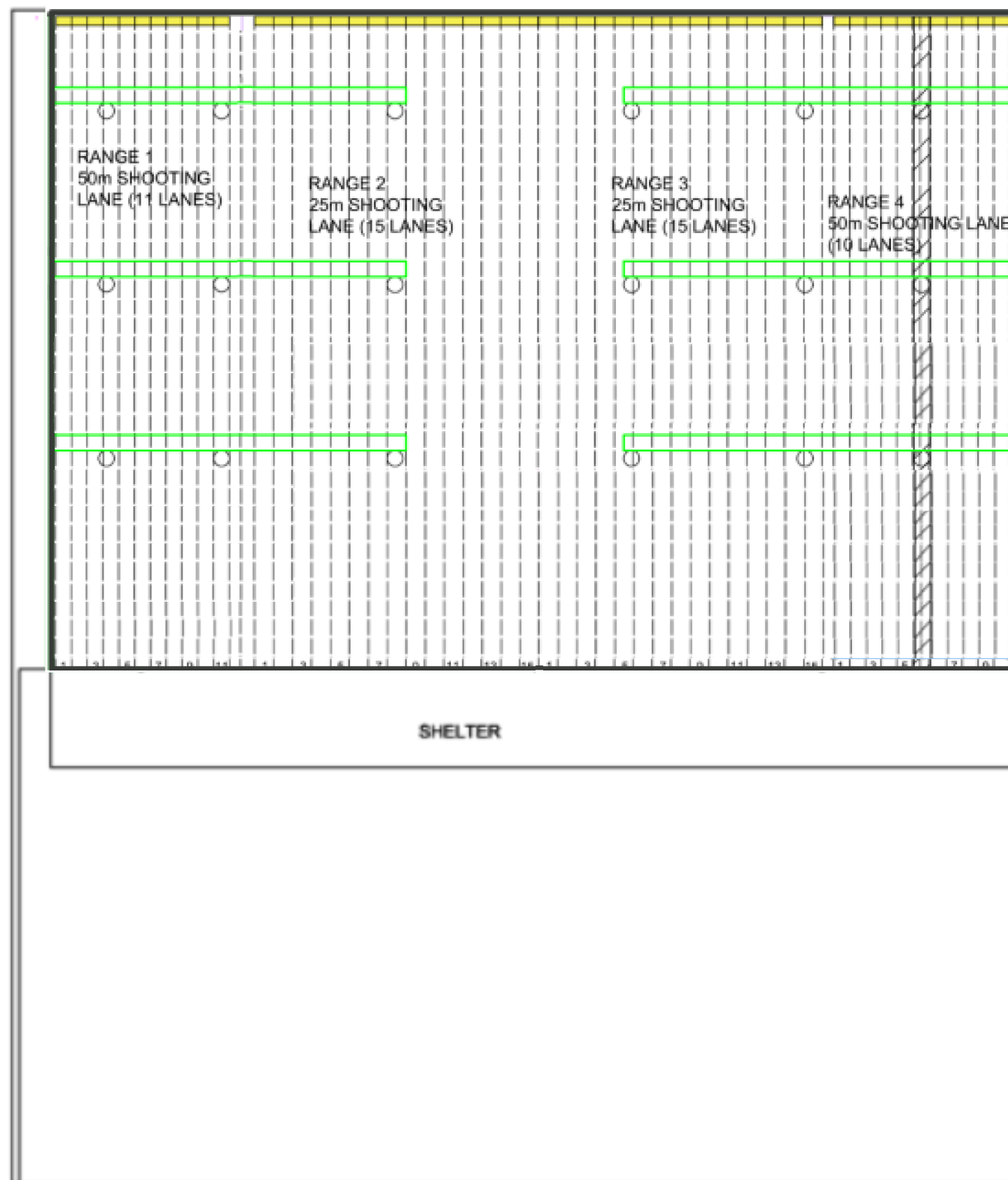
Figure 4.4





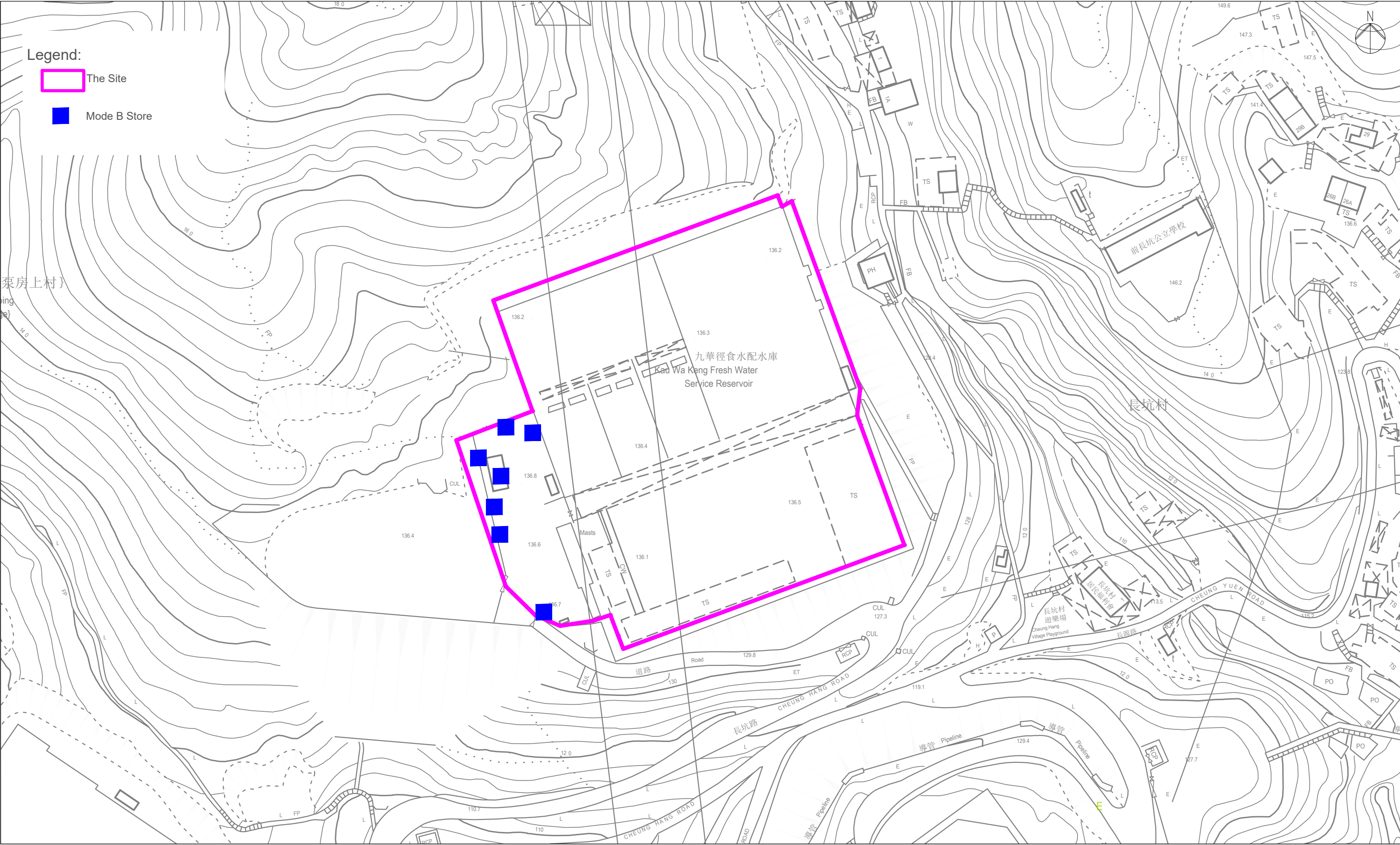
Proposed Shooting Range at Kau Wa Keng
Locations of Chemical Toilets

Figure 4.6



LEGEND:

 Proposed vent pipe connected to existing ventilator



Proposed Shooting Range at Kau Wa Keng
Locations of Mode B Store

Figure 4.9

APPENDIX A

Determination of Surface Characteristics Parameters for AERMET

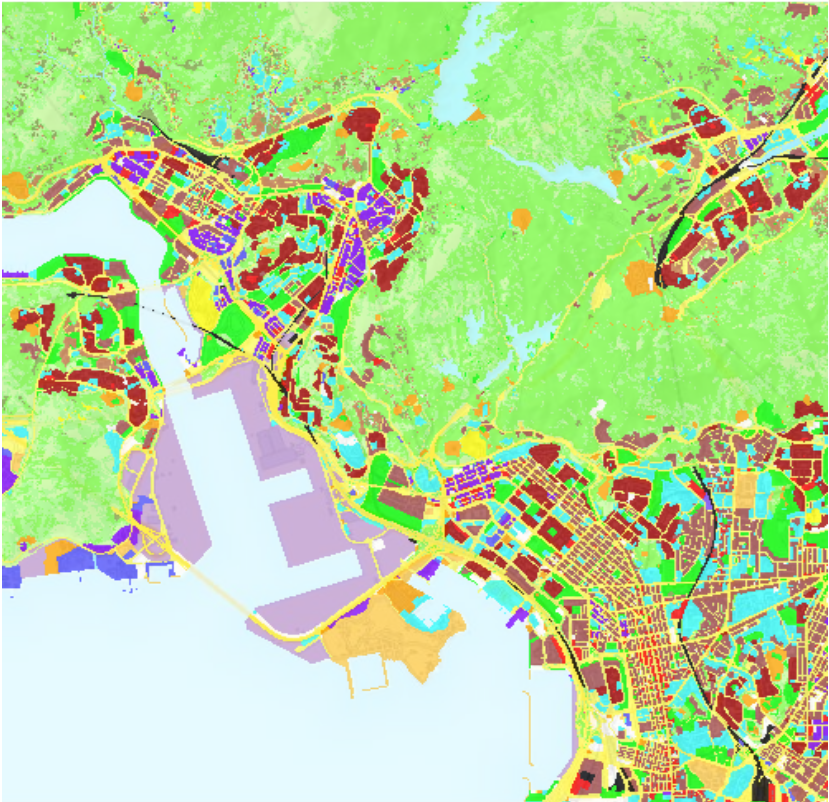
Appendix A Determination of Surface Characteristics Parameters for AERMET

Code	Color Sample	Hong Kong Planning Department Classification	Roughness	Albedo	Bowen Ratio	Grid Count	Percent	Albedo x Percent	b^n/Sn
1		Private Residential	1	0.18	1.5	55289	5.53%	0.00995202	1.022670927
2		Public Residential	1	0.18	1.5	45912	4.59%	0.00826416	1.018790067
3		Rural Settlement	0.375	0.165	0.9	10483	1.05%	0.001729695	0.998896115
11		Commercial/Business and Office	1	0.18	1.5	8613	0.86%	0.00155034	1.003498376
21		Industrial Land	0.7	0.18	1.5	12775	1.28%	0.0022995	1.005193255
22		Industrial Estates/Science and Technology Parks	0.7	0.18	1.5	132	0.01%	0.00002376	1.000053523
23		Warehouse and Open Storage	0.7	0.18	1.5	6131	0.61%	0.00110358	1.002488999
31		Government, Institutional and Community Facilities	0.7	0.18	1.5	45866	4.59%	0.00825588	1.018771065
32		Open Space and Recreation	0.04	0.15	1	39844	3.98%	0.0059766	1
41		Roads and Transport Facilities	0.7	0.18	1.5	108904	10.89%	0.01960272	1.045146192
42		Railways	0.7	0.18	1.5	6188	0.62%	0.00111384	1.002512168
43		Airport	0.07	0.18	1.5	0	0.00%	0	1
44		Port Facilities	0.7	0.18	1.5	38088	3.81%	0.00685584	1.01556322
51		Cemeteries/Funeral Facilities	0.7	0.18	1.5	4388	0.44%	0.00078984	1.001780765
52		Utilities	0.7	0.18	1.5	15434	1.54%	0.00277812	1.00627757
53		Vacant Land/Construction in Progress	0.2	0.18	1	9337	0.93%	0.00168066	1
54		Others	0.2	0.18	1	13765	1.38%	0.0024777	1
61		Agricultural Land	0.1575	0.18	0.55	7814	0.78%	0.00140652	0.995339396
62		Fish Ponds/Gei Wais	0.001	0.1	0.1	0	0.00%	0	1
71		Woodland	1.05	0.1625	0.75	219318	21.93%	0.035639175	0.938855352
72		Shrubland	0.3	0.18	1.25	77776	7.78%	0.01399968	1.01750669
73		Grassland	0.065	0.185	0.8	50366	5.04%	0.00931771	0.988824072
74		Mangrove/Swamp	0.065	0.14	0.225	6	0.00%	0.00000084	0.99999105
81		Badland	0.15	0.1625	0.75	0	0.00%	0	1
83		Rocky Shore	0.05	0.2	4.75	0	0.00%	0	1
91		Reservoirs	0.001	0.1	0.1	11811	1.18%	0.0011811	0.973170644
92		Streams and Nullahs	0.001	0.1	0.1	2442	0.24%	0.0002442	0.994392866
99		SZ Residential *	1	0.18	1.5	0	0.00%	0	1
0		Open Sea *	0.001	0.1	0.1	209318	20.93%	0.0209318	0.617564041
			0.157175	0.646252		1000000			

* Outside Hong Kong border, not belong to PlanD categories.

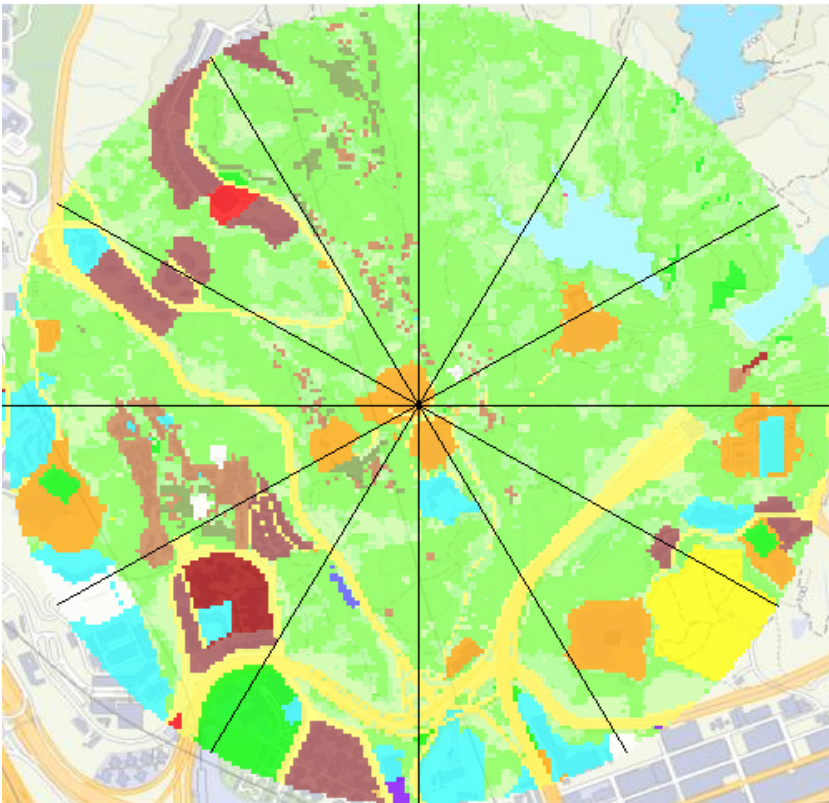
Angle	Group	Inverse-distance Sum	Roughness
0	0 - 30	5.176452751	0.504269
30	30 - 60	5.31768931	0.236540
60	60 - 90	5.176452751	0.480610
90	90 - 120	5.176452751	0.566977
120	120 - 150	5.31768931	0.627405
150	150 - 180	5.176452751	0.598072
180	180 - 210	5.176452751	0.461464
210	210 - 240	5.31768931	0.533288
240	240 - 270	5.176452751	0.559095
270	270 - 300	5.176452751	0.624064
300	300 - 330	5.31768931	0.555798
330	330 - 360	5.176452751	0.605752

Center: X=832615, Y=823115, , Z=138.0; Met Year=2019;



Land Utilization in Hong Kong 2022

Center: X=832615, Y=823115, , Z=138.0; Met Year=2019;



Land Utilization in Hong Kong 2022

APPENDIX B

Emission Inventory for Heavy Metal Emissions

Appendix B Emission Inventory for Heavy Metal Emissions at Outdoor Shooting Ranges

Emission Factor of Heavy Metal Emissions

	Emission factor (g/shot) ^[1]
Copper (Cu)	1.04E-02
Iron (Fe)	3.04E-02
Lead (Pb)	8.16E-03
Zinc (Zn)	1.36E-03

Assume there are maximum allowable shots per hour (i.e., 500 shots/per) in each range, the emission factor of each heavy metal can be calculated as follows:

$$\text{Emission Rate (g/s)} = \text{Emission factor (g/shots)} \times 500 \text{ (shots/hour)} / 3600 \text{ (s/hour)}$$

Emission Inventory of Heavy Metal Emissions

Source ID	Source type	X	Y	Maximum allowable shots per hour	Maximum allowable shots per hour ^[7]	Elevation (mPD)	Release height (mAG) ^[3]	Initial lateral dimension (m) ^[4]	Initial vertical dimension (m) ^[5]	Emission Rate (g/s) ^[2]				Firing hour ^[6]
										Cu	Fe	Pb	Zn	
Range 1_1	VOLUME	832561.0	823129.1	200	30	138.0	1	0.61	0.93	8.69E-05	2.53E-04	6.80E-05	1.13E-05	9am to 7pm
Range 1_2	VOLUME	832563.5	823130.0		30	138.0	1	0.61	0.93	8.69E-05	2.53E-04	6.80E-05	1.13E-05	
Range 1_3	VOLUME	832565.9	823130.9		35	138.0	1	0.61	0.93	1.01E-04	2.95E-04	7.94E-05	1.32E-05	
Range 1_4	VOLUME	832568.3	823131.8		35	138.0	1	0.61	0.93	1.01E-04	2.95E-04	7.94E-05	1.32E-05	
Range 1_5	VOLUME	832570.8	823132.7		35	138.0	1	0.61	0.93	1.01E-04	2.95E-04	7.94E-05	1.32E-05	
Range 1_6	VOLUME	832573.2	823133.6		35	138.0	1	0.61	0.93	1.01E-04	2.95E-04	7.94E-05	1.32E-05	
Range 2_1	VOLUME	832576.9	823135.0	150	18	138.0	1	0.79	0.93	5.22E-05	1.52E-04	4.08E-05	6.80E-06	
Range 2_2	VOLUME	832579.3	823135.9		18	138.0	1	0.79	0.93	5.22E-05	1.52E-04	4.08E-05	6.80E-06	
Range 2_3	VOLUME	832581.7	823136.8		18	138.0	1	0.79	0.93	5.22E-05	1.52E-04	4.08E-05	6.80E-06	
Range 2_4	VOLUME	832584.2	823137.7		18	138.0	1	0.79	0.93	5.22E-05	1.52E-04	4.08E-05	6.80E-06	
Range 2_5	VOLUME	832586.6	823138.6		18	138.0	1	0.79	0.93	5.22E-05	1.52E-04	4.08E-05	6.80E-06	
Range 2_6	VOLUME	832589.1	823139.5		20	138.0	1	0.79	0.93	5.80E-05	1.69E-04	4.54E-05	7.56E-06	
Range 2_7	VOLUME	832591.5	823140.4	120	20	138.0	1	0.79	0.93	5.80E-05	1.69E-04	4.54E-05	7.56E-06	
Range 2_8	VOLUME	832593.9	823141.3		20	138.0	1	0.79	0.93	5.80E-05	1.69E-04	4.54E-05	7.56E-06	
Range 3_1	VOLUME	832596.4	823142.2		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_2	VOLUME	832598.8	823143.1		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_3	VOLUME	832601.2	823144.0		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_4	VOLUME	832603.7	823144.9		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_5	VOLUME	832606.1	823145.8	30	15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_6	VOLUME	832608.5	823146.8		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_7	VOLUME	832611.0	823147.7		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 3_8	VOLUME	832613.4	823148.6		15	138.0	1	0.63	0.93	4.35E-05	1.27E-04	3.40E-05	5.67E-06	
Range 4_1	VOLUME	832615.9	823149.5		5	138.0	1	0.53	0.93	1.45E-05	4.22E-05	1.13E-05	1.89E-06	
Range 4_2	VOLUME	832618.3	823150.4		5	138.0	1	0.53	0.93	1.45E-05	4.22E-05	1.13E-05	1.89E-06	
Range 4_3	VOLUME	832620.7	823151.3	30	5	138.0	1	0.53	0.93	1.45E-05	4.22E-05	1.13E-05	1.89E-06	
Range 4_4	VOLUME	832623.2	823152.2		5	138.0	1	0.53	0.93	1.45E-05	4.22E-05	1.13E-05	1.89E-06	
Range 4_5	VOLUME	832625.6	823153.1		5	138.0	1	0.53	0.93	1.45E-05	4.22E-05	1.13E-05	1.89E-06	
Range 4_6	VOLUME	832628.0	823154.0		5	138.0	1	0.53	0.93	1.45E-05	4.22E-05	1.13E-05	1.89E-06	

Note:

[1] Emission factor is extracted from US EPA AP-42: Compilation of Air Emissions Factors from Stationary Sources Table 15.1.14 and Table 15.1.23.

[2] The highest emission factors for all ammunition types permitted for use in the proposed shooting range have been selected for the assessment.

[3] Assume ammunition is fired at 1 m above ground.

[4] With reference to Table 3-3 of User's Guide for the AMS/EPA Regulatory Model (AERMOD), the initial lateral dimension is calculated by the length of each active firing line divided by 4.3.

[5] Assume the height of covered walkway is 2 m. With reference to Table 3-3 of User's Guide for the AMS/EPA Regulatory Model (AERMOD), the initial vertical dimension is calculated by building height divided by 2.15.

[6] As confirmed by the Project Proponent, the operation hour of the shooting range is 7am to 10pm, whilst firing hour is 9:30am to 6:30pm. Due to input limitation of AERMOD, the firing hour is assumed as 9am to 7pm daily in AERMOD.

[7] Maximum allowable shots for each designated shooting location in each range are adopted in the calculation as a conservative approach.

APPENDIX C

Detailed Assessment Results

Detailed Assessment Results

Proposed Shooting Range at Kau Wa Keng Detailed operation phase assessment results

ASRs and Assessment Height (mAG)			Site			Cu Concentrations in µg/m ³			Fe Concentrations in µg/m ³			Pb Concentrations in µg/m ³			Zn Concentrations in µg/m ³		
						Background Concentration, µg/m ³											
						0.055	0.055	0.018	1.9	1.9	0.559	0.089	0.089	0.011	1.7	1.7	0.098
						Max 1-hour average	Max daily average	Annual Average	Max 1-hour average	Max daily average	Annual Average	Max 1-hour average	Max daily average	Annual Average	Max 1-hour average	Max daily average	Annual Average
AQO			100	3.6	2.4	-	25	17	-	0.15	0.5	-	10	6.7			
A1	1.5	Temporary Structure near 1A Cheung Hang Village	0.65816	0.11383	0.04062	3.65892	2.07156	0.62496	0.56096	0.13503	0.02870	1.77864	1.70767	0.10095			
A1	5	Temporary Structure near 1A Cheung Hang Village	0.67939	0.11482	0.04071	3.72082	2.07445	0.62523	0.57756	0.13580	0.02877	1.78141	1.70780	0.10096			
A1	10	Temporary Structure near 1A Cheung Hang Village	0.58019	0.12427	0.04389	3.43156	2.10200	0.63451	0.49998	0.14320	0.03126	1.76847	1.70903	0.10138			
A2	1.5	1 Cheung Hang Village near Cheung Hang Village Residents Welfare Association	0.40110	0.08488	0.02612	2.90933	1.98713	0.58268	0.35999	0.11239	0.01735	1.74513	1.70390	0.09906			
A2	5	1 Cheung Hang Village near Cheung Hang Village Residents Welfare Association	0.41169	0.08579	0.02642	2.94022	1.98978	0.58356	0.36829	0.11310	0.01759	1.74651	1.70401	0.09910			
A3	1.5	Former Cheung Hang Public School	0.59548	0.12430	0.02640	3.47615	2.10208	0.58349	0.51197	0.14323	0.01757	1.77047	1.70904	0.09909			
A3	5	Former Cheung Hang Public School	0.51915	0.11638	0.02532	3.25356	2.07900	0.58034	0.45224	0.13704	0.01673	1.76052	1.70800	0.09895			
A3	10	Former Cheung Hang Public School	0.44837	0.10061	0.02371	3.04718	2.03300	0.57566	0.39689	0.12469	0.01547	1.75129	1.70595	0.09874			
A4	1.5	Temporary Structure near 22A Cheung Hang Village	0.26649	0.07108	0.02058	2.51677	1.94691	0.56654	0.25453	0.10159	0.01302	1.72758	1.70210	0.09834			
A4	5	Temporary Structure near 22A Cheung Hang Village	0.26923	0.07128	0.02065	2.52475	1.94747	0.56672	0.25667	0.10174	0.01307	1.72793	1.70212	0.09835			
A5	1.5	Kau Wa Keng Pumping Station Upper Village	0.25890	0.07878	0.02369	2.49464	1.96934	0.57559	0.24868	0.10762	0.01546	1.72659	1.70310	0.09874			
A5	5	Kau Wa Keng Pumping Station Upper Village	0.26435	0.07947	0.02386	2.51053	1.97135	0.57608	0.25295	0.10816	0.01559	1.72730	1.70319	0.09876			
A6	1.5	Kau Wa Keng Pumping Station Staff Quarters	0.63068	0.08934	0.02181	3.57886	2.00016	0.57010	0.53978	0.11590	0.01398	1.77506	1.70448	0.09850			
A6	5	Kau Wa Keng Pumping Station Staff Quarters	0.61843	0.08936	0.02186	3.54312	2.00020	0.57027	0.53018	0.11591	0.01403	1.77347	1.70448	0.09850			
A6	10	Kau Wa Keng Pumping Station Staff Quarters	0.58157	0.08903	0.02194	3.43563	1.99924	0.57049	0.50132	0.11565	0.01409	1.76866	1.70444	0.09851			
A7	1.5	Neighbourhood Advice-Action Council Fairyland	0.16869	0.06270	0.01958	2.23155	1.92246	0.56362	0.17801	0.09503	0.01224	1.71482	1.70100	0.09821			
A7	5	Neighbourhood Advice-Action Council Fairyland	0.17334	0.06275	0.01961	2.24513	1.92260	0.56369	0.18166	0.09506	0.01226	1.71543	1.70101	0.09821			
A7	10	Neighbourhood Advice-Action Council Fairyland	0.17729	0.06275	0.01962	2.25663	1.92260	0.56372	0.18475	0.09506	0.01227	1.71595	1.70101	0.09821			
A7	15	Neighbourhood Advice-Action Council Fairyland	0.17498	0.06267	0.01960	2.24990	1.92237	0.56367	0.18294	0.09500	0.01225	1.71564	1.70100	0.09821			
A8	1.5	Temporary Structure near 28 Cheung Hang Village	0.37180	0.08057	0.02501	2.82389	1.97458	0.57943	0.33707	0.10903	0.01649	1.74131	1.70334	0.09891			
A8	5	Temporary Structure near 28 Cheung Hang Village	0.36865	0.08093	0.02475	2.81471	1.97561	0.57869	0.33461	0.10930	0.01629	1.74090	1.70338	0.09888			

Note:

[1] For the hourly and daily data, the maximum daily concentrations of the relevant metals at Kwai Chung AQMS from the latest five years (i.e. 2019-2023) are adopted as the background concentrations. For the annual data, the maximum annual concentrations of the relevant metals at Kwai Chung AQMS from 2019 to 2023 are adopted as the background concentrations.

- The predicted concentration has included the background heavy metal concentrations (Year 2019 to 2023)

APPENDIX D

Noise Measurement Results

Project: Proposed Shooting Range at Kau Wa Keng
Date: 19-May-24
Time: 11:55-12:30
Venue: Shooting Range at Pillar Point
Subect: .223 rifle and .762 rifle

Record ID	Description	Parameter	Noise Level
1	Background noise	Leq	56.5 dB(A)
2	.223 rifle, measurement distance=2m, at 12:00 direction	SEL	104.1 dB(A)
3	.223 rifle, measurement distance=2m, at 1:30 direction	SEL	103.3 dB(A)
4	.223 rifle, measurement distance=2m, at 10:30 direction	SEL	105.2 dB(A)
5	.223 rifle, measurement distance=2m, at 7:30 direction	SEL	106.4 dB(A)
6	.223 rifle, measurement distance=2m, at 4:30 direction	SEL	103.1 dB(A)
7	.762 rifle, measurement distance=2m, at 12:00 direction	SEL	105.4 dB(A)
8	.762 rifle, measurement distance=2m, at 1:30 direction	SEL	107.1 dB(A)
9	.762 rifle, measurement distance=2m, at 10:30 direction	SEL	102.2 dB(A)
10	.762 rifle, measurement distance=2m, at 7:30 direction	SEL	105.3 dB(A)
11	.762 rifle, measurement distance=2m, at 4:30 direction	SEL	107.1 dB(A)

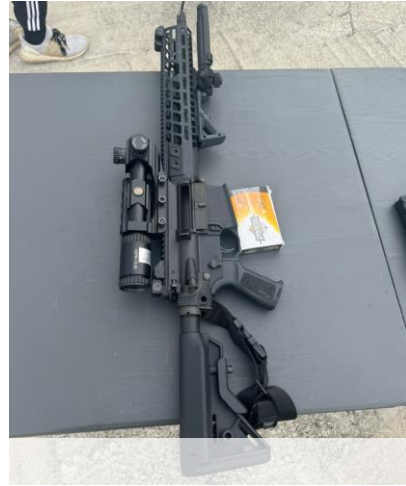
Remark:

12:00 direction - in front of the shooter
1:30 direction - front right hand side of the shooter
4:30 direction - rear right hand side of the shooter
7:30 direction - rear left hand side of the shooter
10:30 direction - front left hand side of the shooter

Photos Taken during Measurement Exercise



.223 Rifle



.762 Rifle



Shooting Range at Pillar Point



Noise Measurement during
shooting

APPENDIX E

Noise Prediction Calculations

[illegible]

Table A.2 Calculation of Unmitigated Noise Contribution from All Shooting Activities from Each Shooting Range on NSR 2												
Scenarios	1			2		3		4		5		
Range Number	1	4	2	3	2	3	2	3	2	3		
Shooting Activity [Note 1]	SSL (All Firearms)	SOM (All Firearms)	SSL (Rifle only)	SSL (.22 ammunition)	SSL (.22 ammunition)	SSL (All Firearms between .32 to .45 ammunition)	SSL (All Firearms between .32 to .45 ammunition)	SSL (.22 ammunition)	SSL (.22 ammunition)	SSL (All firearms)	SSL (All Firearms except: .45 Pistol, 9mm Pistol and .38 Revolver)	
Representative Source Point	N2-R5	N2-R1	N2-R4	N2-R2	N2-R3	N2-R2	N2-R3	N2-R2	N2-R3	N2-R2	N2-R3	
Average SEL for 1 shot, dB(A)	114.4	107.1	105.4	105.4	105.4	114.4	114.4	105.4	105.4	114.4	114.4	
Reference distance, m	2	2	2	2	2	2	2	2	2	2	2	
Number of shots in 30 min	45	15	15	15	15	10	10	105	105	30	30	
SEL in 30min at reference distance, dB(A)	130.9	126.2	118.9	117.2	117.2	124.4	124.4	125.6	125.6	129.2	129.2	
Distance from NSR2, m	123.9	133.8	76.7	106.3	88.8	106.3	88.8	106.3	88.8	106.3	88.8	
SEL in 30min at NSR2, dB(A)	95.1	89.7	87.2	82.7	84.2	89.9	91.4	91.1	92.7	94.7	96.2	
Leq(30min) at NSR2, dB(A)	62.5	57.1	54.6	50.1	51.7	57.3	58.9	58.6	60.1	62.1	63.7	
Impulsiveness Correction, dB(A)	3	3	3	3	3	3	3	3	3	3	3	
Screening Correction, dB(A)	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	
Facade correction, dB(A)	3	3	3	3	3	3	3	3	3	3	3	
Corrected Leq(30min) at NSR2, dB(A)	58.5	53.1	50.6	46.1	47.7	53.3	54.9	54.6	56.1	58.1	59.7	

Table A.4 Calculation of Mitigated Noise Contribution from All Shooting Activities from Each Shooting Range on NSR 2													
Scenarios	1		2		3		4		5				
Range Number	1	4	2	3	2	3	2	3	2	3			
Shooting Activity [Note 1]	SSL (All Firearms)	SOM (All Firearms)	SSL (Rifle only)	SSL (.22 ammunitions)	SSL (.22 ammunition)	SSL (All Firearms between .32 to .45 ammunition)	SSL (All Firearms between .32 to .45 ammunition)	SSL (.22 ammunitions)	SSL (.22 ammunition)	SSL (All firearms)	SSL (All Firearms except: .45 Pistol, 9mm Pistol and .38 Revolver)		
Representative Source Point	N2-R5	N2-R1	N2-R4	N2-R2	N2-R3	N2-R2	N2-R3	N2-R2	N2-R3	N2-R2	N2-R3		
Average SEL for 1 shot, dB(A)	114.4	114.4	107.1	105.4	105.4	114.4	114.4	105.4	105.4	114.4	114.4		
Reference distance, m	2	2	2	2	2	2	2	2	2	2	2		
Number of shots in 30 min	45	15	15	15	15	10	10	105	105	30	30		
SEL in 30min at reference distance, dB(A)	130.9	126.2	118.9	117.2	117.2	124.4	124.4	125.6	125.6	129.2	129.2		
Distance from NSR2, m	123.9	133.8	76.7	106.3	88.8	106.3	88.8	106.3	88.8	106.3	88.8		
SEL in 30min at NSR2, dB(A)	95.1	89.7	87.2	82.7	84.2	89.9	91.4	91.1	92.7	94.7	96.2		
Leq(30min) at NSR2, dB(A)	62.5	57.1	54.6	50.1	51.7	57.3	58.9	58.6	60.1	62.1	63.7		
Impulsiveness Correction, dB(A)	3	3	3	3	3	3	3	3	3	3	3		
Screening Correction, dB(A)	-20.0	-20.0	-17.6	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0		
Facade correction, dB(A)	3	3	3	3	3	3	3	3	3	3	3		
Corrected Leq(30min) at NSR2, dB(A)	48.5	43.1	43.1	36.1	37.7	43.3	44.9	44.6	46.1	48.1	49.7		
Scenarios	6		7	8		1		9		3		4	
Range Number	2	3	4	1		2	3	4	1		2	3	4
Shooting Activity [Note 1]	SSL (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SSL (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SSL (Rifle only)	SSL (All firearms)	SOM (All firearms)	SSL (All Firearms except: .45 and 9mm Pistol)	SSL (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SSL (Rifle only)	SSL (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SOM (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SSL (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SSL (All Firearms except: .45 Pistol, 9mm Pistol, .38 Revolver)	SSL (Rifle only)
Representative Source Point	N2-R2	N2-R3	N2-R4	N2-R5	N2-R1	N2-R2	N2-R3	N2-R4	N2-R5	N2-R1	N2-R2	N2-R3	N2-R4
Average SEL for 1 shot, dB(A)	106.3	106.3	107.1	114.4	114.4	110.5	106.3	107.1	106.3	106.3	106.3	106.3	107.1
Reference distance, m	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of shots in 30 min	125	85	15	50	50	40	40	40	100	100	75	60	15
SEL in 30min at reference distance, dB(A)	127.3	125.6	118.9	131.4	131.4	126.5	122.3	123.1	126.3	126.3	125.1	124.1	118.9
Distance from NSR2, m	106.3	88.8	76.7	123.9	133.8	106.3	88.8	76.7	123.9	133.8	106.3	88.8	76.7
SEL in 30min at NSR2, dB(A)	92.8	92.6	87.2	95.6	94.9	92.0	89.4	91.4	90.5	89.8	90.5	91.1	87.2
Leq(30min) at NSR2, dB(A)	60.2	60.1	54.6	63.0	62.3	59.5	56.8	58.9	57.9	57.2	58.0	58.6	54.6
Impulsiveness Correction, dB(A)	3	3	3	3	3	3	3	3	3	3	3	3	3
Screening Correction, dB(A)	-20.0	-20.0	-17.6	-20.0	-20.0	-20.0	-20.0	-17.6	-20.0	-20.0	-20.0	-20.0	-17.6
Facade correction, dB(A)	3	3	3	3	3	3	3	3	3	3	3	3	3
Corrected Leq(30min) at NSR2, dB(A)	46.2	46.1	43.1	49.0	48.3	45.5	42.8	47.3	43.9	43.2	44.0	44.6	43.1
Notes:													
1. "SSL" stands for shooting at the standing location, while "SOM" stands for shooting on move. Types of firearms refer to Table 4.8.													
2. As advised by firearm expert, .45 ammunition produces the highest noise level amongst all handguns of .22/.32/.38/.357/40/.41/.45 calibres and rifles of .22/.223/.762 calibres. The SEL of .45 pistol is adopted as a worst-case scenario for calculation for "All Firearms" case and "All Firearms between .32 to .45 ammunition"													

Table A.5 Calculation of Cumulative Noise Impact from the Project on NSR 1								
NOISE IMPACT	RANGE 1, dB(A)	RANGE 2, dB(A)	RANGE 3, dB(A)	RANGE 4, dB(A)	CUMULATIVE NOISE LEVEL AT NSR 1, dB(A)	COMPLIANCE (Y/N)	EXCEEDANCE, dB(A)	
UNMITIGATED								
Scenario 1 (Range 1 + Range 4)	59.6	-	-	52.9	60	N	5	
Scenario 2 (Range 2 + Range 3)	-	47.6	49.7	-	52	Y	-	
Scenario 3 (Range 2 + Range 3)	-	54.8	56.9	-	59	N	4	
Scenario 4 (Range 2 + Range 3)	-	56.0	58.1	-	60	N	5	
Scenario 5 (Range 2 + Range 3)	-	59.6	61.7	-	64	N	9	
Scenario 6 (Range 2 + Range 3)	-	57.7	58.1	-	61	N	6	
Scenario 7 (Range 4)	-	-	-	52.9	53	Y	-	
Scenario 8 (All Ranges)	60.2	56.9	54.8	57.1	64	N	9	
Scenario 9 (All Ranges)	55.1	55.5	56.6	52.9	61	N	6	
MITIGATED								
Scenario 1 (Range 1 + Range 4)	49.6	-	-	44.8	51	Y	-	
Scenario 2 (Range 2 + Range 3)	-	37.6	39.7	-	42	Y	-	
Scenario 3 (Range 2 + Range 3)	-	44.8	46.9	-	49	Y	-	
Scenario 4 (Range 2 + Range 3)	-	46.0	48.1	-	50	Y	-	
Scenario 5 (Range 2 + Range 3)	-	49.6	51.7	-	54	Y	-	
Scenario 6 (Range 2 + Range 3)	-	47.7	48.1	-	51	Y	-	
Scenario 7 (Range 4)	-	-	-	44.8	45	Y	-	
Scenario 8 (All Ranges)	50.2	46.9	44.8	49.0	54	Y	-	
Scenario 9 (All Ranges)	45.1	45.5	46.6	44.8	52	Y	-	
Table A.6 Calculation of Cumulative Noise Impact from the Project on NSR 2								
NOISE IMPACT	RANGE 1, dB(A)	RANGE 2, dB(A)	RANGE 3, dB(A)	RANGE 4, dB(A)	CUMULATIVE NOISE LEVEL AT NSR 2, dB(A)	COMPLIANCE (Y/N)	EXCEEDANCE, dB(A)	
UNMITIGATED								
Scenario 1 (Range 1 + Range 4)	59.0	-	-	50.6	60	N	5	
Scenario 2 (Range 2+ Range 3)	-	46.1	47.7	-	50	Y	-	
Scenario 3 (Range 2+ Range 3)	-	53.3	55.0	-	57	N	2	
Scenario 4 (Range 2+ Range 3)	-	54.5	56.2	-	58	N	3	
Scenario 5 (Range 2+ Range 3)	-	58.1	59.7	-	62	N	7	
Scenario 6 (Range 2+ Range 3)	-	56.2	56.2	-	59	N	4	
Scenario 7 (Range 4)	-	-	-	50.6	51	Y	-	
Scenario 8 (All Ranges)	59.4	55.4	52.9	54.8	62	N	7	
Scenario 9 (All Ranges)	54.3	54.0	54.7	50.6	60	N	5	
MITIGATED								
Scenario 1 (Range 1 + Range 4)	49.0	-	-	44.5	50	Y	-	
Scenario 2 (Range 2+ Range 3)	-	36.1	37.7	-	40	Y	-	
Scenario 3 (Range 2+ Range 3)	-	43.3	45.0	-	47	Y	-	
Scenario 4 (Range 2+ Range 3)	-	44.5	46.2	-	48	Y	-	
Scenario 5 (Range 2+ Range 3)	-	48.1	49.7	-	52	Y	-	
Scenario 6 (Range 2+ Range 3)	-	46.2	46.2	-	49	Y	-	
Scenario 7 (Range 4)	-	-	-	44.5	44	Y	-	
Scenario 8 (All Ranges)	49.4	45.4	42.9	48.7	53	Y	-	
Scenario 9 (All Ranges)	44.3	44.0	44.7	44.5	50	Y	-	

Calculation of Barrier Correction toward Various Fixed Noise Sources at NSR 1

	Elevation (m)				Horizontal Distance (m)			Slant Distance (m)				Path differen	Cumulative barrier attenuation					
	S	B1	B2	Receiver	S-B1	R-B2	B1-B2	dss	dsr	a	e	d	z	kmet	C2	C3	Dz	Dz*
N1-R1	137.2	138.2	138.7	120	7.1	34.1	65.0	6.0	37.0	27.9	64.0	107.6	3.0	0.9	20.0	3.0	24.1	20.0
N1-R2	137.4	138.2	138.7	120	5.8	37.7	44.3	9.7	37.0	43.0	36.9	89.5	4.5	1.0	20.0	2.9	25.7	20.0
N1-R3	137.4	138.7	N/A	120	26.4	41.8	N/A	22.7	38.1	42.8	0	70.4	3.9	1.0	20.0	1.0	20.5	20.0
N1-R4	137.2	138.7	N/A	120	8.1	48.6	N/A	7.0	36.7	43.2	0	59.3	2.2	1.0	20.0	1.0	18.1	18.1
N1-R5	137.4	138.2	138.7	120	4.1	35.9	67.9	3.5	38.1	43.0	62.8	109.3	3.5	1.0	20.0	3.0	24.8	20.0

^ Sectional drawing between N1-R5 fixed noise source and NSR1 is provided in Figure A.1. As the elevations of all fixed noise sources are similar, the N1-R5 is selected as representative fixed noise sources to demonstrate the elevation difference between the noise source and NSR1 in the sectional drawings.

Calculation of Barrier Correction toward Various Fixed Noise Sources at NSR 2			
		λ	0.686

	Elevation (m)				Horizontal Distance (m)			Slant Distance (m)					Path differ	Cumulative barrier attenuation				
	S	B1	B2	Receiver	S-B1	R-B2	B1-B2	dss	dsr	a	e	d	z	kmnet	C2	C3	Dz	Dz*
N2-R1	137.2	138.2	139.5	116.3	7.8	50.0	75.2	6.3	47.8	72.2	62.8	134.6	2.7	0.9	20.0	3.0	23.5	20.0
N2-R2	137.4	139.5	139.5	116.3	35.1	49.8	19.5	29.6	47.8	57.4	15.6	106.5	2.8	0.9	20.0	2.7	23.1	20.0
N2-R3	137.4	139.5	139.5	116.3	8.2	55.7	21.6	7.0	47.8	57.8	15.6	88.1	3.0	1.0	20.0	2.7	23.7	20.0
N2-R4	137.2	139.5	139.5	116.3	4.9	65.0	4.4	3.9	47.8	57.0	2.1	77.2	1.1	1.0	20.0	1.2	16.1	16.1
N2-R5	137.4	139.5	139.5	116.3	51.1	46.7	18.2	50.2	47.8	57.6	15.6	117.9	9.5	0.9	20.0	2.7	28.5	20.0

#: Barrier correction has been capped to 20dB(A) for conservative approach.

A Sectional drawing between N2-R2 fixed noise source and NSR2 is provided in Figure A.2. As the elevations of all fixed noise sources are similar, the N2-R2 is selected as representative fixed noise source to demonstrate the elevation difference between the fixed noise sources and NSR2 in the sectional drawings.

Figure A.1 Cross Section Between NSR 1 and Representative Notional Noise Source (N1-R5)

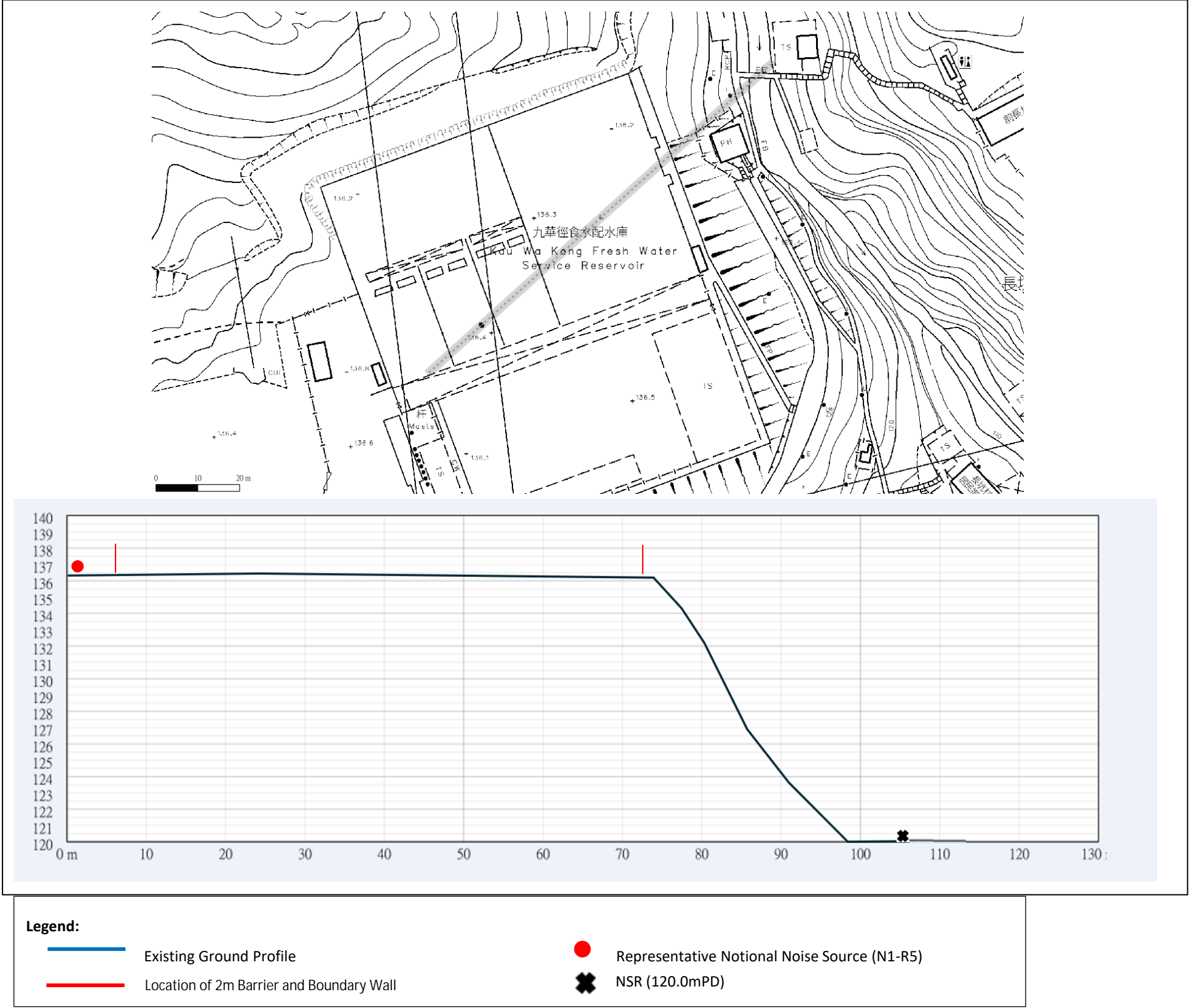
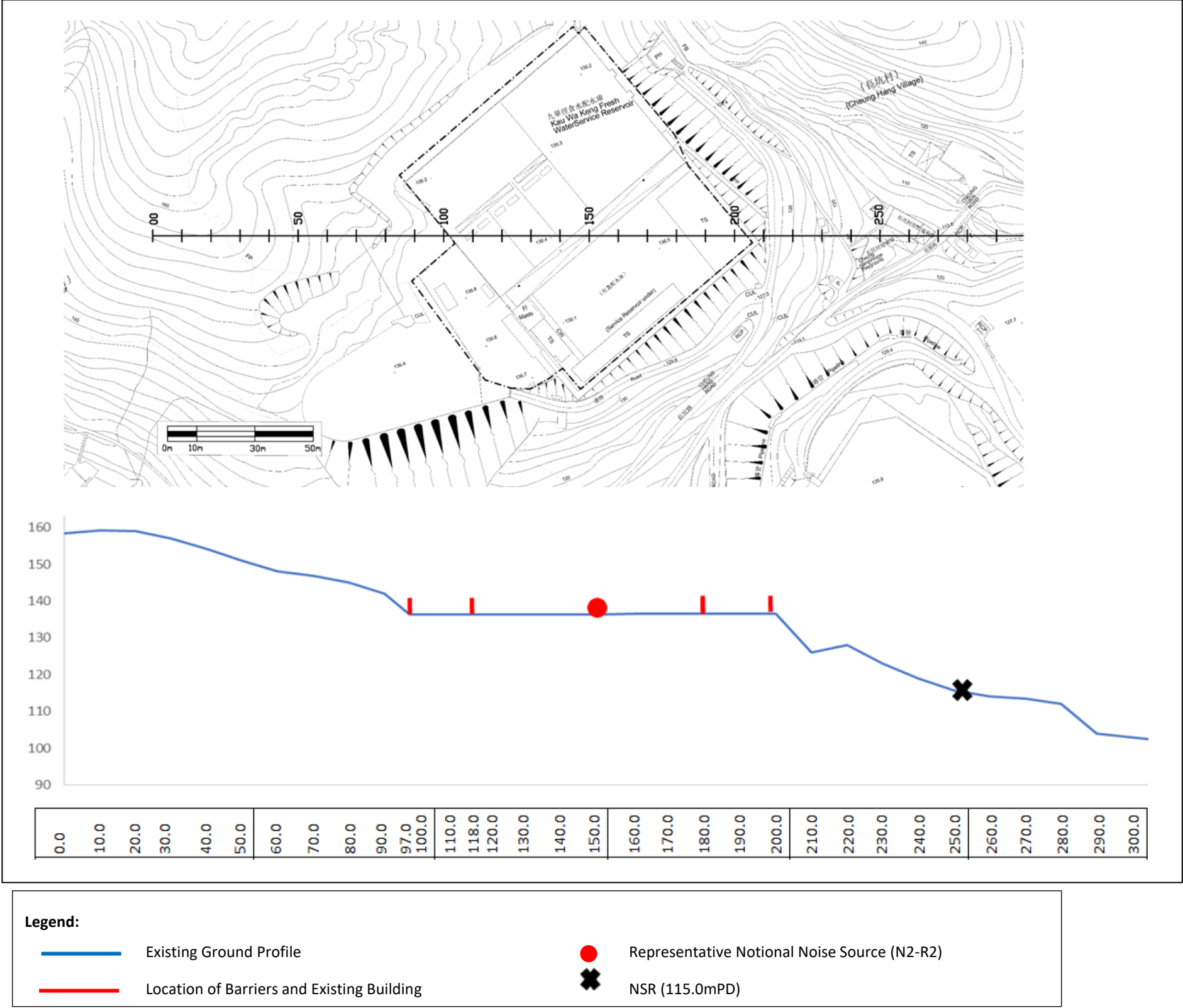


Figure A.2 Cross Section Between NSR 2 and Representative Notional Noise Source (N2-R2)



The barrier attenuation D_z in decibels, shall be calculated for this path by [Formula \(18\)](#) with [Formula \(19\)](#):

$$D_z = 10 \lg \left[1 + \left(2 + \left(\frac{C_2}{\lambda} \right) C_3 z \right) K_{\text{met}} \right] \text{ dB} \quad \text{for } z > z_{\min} \quad (18)$$

and

$$D_z = 0 \text{ dB} \quad \text{for } z \leq z_{\min}$$

with

$$z_{\min} = -2\lambda / (C_2 C_3) \quad (19)$$

where

C_2 is equal to 20, and includes the effect of ground reflections; if in special cases ground reflections are taken into account separately by image sources, $C_2 = 40$;

C_3 is equal to 1 for single diffraction ($e = 0$);

C_3 is calculated by [Formula 20](#) for multiple diffraction;

e is the length of the ray path between the first diffracting edge behind the source and the last diffracting edge in front of the receiver in case of more than one diffracting edge, expressed in metres. In case of one single diffracting edge e equals zero;

λ is the wavelength of sound at the nominal mid-band frequency of the octave band, expressed in metres;

z is the difference between the path lengths of diffracted and direct sound, as calculated by [Formulae \(22\)](#) or [\(24\)](#), expressed in metres;

K_{met} is the correction factor for meteorological effects, given by [Formula \(21\)](#).

$$C_3 = \left[1 + (5\lambda / e)^2 \right] / \left[\left(\frac{1}{3} \right) + (5\lambda / e)^2 \right] \quad (20)$$

$$K_{\text{met}} = \exp \left\{ - (1 / 2000) \sqrt{[\max(d_{\text{SS}}, d_{\text{SR}}) + e] \cdot \min(d_{\text{SS}}, d_{\text{SR}}) \cdot d / [2(z - z_{\min})]} \right\} \quad (21)$$

where

d_{SS} is the length of the ray path from the source to the (first) diffraction edge, expressed in metres (S-E₁ in [Figure 9](#));

d_{SR} is the length of the ray path from the (last) diffraction edge to the receiver, expressed in metres (E₄-R in [Figure 9](#));

d is the distance from the source to the receiver; expressed in metres (S-R in [Figure 9](#)).

For lateral diffraction around obstacles, it shall be assumed that $K_{\text{met}} = 1$.

With example [Figures 8](#) and [9](#) the first and last diffracting edges are E₁ and E₄ - e is consequently the sum of the lengths E₁-E₂, E₂-E₃ and E₃-E₄.

The path length difference shall be calculated by means of [Formula \(22\)](#):

$$z = (d_{\text{SS}} + d_{\text{SR}} + e) - d \quad (22)$$

If the line of sight between the source S and receiver R passes above the top edge of a single barrier, z is given a negative sign.

If the direct line of sight is not blocked and the ray surpasses more edges E_n along the profile S-R, the largest value determines the relevant path length difference according to [Formula \(23\)](#):

$$z = \max(z_n) \quad (23)$$

where z_n is the negative path length difference to the edge n and where all edges under the propagation path are included to find the maximum value with [Formula \(22\)](#) with e equal 0.

APPENDIX F

Sample Noise Barrier Material Specification

KINETICS®

Sound Absorber/Noise Barrier

Composites

Model KBC

Description

Kinetics KBC Sound Absorber/Noise Barrier Composites are thin, rugged, high-performing, flexible acoustical quilt and vinyl composites designed to solve noise control applications where sound absorption and sound blocking must be increased. KBC composites are available with 0.50, 1.0, or 2.0 psf (2.5, 4.9 or 9.8 kg/m²) mass loaded vinyl barriers with a quilted aluminum cloth faced fiberglass absorber on one or both sides of the barrier.

KBC-50RBQ and 100RBQ are used when a noise source is located on one side of the acoustical material. Sound originating from the source is initially absorbed by the quilted fiberglass and then blocked by the vinyl barrier. The reflected sound waves are further dissipated by the fiberglass absorber.

KBC-50BQQ, 100BQQ, and 200BQQ perform in the same manner except that they are designed to absorb sound on both sides of the composite, with one side acting as a decoupling layer.

Kinetics KBC Composites can be installed free hanging or attached directly to a noise-radiating surface. KBC-50BQQ, 100BQQ, and 200BQQ are ideal as an internal lining on any rigid structure that requires significant transmission loss improvement. In this manner, the limp mass vinyl barrier is decoupled from the structure by the fiberglass absorber which allows the barrier to vibrate freely thus increasing sound transmission loss performance.



Application

KBC Sound Absorber/Noise Barrier Composites are ideal for many diverse industrial and OEM applications where both reverberation control and sound transmission loss are required. Industrial applications include enclosures, machinery cover linings, and additions to existing walls or barriers. Architectural applications include crosstalk barriers, room dividers, ceiling barriers, and pipe and duct wrap.

Specification

Sound Absorber/Noise Barrier composites shall be of the description and acoustical data listed in this brochure. Absorber/Barrier composites shall be model KBC by Kinetics Noise Control.

Sound Transmission Loss (dB)

ASTM E90-90

Product	Weight		Frequency (Hz)						
	lb/ft ²	kg/m ²	125	250	500	1000	2000	4000	STC*
KBC-50RBQ	0.7	3.4	6	12	17	27	38	46	23
KBC-100RBQ	1.3	6.4	10	16	22	30	42	49	27
KBC-50BQQ	1.0	4.9	7	12	18	31	46	50	24
KBC-100BQQ	1.5	7.4	11	16	28	41	50	53	29
KBC-200BQQ	2.5	12.5	16	20	30	40	51	55	33

*Per ASTM designation E413-87

Absorption Characteristics

Product	Octave Band Frequency (Hz)						
	125	250	500	1000	2000	4000	NRC
Q - 1" Quilt	0.12	0.47	0.85	0.84	0.64	0.62	0.70
Q2 - 2" Quilt	0.08	0.33	0.79	1.02	1.04	1.02	0.80

Product Types

KBC-50RBQ 0.50 psf (2.5 kg/m²) Limp Barrier Material, reinforced with a fiberglass screen, loaded with barium sulphate, with a quilted faced fiberglass absorber on one side. The barrier and absorber are silver in color. Available in 54" x 25' (1.37m x 7.62m) rolls. Nominal thickness 1" (25mm).

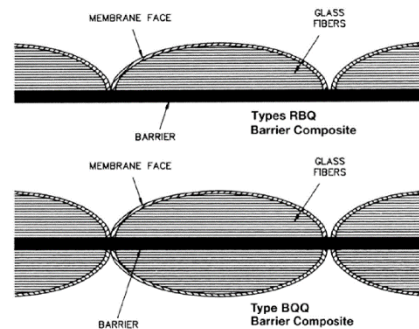
KBC-100RBQ 1.0 psf (4.9 kg/m²) Limp Barrier Material, reinforced with a fiberglass screen, loaded with barium sulphate, with a quilted faced fiberglass absorber on one side. The barrier and absorber are silver in color. Available in 54" x 25' (1.37m x 7.62m) rolls. Nominal thickness 1" (25mm).

KBC-50BQQ 0.50 psf (2.5 kg/m²) Limp Barrier Material, loaded with barium sulphate with a quilted faced fiberglass absorber on both sides. The absorber is silver in color. Available in 48" x 25' (1.22m x 7.62m) rolls. Nominal thickness 2" (51 mm).

KBC-100BQQ 1.0 psf (4.9 kg/m²) Limp Barrier Material, loaded with barium sulphate, with a quilted faced fiberglass absorber on both sides. The absorber is silver in color. Available in 48" x 25' (1.22m x 7.62m) rolls. Nominal thickness 2" (51 mm).

KBC-200BQQ 2.0 psf (9.8 kg/m²) Limp Barrier Material, loaded with barium sulphate, with a quilted faced fiberglass absorber on both sides. The absorber is silver in color. Available in 48" x 12.5' (1.22m x 7.62m) rolls. Nominal thickness 2" (51 mm).

Vinyls and fiberglass facings are available in other colors. Consult Kinetics Noise Control for availability.



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APPENDIX G

Sample Daily Shooting Record Sheet

Kau Wah Keng Shooting Range

Daily Shooting Record Sheet

Date: _____

[illegible]

Bullet Head Recovered (numbers):

Range Officer Name:

Cartridge Casings Recovered (numbers):

Range Officer Signature:

Total Weight of Shooting Waste (kg):