

Environmental Permit No. FEP-01/571/2019/C

Proposed Golf Course Development at Tai Po Lot No. 246 Shuen Wan

Environmental Team Leader Certification

Reference Document

Document to be Certified: Updated Construction Phase Landfill Gas Hazard Assessment

Date of Report: February 2026

Date received by ETL: 25 February 2026

Reference EP Condition

Environmental Permit Condition: 2.22

The Permit Holder shall, at least three months before the commencement of construction of the Project, submit to the Director for approval four hard copies and one electronic copy of an Updated Construction Phase Landfill Gas Hazard Assessment (Updated CPLFGHA), which shall include a review of the qualitative landfill gas hazard assessment in the approved EIA report (Register No. AEIAR-221/2019), preparation of a detailed and updated qualitative landfill gas hazard assessment and associated mitigation measures related to the interfacing and modification works of the existing landfill restoration facilities, preparation of detailed design of gas protection measures and the establishment of maintenance and monitoring programmes to ensure the continued performance of the proposed control measures for construction phase of the Project. The Updated CPLFGHA shall take into account the recommendations of the approved Design Plan and the approved Works Plan in Conditions 2.20 and 2.21 of this Permit respectively. The Updated CPLFGHA shall be certified by ET Leader and verified by the IEC as conforming to the findings and recommendations of the approved EIA Report (Register No. AEIAR-221/2019) for approval of the Director. All recommendations in the approved Updated CPLFGHA shall be fully implemented during construction phase of the Project.

ETL Certification

I hereby certify that the above reference report complies with the above referenced condition of FEP-01/571/2019/C.



Mr. Calvin Leung
Environmental Team Leader

Date: 26 February 2026

Environmental Permit No. FEP-01/571/2019/C

Proposed Golf Course Development at Tai Po Lot No. 246 Shuen Wan

Independent Environmental Checker Verification

Reference Document

| | |
|--------------------------|---|
| Document to be Verified: | Updated Construction Phase Landfill Gas Hazard Assessment |
| Date of Report: | February 2026 |
| Date received by IEC: | 25 February 2026 |

Reference EP Condition

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IEC Verification

I hereby verify that the above reference report complies with the above referenced condition of FEP-01/571/2019/C.



Mr. Adi Lee
Independent Environmental Checker

Date: 26 February 2026

Tai Po Golf Club Limited

Proposed Golf Course Development at Tai Po Lot No. 246 Shuen Wan

Updated Construction Phase Landfill Gas Hazard Assessment

Reference: 289499-REP-023-04

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 289499

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Appendices

Appendix 1.1

Figure 1 in FEP-571/2019/C

Appendix 2.1

Figure 9.1 of the approved EIA Report

Appendix 3.1

Implementation Schedule of Precautionary and Protective Measure for Landfill Gas Hazard

1. Introduction

1.1 Project Background

- 1.1.1.1 In June 2017, the Chief Executive in Council has agreed in principle to the government proposal to grant a piece of land in Tai Po in exchange for its private land in Sha Lo Tung which has high ecological values. Under the non-in-situ land exchange proposal, the piece of land at the Shuen Wan Restored Landfill in Tai Po will be granted and the Sha Lo Tung site would be considered by government for active conservation management to avoid degradation and damage for long-term public enjoyment. This land exchange proposal is a unique, exceptional and isolated case, adding the idea is technically feasible as the private land ownership is largely unified under one entity and both Sha Lo Tung and the land at the landfill site, which has been planned for golf course development, are located in Tai Po, as shown in Figure 1 of FEP-01/571/2019/C (extracted as **Appendix 1.1**). The non-in-situ land exchange proposal has been completed in July 2022, and the Project Site has been handed over to the Project Proponent (PP).
- 1.1.1.2 The Project is a Designated Project (DP) under Environmental Impact Assessment Ordinance (EIAO), and an Environmental Impact Assessment (EIA) study was conducted in 2017. The *Shuen Wan Golf Course EIA Report* was approved by the Director of Environmental Protection (DEP) on 5 July 2019 (AEIAR-221/2019) (“the approved EIA Report”) with the Environmental Permit (EP, EP-571/2019) issued on 20 September 2019. An application of Further Environmental Permit (FEP) has been made by Tai Po Golf Club Limited (the PP) and FEP was issued on 29 November 2022 (FEP-01/571/2019). Besides, surrender of EP-571/2019 has been applied and approved on 9 December 2022. In addition, an application for variation of EP has been made on 16 May 2023 to amend FEP-01/571/2019, and the amended EP was issued on 6 June 2023 (FEP-01/571/2019/A). Moreover, an application for variation of EP has been made on 4 August 2025 and approved on 2 September 2025 (FEP-01/571/2019/B). Another application for variation of EP has been made on 14 January 2026 and approved on 12 February 2026 (FEP-01/571/2019/C).
- 1.1.1.3 As stipulated in Condition 2.22 of FEP-01/571/2019/C, the Permit Holder shall, at least three months before the commencement of construction of the Project, submit to the DEP for approval four hard copies and one electronic copy of an Updated Construction Phase Landfill Gas Hazard Assessment (Updated CPLFGHA), which shall include a review of the qualitative landfill gas hazard assessment in the approved EIA Report, preparation of a detailed and updated qualitative landfill gas hazard assessment and associated mitigation measures related to the interfacing and modification works of the existing landfill restoration facilities, preparation of detailed design of gas protection measures and the establishment of maintenance and monitoring programmes to ensure the continued performance of the proposed control measures for construction phase of the Project. The Updated CPLFGHA shall take into account the recommendations of the approved Design Plan and the approved Works Plan in Conditions 2.20 and 2.21 of the EP respectively. The Updated CPLFGHA shall be certified by Environmental Team (ET) Leader and verified by the Independent Environmental Checker (IEC) as conforming to the findings and recommendations of the approved EIA Report for approval of DEP. All recommendations in the approved Updated CPLFGHA shall be fully implemented during construction phase of the Project.

1.2 Purpose of the Updated CPLFGHA

1.2.1.1 The Updated CPLFGHA is prepared to comply with Condition 2.22 of FEP-01/571/2019/C. This Updated CPLFGHA contains a review of the qualitative landfill gas hazard assessment in the approved EIA Report, preparation of a detailed and updated qualitative landfill gas hazard assessment and associated mitigation measures related to the interfacing and modification works of the existing landfill restoration facilities, preparation of detailed design of gas protection measures, the establishment of maintenance and monitoring programmes to ensure the continued performance of the proposed control measures for construction phase of the Project, and the recommendations of the approved Design Plan and the approved Works Plan of the EP respectively.

1.3 Structure of the Updated CPLFGHA

1.3.1.1 The structure of the Updated CPLFGHA is given below:

- Section 1** Introduces the project background, purposes and structures of this Updated CPLFGHA.
- Section 2** Describes the relevant legislation, standards and guidelines applicable to the assessment.
- Section 3** Describes the details of the methodology of qualitative risk assessment in construction phase, as well as evaluates and provides recommendations with the assessment results.
- Section 4** Summarises and concludes the findings

2. Legislation, Standards and Guidelines

2.1 General

2.1.1.1 The relevant legislation, standards and guidelines applicable to the present study for the assessment of landfill gas (LFG) hazards include:

- Section 1.1 (f) in Annex 7 of Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM);
- Section 3.3 in Annex 19 of EIAO-TM;
- Landfill Gas Hazard Assessment Guidance Note (1997) (EPD/TR8/97); and
- Landfill Gas Hazard Assessment for Developments adjacent to Landfills (ProPECC PN3/96).

2.1.1.2 These legislation and guidelines recommended that in general, a qualitative assessment of the risk posed by LFG is required for a development which is proposed within a 250m “Consultation Zone” around any landfill site, to ensure appropriate precautionary measures would be designed and implemented to safeguard the development.

2.2 Potential Hazard and Properties of LFG

2.2.1.1 Methane is odourless and colourless, and typically associated with numerous highly odoriferous compounds in LFG which will give some warning of its presence. However, the absence of odour should not be taken to mean that no methane gas is present – this can only be confirmed by using appropriately calibrated methane detectors. Methane is a flammable gas and will burn when mixed with air between approximately 5% and 15% by volume, the Lower Explosive Limit (LEL) and Upper Explosive Limit (UEL) respectively. A mixture of methane and air with a composition between the LEL and UEL ignited in a confined space could lead to an explosion. Methane is also an asphyxiant.

2.2.1.2 Carbon dioxide, which is another major component of LFG, could induce asphyxia and adverse health effects. The long-term eight-hour Occupational Exposure Limit (OEL) is 0.5% by volume. Similar to methane, it is also odourless and colourless, and can only be detected by using appropriately calibrated detectors.

2.2.1.3 Gas buoyancy: Methane is lighter than air whereas carbon dioxide is heavier than air. Typical mixtures of LFG are likely to have a density close to or equal to that of air. However, site conditions may result in a ratio of methane to carbon dioxide which may make the gas mixture lighter or heavier than air. As a result, LFG may be concentrated in the bottoms of the trenches or excavations, or may rise up and accumulate beneath structures and foundations.

2.3 Assessment Criteria

2.3.1.1 In accordance with Environmental Protection Department (EPD)’s LFG Hazard Assessment Guidance Note, the risk due to LFG shall be evaluated based upon the following three criteria, each of which is further described as follows:

- Source:** the location, nature and likely quantities/concentrations of LFG which has the potential to affect the Project Site;
- Pathway:** the nature and length of potential pathways through which LFG must pass to reach the Project Site; and
- Target:** the elements of the development which are sensitive to the effects of LFG.

Source

2.3.1.2 The classification of the Source (i.e. the landfill) is determined as follows:

Major: Recently filled landfill site at which there is little or no control to prevent migration of gas or at which the efficacy of the gas control measures has not been assessed; or

Any landfill site at which monitoring has demonstrated that there is significant migration of gas beyond the site boundary.

Medium: Landfill site at which some form of gas control has been installed (e.g. lined site or one where vents or barriers have been retrospectively installed) but where there are only limited monitoring data to demonstrate its efficacy to prevent migration of gas; or

Landfill site where comprehensive monitoring has demonstrated that there is no migration of gas beyond the landfill boundary but where the control of gas relies solely on an active gas extraction system or any other single control system which is vulnerable to failure.

Minor: Landfill sites at which gas control have been installed and proven to be effective by comprehensive monitoring which has demonstrated that there is no migration of gas beyond the landfill boundary (or any specific control measures) and at which control of gas does not rely solely on an active gas extraction system or any other single control measure which is vulnerable to failure; or

Old landfill sites where the maximum concentration of methane within the waste, as measured at several locations across the landfill and on at least four occasions over a period of at least 3 months, is less than 5% by volume (v/v).

Pathway

2.3.1.3 Generally, three types of pathways are considered for the transmission of LFG. They are:

- Man-made pathways e.g. utility connections, stormwater channels, etc.;
- Natural pathways such as rock jointing planes, fissures, and other naturally occurring phenomena which may promote or give rise to the transmission of gas over distances; and

- A combination of the previous categories. An example of the latter may be, for instance, where a specific geological feature promotes gas transmission but which stops short of directly linking the landfill and target. A man-made connection, however, may also co-exist near the edge of the geological feature, in combination with the former, may act to link the two sites. In this instance, careful assessment of the likelihood of the mechanism acting to link the two pathways needs to be undertaken before assigning an appropriate pathway classification.

2.3.1.4 The board classification of the pathway is as follows:

| | |
|---------------------------------|--|
| Very short/direct: | Path length of less than 50m for unsaturated permeable strata and fissures rock or less than 100m for man-made conduits. |
| Moderately short/direct: | Path length of 50 to 100m for unsaturated permeable soil or fissured rock or 100 to 250m for man-made conduits. |
| Long/indirect: | Path length of 100 to 250m for unsaturated permeable soil and fissured rock. |

2.3.1.5 In classifying the pathway, however, adjustment to the above general guidelines will often be required to take account of other factors which will affect the extent of gas migration including the following:

- particular permeability of the soils;
- spacing, tightness and direction of the fissures/joints;
- topography;
- depth and thickness of the medium through which the gas may migrate (which may be affected by groundwater level);
- the nature of the strata over the potential pathway;
- the number of different media involved; and
- depth to groundwater table and flow patterns.

Target

2.3.1.6 Different types of targets may be broadly classified as follows:

Highly Sensitivity: Buildings and structures with ground level or below ground rooms/voids or into which services enter directly from the ground and to which members of the general public have unrestricted access or which contain sources of ignition.

This would include any developments where there is a possibility of additional structure being erected directly on the ground on an ad hoc basis and thereby without due regard to the potential risks.

Medium Sensitivity: Other buildings, structures or service voids which are accessed only by authorised, well-trained personnel, such as

the staff of utility companies, who have been briefed on the potential hazards relating to LFG and the specific safety procedures to be followed.

Deep excavations.

Low Sensitivity:

Buildings and structures which are less prone to gas ingress by virtue of their design (such as those with a raised floor slab).

Shallow excavations.

Developments which involve essentially outdoor activities but where evolution of gas could pose potential problems.

2.3.1.7 The above categories should be used as a general guide only and particular aspects of a building or development may render it more or less sensitive than indicated. Account should be taken of any particular circumstances when assigning a target to one of the three indicated categories.

2.3.1.8 Following the determination of the categories of source, pathway and target in which the combination of landfill, pathway and development fall, a qualitative assessment of the overall risk is undertaken with reference to **Table 2.1**. The potential implications associated with the various qualitative risk categories are summarised in **Table 2.2**.

Table 2.1 Classification of Risk Categories

| Source | Pathway | Target | Risk Category |
|--------|-----------------------|--------|---------------|
| Major | Very short/direct | High | Very high |
| | | Medium | High |
| | | Low | Medium |
| | Moderate short/direct | High | High |
| | | Medium | Medium |
| | | Low | Low |
| | Long/indirect | High | High |
| | | Medium | Medium |
| | | Low | Low |
| Medium | Very short/direct | High | High |
| | | Medium | Medium |
| | | Low | Low |
| | Moderate short/direct | High | High |
| | | Medium | Medium |
| | | Low | Low |
| | Long/indirect | High | Medium |
| | | Medium | Low |
| | | Low | Very low |
| Minor | Very short/direct | High | High |
| | | Medium | Medium |

| Source | Pathway | Target | Risk Category |
|--------|-----------------------|--------|---------------|
| | Moderate short/direct | Low | Low |
| | | High | Medium |
| | | Medium | Low |
| | | Low | Very low |
| | Long/indirect | High | Medium |
| | | Medium | Low |
| | | Low | Very low |

Table 2.2 General Categorisations of Risks

| Category | Level of Risk | Implication |
|----------|--------------------------|--|
| A | Very high (undesirable) | The type of development being proposed is very undesirable and less sensitive form of development should be considered. At the very least, extensive engineering measures, alarm systems and emergency action plans are likely to be required. |
| B | High | Significant engineering measures will be required to protect the planned development. |
| C | Medium | Engineering measures will be required to protect the proposed development. |
| D | Low | Some precautionary measures will be required to ensure that the planned development is safe. |
| E | Very low (insignificant) | The risk is so low that no precautionary measures are required. |

2.3.1.9 Five generic forms of protection will be used in mitigating the hazards to developments. These generic forms corresponding to the five risk levels are set out in **Table 2.3**. The terms used in **Table 2.3** are defined in **Table 2.4**.

Table 2.3 Generic Protection Measures for Planning Stage Categorisation

| Category | Generic Protection Measures |
|----------|--|
| A | For the planned development active control of gas, supported by barriers and detection systems. Another, less sensitive form of development should also be considered. |
| B | Active control of gas, including barriers and detection systems ^[1] |
| C | Use of “semi-active” or enhanced passive controls. Detection systems in some situations. |
| D | Passive control of gas only. |
| E | No precautionary measures required. |

Note:

[1] The gas protection measures required to allow the safe development of Category A risk development will need to be more extensive than those for a Category B risk development.

Table 2.4 Definitions of Control Terms

| Term | Definition |
|-----------------------|---|
| Active control | Control of gas by mechanical means e.g. ventilation of spaces with air to dilute gas, or extraction of gas from the development site using fans or blowers. |
| “Semi-active control” | Use of wind driven cowls and other devices which assist in the ventilation of gas but do not rely on electrically powered fans. |

| Term | Definition |
|-------------------|---|
| Passive control | Provision of barriers to the movement of gas e.g. membranes in floors or walls, or in trenches, coupled with high permeability vents such as no-fines gravel in trenches or voids/permeable layers below structures. |
| Detection systems | Electronic systems based upon, for example, catalytic oxidation or infra-red measurement principles, which can detect low concentrations of gas in the atmosphere and can be linked to alarms and/or telemetry systems. |

3. Qualitative Risk Assessment in Construction Phase

3.1 Assessment Methodology

3.1.1.1 In accordance with the procedures recommended in LFG Hazard Assessment Guidance Note and the EIA Study Brief (ESB-303/2017), the following tasks have been undertaken in the approved EIA Report to allow a full consideration of the potential risk of LFG from the Shuen Wan Restored Landfill to the proposed golf course. During current detailed design stage, qualitative LFG hazard assessment during construction phase in the approved EIA Report has been reviewed and updated accordingly.

- Review of background information (including LFG monitoring data, if any) and studies related to the Shuen Wan Restored Landfill;
- Identification of the nature and extent of the sources, including the likely concentrations/amounts of hazardous emissions which might have the potential for causing impacts on the Project;
- Identification of possible pathways through the ground, underground cavities, utilities or groundwater, and the nature of these pathways through which hazardous emissions must traverse if they were to reach the facilities within the Project Site during construction phase;
- Identification of the potential targets associated with the Project during construction phase which are sensitive to the impacts of the hazardous emissions;
- Qualitative assessment on the degree of risk which the hazardous emissions may pose to the target for each of the source-pathway-target combinations;
- Design of suitable level of precautionary measures and types of protection measures and emergency procedures for the construction of the development proposed under the Project; and
- Identification of monitoring requirements for assessing the adequacy and performance of the implemented protection measures.

3.2 Desktop Study

3.2.1.1 The information and documents which have been used as background materials for the preparation of this assessment include the following:

- Hong Kong Geological Survey Map (HGM20 series scale 1:20,000) (1986);
- Geotechnical Review for Restored Shuen Wan Landfill - Final Geotechnical Assessment Report (2011) provided by EPD; and
- LFG monitoring data for the Shuen Wan Landfill - Annual Environmental Audit Reports (from 2012 to 2021) provided by EPD;
- Approved EIA report for the Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong (AEIAR-071/2003);
- Approved EIA report for Tai Po Sewage Treatment Works Stage V (AEIAR-081/2004);
- Approved EIA report for Shuen Wan Golf Course (AEIAR-221/2019); and

- Approved EIA report for Upgrading of Tai Po Sewage Treatment Works (AEIAR-244/2022).

History of Shuen Wan Restored Landfill

- 3.2.1.2 The Project Site is approximately 53ha (**Appendix 1.1**). It is bounded by Ting Kok Road to the north, Fortune Garden to the northeast, Tai Po Industrial Estate (TPIE) to the west and Tolo Harbour to the east and south.
- 3.2.1.3 The Project Site was once part of the Tolo Harbour before 1970s. In the early 1970s, the Project Site was progressively reclaimed for the subsequent landfilling activities. The Shuen Wan Restored Landfill was opened for the reception of waste in 1973 and closed in 1995.
- 3.2.1.4 Subsequent to the closure of the landfill site, the restoration works for Shuen Wan Landfill commenced in December 1996 and was completed in December 1997. The 250m Consultation Zone of Shuen Wan Restored Landfill is shown in Figure 9.1 of the approved EIA Report (extracted as **Appendix 2.1**). Since then, monthly environmental monitoring (e.g. LFG, groundwater, leachate, surface water, etc.) and annually environmental audit have been conducted.
- 3.2.1.5 The Defect Correction Period commenced in January 1998 and ended in December 1998. The Aftercare Period commenced in December 1998 and will end in December 2027. EPD's Landfill Operator has been maintaining the existing landfill facilities, including management systems for LFG and leachate, etc. and will continue the environmental monitoring on landfill restoration works, e.g. LFG and leachate, etc. during construction and operational phases of the Project until Year 2027. Part of the Shuen Wan Restored Landfill has been serving as a 145-bay golf driving range for public use since Year 1999 and ceased operation in Year 2022.
- 3.2.1.6 After the handover of Project Site to the PP in July 2022, the Project Site is currently vacant.

Restoration Facilities

- 3.2.1.7 The restoration facilities for Shuen Wan Landfill mainly consist of landfill capping layer, LFG management system and leachate management system as described below:
- i) Landfill Capping Layer
- 3.2.1.8 According to the as-built drawings of Shuen Wan Restored Landfill, the components of the landfill capping layer include the following (from top to bottom):
- An approximately 800mm – 850mm thick soil layer of general cover, hydroseeded to act as the growing medium;
 - A geocomposite drainage layer consists of filtration geotextile, high density polyethylene (HDPE) geonet, very flexible polyethylene (VFPE) geomembrane and cushion geotextile; and
 - A 500mm thick final intermediate soil cover.

ii) LFG Management System

3.2.1.9 According to the as-built drawings of Shuen Wan Restored Landfill, the LFG management system consists of active gas extraction wells, LFG utilisation plant, flaring system for LFG, passive vent trenches/pipes and monitoring of LFG both on site and off site.

3.2.1.10 Active gas extraction from the waste is used to relieve the pressure build-up in the waste to prevent LFG from migrating off site laterally or vertically. The extracted LFG is delivered to the Hong Kong and China Gas Company Limited (HKGC) Tai Po Gas Production Plant through the LFG utilisation plant for town gas production. However, when LFG utilisation plant is under maintenance, flaring system will be switched from standby mode to active mode for LFG treatment. Meanwhile, passive vent trenches and pipes use existing variations in landfill pressures and gas concentrations to vent LFG. In addition, methane and carbon dioxide are monitored by the Gas Monitoring Probes (GMPs) on a monthly basis.

iii) Leachate Management System

3.2.1.11 The leachate management system consists of the active leachate extraction system, leachate collection chambers and the Leachate Pre-treatment Works.

3.2.1.12 The active leachate extraction system is used to pump the leachate from the platform and slopes to the leachate collection chambers. Three leachate collection chambers are located on the perimeter of the site. They collect the leachate intercepted by both peripheral drains beneath part of the capping layers at 30mPD, 40mPD and 38mPD platforms and side slope, followed by a series of horizontal sub-drains. The leachate collected in the chambers is pumped to the Leachate Pre-treatment Works and subsequently conveyed to the Tai Po Sewage Treatment Works for treatment.

3.3 Source

3.3.1.1 As part of the Shuen Wan Landfill Restoration Contract, a comprehensive monitoring programme commenced in December 1996 and is still being implemented on a monthly basis until Year 2027 when the restoration contract ends.

3.3.1.2 According to the Annual Environmental Audit Report (i.e. from 2012 to 2021), a LFG monitoring system, including 22 multiple-level and 28 single-level GMPs, has been installed and monitoring the levels of methane (CH₄) and carbon dioxide (CO₂) within and along the boundary of Shuen Wan Restored Landfill. Monitoring data during the course of January 2012 and December 2021 obtained from EPD have been reviewed. No methane gas was detected at any multiple-level or single-level monitoring well from January 2012 to December 2021. The carbon dioxide levels were ranged from 0 to 7.4% v/v during the period and were all below 8.6% v/v (i.e. 1.5% v/v above the natural background of 7.1% v/v) in these ten years. According to the Annual Environmental Audit Reports in the respective reporting years, the occasionally high levels of carbon dioxide measured were unlikely caused by migration of LFG from the Shuen Wan Restored Landfill. Instead, it is more likely generated by other means such as plant roots or calcium oxide beneath the ground.

- 3.3.1.3 Surface methane has also been monitored quarterly for the entire Shuen Wan Restored Landfill. According to the Annual Environmental Audit Reports, the methane concentrations fluctuated within the range of 1.0 to 9.8ppm, which are much lower than the target limit of 10,000ppm (1% v/v), from Year 2012 to Year 2021.
- 3.3.1.4 Furthermore, multiple LFG control measures, including landfill capping layer, passive vent trenches/pipes and active LFG extraction system, have been installed in Shuen Wan Restored Landfill to prevent any unintended migration of LFG and are regarded as fail safe. Comprehensive monitoring has been undertaken by EPD's Landfill Operator for the Shuen Wan Restored Landfill.
- 3.3.1.5 In summary, no methane was detected at any GMP of Shuen Wan Restored Landfill, whilst carbon dioxide levels at all LFG monitoring locations were in compliance with the Standard Compliance Level during the course of January 2012 and December 2021. Meanwhile, multiple LFG control measures, such as landfill capping layer, passive vent trenches/pipes and active LFG extraction system, have been installed in Shuen Wan Restored Landfill.
- 3.3.1.6 However, according to Landfill Gas Hazard Assessment Guidance Note, the monitoring criterion for carbon dioxide is 1.5% v/v, at which the historical monitoring data in past 10 years would occasionally exceed. As a conservative assessment, the Shuen Wan Restored Landfill is classified as **Medium**.

3.4 Pathway

Natural Pathway

- 3.4.1.1 In accordance with Geotechnical Review for Restored Shuen Wan Landfill (2011), the geological formation beneath Shuen Wan Landfill mainly comprises reclamation fill, underlain by Quaternary superficial deposits of fine and medium marine sands, debris flow deposits, alluvium and fill. Further, no major fault lines or fissures have been identified across the Shuen Wan Restored Landfill for migration of LFG.
- 3.4.1.2 As the Project is located right above the Shuen Wan Restored Landfill, the potential natural pathway for LFG migration is categorised as **Very Short/Direct**.

Man-made Pathway

- 3.4.1.3 According to the approved EIA Report, existing utilities and services directly linking Shuen Wan Restored Landfill and the Project Site were reviewed based on the utility layout plans provided by Hong Kong and China Gas Company Limited, Water Supplies Department, HGC Global Communications Limited, Hong Kong Telecommunications Limited and Hong Kong Broadband Network. Utility pipelines within Shuen Wan Restored Landfill are also reviewed from the as-built drawings of Shuen Wan Restored Landfill.
- 3.4.1.4 According to the approved EIA Report, existing underground utilities, including power cables, water pipelines and utility pipelines can be found within and around the boundary of the Project Site. It is therefore concluded that the Shuen Wan Restored Landfill, the potential man-made pathway for LFG migration is categorised as **Very Short/Direct**.

Combination of Natural and Man-made Pathways

- 3.4.1.5 The potential pathway of LFG migration from the source to the targets of the Project can be a combination of natural strata (i.e. the natural pathways) and subsequently through man-made facilities such as utilities connections (i.e. the man-made pathways).
- 3.4.1.6 This mode of transmission generally requires a series of events to occur in order for gas to potentially affect the Project. The path length for the migration of LFG by a combination of natural and man-made pathways is generally much longer than the direct distance between the source and the target. However, the target is located right atop or adjacent to the Shuen Wan Restored Landfill. The potential combination of natural and man-made pathway for LFG migration is therefore categorised as **Very Short/Direct**.

3.5 Target

- 3.5.1.1 As the Project Site is located atop the Shuen Wan Restored Landfill, construction works will be undertaken within the Consultation Zone. The construction works associated with the Project include:
- tree felling;
 - site formation (including excavation and filling);
 - modification of existing LFG and leachate collection system;
 - relocation/modification of the leachate pumping chamber;
 - relocation of passive vents and groundwater monitoring wells;
 - road works and utilities installation;
 - civil and electrical and mechanical (E&M) works for buildings (including car park) and ancillary facilities (e.g. plant rooms and water storage tanks); and
 - temporary site office.
- 3.5.1.2 During construction phase, excavation may be required and the areas of confined spaces and trenches are especially at a higher risk to the exposure of LFG. In addition, indoor construction workers working in buildings and ancillary facilities such as plant rooms and water storage tanks may also at risk to the exposure of LFG.
- 3.5.1.3 Nevertheless, during the construction phase, the Project Site would only be accessible by authorised, well-trained personnel who would have been briefed on the potential hazards relating to LFG and the specific safety procedures to be followed. As such, the sensitivity of construction workforce is considered as **Medium Sensitive**.

3.6 Evaluation of Potential Impacts on Targets

- 3.6.1.1 With all the information regarding the sources, pathways and receivers identified in the previous sections, a qualitative risk assessment of LFG hazards during the construction phase is summarised in **Table 3.1**.

Table 3.1 Qualitative Risk Assessment of LFG Hazards in the Construction Phase

| Source | Pathway | Target | Risk |
|---|--|-----------------------------|---------------|
| Shuen Wan Restored Landfill as LFG source: Medium Source | Natural: Very Short/Direct Man-made: Very Short/Direct Combined natural and man-made pathway: Very Short/Direct | Project Site: Medium | Medium |

3.7 Recommended Precautionary and Protective Measures on Targets

3.7.1.1 The source-pathway-target analysis as summarised in **Table 3.1** has concluded that the overall risk level is **Medium** for the Project Site. With reference to **Table 2.3** and **Table 2.4**, for medium risk targets, engineering measures would be required to protect the Project Site which includes the use of “semi-active”, enhanced passive gas controls and/or detection systems in some situations.

3.7.1.2 The following sections provide general advice and recommendations for the avoidance of environmental impacts related to LFG during the construction phase. Where applicable, specific measures for handling the hazards identified during the construction phase will also be addressed to further reduce the likelihood of incidents and increase the level of the safety to the workers. The implementation schedule of the recommended precautionary and protective measures is summarised in **Appendix 3.1**.

General Hazards which may be Encountered

3.7.1.3 The PP should be aware of, and should inform the Contractors accordingly, that methane and carbon dioxide are always likely to be present in soil voids. In addition, the PP should be aware of the hazards of LFG.

Outline of Safety Requirements

3.7.1.4 During construction, safety procedures should be implemented to minimise the risk of:

- fires and explosions;
- asphyxiation of workers; and
- toxicity effects.

3.7.1.5 Precautions should be clearly laid down and rigidly adhered to with respect to:

- trenching and excavation; and
- creation of confined spaces at, near to or below ground level.

3.7.1.6 In addition to normal site safety procedures, gas detection equipment and appropriate breathing apparatus should be available and used when entering confined spaces or trenches deeper than 1 metre.

Additional General Requirements

i) Appointment of Safety Officer

3.7.1.7 A Safety Officer trained in the use of gas detection equipment and LFG related hazards should be present on site throughout the ground works phase. The Safety Officer should be provided with an intrinsically safe portable instrument, which is appropriately calibrated and able to measure the following gases in the ranges indicated below:

Methane 0-100% LEL and 0-100% v/v

Carbon dioxide 0-100%

Oxygen 0-21%

ii) Safety Measures

3.7.1.8 All personnel who work on site and all visitors to the site should be made aware of the possibility of ignition of gas in the vicinity of the excavations. Safety notices should be posted warning of the potential hazards.

3.7.1.9 Those staff who work within the Consultation Zone, should receive appropriate training on working in areas susceptible to LFG, fire and explosion hazards.

3.7.1.10 An excavation procedure or code of practice to minimise LFG related risk should be devised and carried out by the Safety Officer.

3.7.1.11 No worker should be allowed to work alone at any time in or near to any excavation. At least one other worker should be available to assist with a rescue if needed.

3.7.1.12 Smoking, naked flames and other sources of ignition should be prohibited within 15m of any excavation or ground-level confined space. “No Smoking”, “No Naked Flame” and “Potential Hazard of Landfill Gas” notices in Chinese and English should be posted prominently around the Project Site.

3.7.1.13 Welding, flame-cutting or other hot works should be confined to open areas at least 15m from any trench or excavation.

3.7.1.14 Welding, flame-cutting or other hot works may only be carried out in trenches or confined spaces when controlled by a “permit to work” procedure, properly authorised by Safety Officer.

3.7.1.15 The permit to work procedure should set down clearly the requirements for continuous monitoring for methane, carbon dioxide and oxygen throughout the period during which the hot works are in progress. The procedure should also require the presence of the Safety Officer, in attendance outside the confined area, who shall be responsible for reviewing the gas measurements as they are made, and who shall have executive responsibility for suspending the work in the event of unacceptable or hazardous conditions. Only those workers who are appropriately trained and fully aware of the potentially hazardous conditions which may arise should be permitted to carry out hot works in confined areas.

- 3.7.1.16 Ground level construction plant should be fitted with vertical exhausts at least 0.6m above ground level and with spark arrestors.
- 3.7.1.17 Any electrical equipment, such as motors and extension cords, should be intrinsically safe.
- 3.7.1.18 During piping assembly or conduiting construction, all valves/seals should be closed immediately after installation. As construction progresses, all valves/seals should be closed as installed to prevent the migration of gases through the pipeline/conduit. All piping/conduiting should be capped at the end of each working day.
- 3.7.1.19 Temporary facilities such as mobile site offices, equipment stores, mess rooms, etc. should be raised clear of the ground and provided with regular gas detection. If buildings are raised clear of the ground, a minimum, clear separation distance (as measured from the highest point on the ground surface to the underside of the lowest floor joist) should be 500mm.
- 3.7.1.20 During construction, adequate fire extinguishing equipment, fire-resistant clothing and breathing apparatus sets, should be made available on site. Appropriate training in their use should be provided, and all such equipment should be properly maintained and kept in good condition.
- 3.7.1.21 Fire drills should be organised at not less than six months intervals.
- 3.7.1.22 The PP should formulate a health and safety policy standards and instructions for site personnel to follow.
- iii) Monitoring
- 3.7.1.23 LFG should be closely monitored, particularly at which the ground-works are to be conducted. Periodically during ground-works construction, the works area should be monitored by the site Safety Officer for oxygen, methane and carbon dioxide gas concentrations using appropriately calibrated portable gas detection equipment, which should be properly maintained and kept in good condition. Routine monitoring should be carried out in all excavations, manholes, chambers and any other confined spaces that may have been created. The monitoring frequency and areas to be monitored should be set down prior to commencement of ground-works by the Safety Officers. The monitoring requirement of excavations stated in the LFG Hazard Assessment Guidance Note sections 8.25 to 8.27 will be followed. All measurements of LFG should be recorded and documented by a standard record form. The form will detail the location, time of monitoring and equipment used, together with the gas concentrations measured to ensure all relevant data are recorded. LFG monitoring during construction phase will be reported in the monthly Environmental Monitoring and Audit (EM&A) Reports.
- 3.7.1.24 The gas detection equipment should be appropriately calibrated and able to measure the following gases in the ranges indicated below as in **Section 3.7.1.7**:
- | | |
|----------------|---------------------------|
| Methane | 0-100% LEL and 0-100% v/v |
| Carbon dioxide | 0-100% |
| Oxygen | 0-21% |

- 3.7.1.25 Monitoring should be performed properly to make sure that the area is free of LFG before any man enters into the area.
- 3.7.1.26 All measurements in excavations should be made with the extended monitoring tube located not more than 10mm from the exposed ground surface. The monitoring should be undertaken by the Safety Officer.
- 3.7.1.27 For excavations deeper than 1m, measurements should be carried out:
- at the ground surface before excavation commences;
 - immediately before any worker enters the excavation;
 - at the beginning of each working day for the entire period the excavation remains open; and
 - periodically throughout the working day whilst workers are in the excavation.
- 3.7.1.28 For excavations between 0.3m and 1m deep, measurements should be carried out:
- directly after the excavation has been completed; and
 - periodically whilst the excavation remains open.
- 3.7.1.29 For excavations less than 0.3m deep, monitoring may be omitted, at the discretion of the Safety Officer or other appropriately competent environmental specialist.
- 3.7.1.30 Depending on the results of the measurements, actions required will vary and should be set down by the Safety Officer or other appropriately environmental specialist. As a minimum, these should encompass those actions specified in **Table 3.2**.

iv) Emergency Management

- 3.7.1.31 To ensure that excavation procedures are implemented in the event of the trigger levels specified in **Table 3.2** being exceeded, the Safety Officer is responsible for dealing with any emergency which may occur due to LFG.

Table 3.2 Actions in the Event of LFG being Detected in Excavations

| Parameter | Monitoring Results | Actions |
|----------------|------------------------------|--|
| Methane | >10% LEL (i.e. >0.5% v/v) | Prohibit hot works; Ventilate to restore methane to <10%LEL. |
| | >20% LEL (i.e. >1.0% v/v) | Stop works; Inform EPD and Landfill Operator; Evacuate all personnel/prohibit entry; Increase ventilation to restore methane to <10% LEL. |
| Carbon dioxide | >0.5% v/v | Ventilate to restore carbon dioxide to <0.5% v/v. |
| | >1.5% v/v | Stop works; Inform EPD and Landfill Operator; Evacuate all personnel/prohibit entry; Increase ventilation to restore carbon dioxide to <0.5% v/v. |
| Oxygen | <19% | Ventilation trench/void to restore oxygen to >19% |
| | <18% | Stop works; Inform EPD and Landfill Operator; |

| Parameter | Monitoring Results | Actions |
|-----------|--------------------|--|
| | | Evacuate personnel/prohibit entry; Increase ventilation to restore oxygen to >19% |

3.7.1.32 In any emergency situation, the Safety Officer, or his deputies, shall have the necessary authority and shall ensure that the confined space is evacuated and the necessary works implemented for reducing the concentrations of gas. The following organizations should also be contacted as appropriate:

- Hong Kong Police Force;
- Fire Services Department;
- EPD; and
- Landfill Operator.

3.8 Evaluation of Potential Impacts on Landfill Restoration Facilities

3.8.1.1 The proposed golf course is located atop the existing Shuen Wan Restored Landfill. The existing restoration facilities installed mainly include:

- Landfill capping layer;
- LFG management system; and
- Leachate management system.

3.8.1.2 As discussed in **Section 3.5.1.1**, during the construction phase, the construction works associated with the Project include:

- tree felling;
- site formation (including excavation and filling);
- modification of existing LFG and leachate collection system;
- relocation/modification of leachate pumping chamber;
- relocation of passive vents and groundwater monitoring wells;
- replacement of infiltration cells;
- road works and utilities installation;
- civil and E&M works for buildings (including car park) and ancillary facilities (e.g. plant rooms and water storage tanks); and
- temporary site office.

Tree Felling

3.8.1.3 The Project would involve tree felling and removal of existing vegetation on top of the landfill capping layer. Trees would be transplanted/felled, whereas vegetation would be removed for turf paving. Protective and precautionary measures would be required to avoid any potential soil erosion.

Site Formation

- 3.8.1.4 Excavation may be required within the Project Site as well. However, buildings, ancillary facilities, and access road, etc. would be placed outside the waste boundary where the landfill capping layer has been installed. Thus, this avoids deep excavation and heavy construction atop the waste boundary. For any inevitable excavation on the existing landfill capping layer, a method statement should be submitted to EPD for approval before the works commence. The method statement should assess the risk of excavation based upon the excavation depth, equipment, extent and types of landfill capping system underneath. Excavation works on the existing landfill capping layer will only be performed in accordance with the approved method statement by Specialist Contractor. In addition, only machinery with allowable weight would be placed atop the waste boundary to avoid any potential settlement and damage of capping layer.
- 3.8.1.5 As discussed in **Section 3.5.1.1**, filling work would be conducted during the construction phase. Settlement monitoring and precautionary measures shall be developed during the construction phase to control the potential settlement. Adverse impact on the landfill stability and the settlement of the Shuen Wan Restored Landfill are not anticipated.
- 3.8.1.6 In addition, the surface water drainage system will be re-provided for the entire golf course after the filling activities to facilitate effective collection of surface water. The surface water collected from the surface water drainage system will be conveyed to water storage tanks for storage and reuse. Thus, significant percolation of rainwater to the underneath waste layer is not anticipated. The residual agrochemicals seeped into the covering soil will be degraded through various environmental fate processes. The residual agrochemicals seeped into the waste mass would be in tiny amount and would not significantly change the pollution characteristics of leachate. Interference of agrochemicals in the leachate management system would be insignificant.

Modification of Existing LFG and Leachate Collection System

- 3.8.1.7 Due to extensive coverage of existing LFG and leachate extraction wells in the Project Site and consideration of safety of golfers, it is unavoidable that some of the extraction wells will be relocated to avoid conflict with the teeing ground and fairway. New extraction wells and the new horizontal header pipes will be installed to convey the LFG and leachate to the nearby existing network. The existing locations of extraction wells have been reviewed in the Design Plan required under Condition 2.20 of the EP.
- 3.8.1.8 During the modification works for LFG and leachate monitoring wells, the capping layer or liner would require some relatively minor works. Any affected liner will be properly sealed with new liner and sufficient overlapping will be provided between the old and new liners. Capping layout will be reinstated after the completion of the modification of wells.
- 3.8.1.9 According to the Design Plan, the modifications would likely include the following 3 types:
- Vertical extension of the extraction wells; or
 - Horizontal extension of the extraction wells; or
 - Relocation of the extraction wells.

- 3.8.1.10 Vertical extension of the extraction wells would involve extension of vertical shafts and header pipes to suit the final finishes level. Hence, it can be seen that vertical extension of the extraction wells would not adversely affect the current operation of the landfill sites and would not generate any secondary environmental impacts such as significant gaseous emission to the environment.
- 3.8.1.11 Horizontal extension of the extraction wells would involve extension of shafts by inserting a 90-degree bend. The bended shaft would be connected to horizontal header pipe, which will be buried in soil without affecting the proposed teeing ground and fairway of the future golf course. Similar to the vertical extension, the horizontal extraction would not adversely affect the existing operation and would not generate any secondary environmental impacts such as significant gaseous emission to the environment.
- 3.8.1.12 In comparison, relocation of the extraction wells would involve installation of new wells and header pipes. The details of the Design Plan/Works Plan have been provided in the Design Plan. In order to minimize any impacts on the LFG system, it is proposed that the relocation of the extraction wells should be conducted in phases. Since the existing 87 numbers of gas extraction wells remain in function during the modification process, both the LFG system and leachate system would remain in slightly negative pressure status. This would help to ensure insignificant release of both gaseous emission and liquid during the modification works. The impact of new well installation is also isolated and local, with well shaft diameter ranging 75mm to 300mm compares to the entire waste mass of 50ha. The existing wells being affected will only be demolished after the commissioning of the new wells. Details on the modification works and the associated impact on the existing restoration facilities have been included in the Design Plan.

Relocation/Modification of Leachate Pumping Chamber

- 3.8.1.13 Further, the location of the leachate pumping chamber will conflict with the ancillary facilities of the Project. It is thus proposed to relocate the pumping chamber as well as the associated leachate extraction wells and horizontal header pipes. New extraction wells and new horizontal header pipes will be installed to convey the leachate from the waste mass to the new pumping chamber. Modification to the capping layer will be required and sufficient overlapping will be provided for both existing and new capping to avoid adverse odour impact.
- 3.8.1.14 Details of the relocation or modification of leachate pumping chambers have been provided in the Design Plan, with potential environmental impacts, safety precaution and monitoring proposed. As a result, adverse environmental impact to the surrounding is unlikely.

Relocation of Passive Vents and Groundwater Monitoring Wells

- 3.8.1.15 In addition, there are existing LFG passive vents along the boundary of the Project close to the Fortune Garden. As there will be a new internal road running along the site boundary to the ancillary facilities, the existing LFG passive vents will be abandoned and new passive vents will be installed along the access road.

- 3.8.1.16 Likewise, for the existing groundwater monitoring wells near the seawall conflicting with the access road and ancillary facilities, new groundwater monitoring wells will be installed and the existing wells will be abandoned.
- 3.8.1.17 As both passive vents and groundwater monitoring wells are located outside the waste mass, there should be no adverse impact due to the relocation works.

Replacement of Infiltration Cells

- 3.8.1.18 There are three existing infiltration cells installed across the Project Site. As the locations of the existing infiltration cells clash with the proposed golf course development, they are proposed to be decommissioned and replaced. Details of the replacement of infiltration cells have been provided in the Design Plan, with potential environmental impacts and mitigation measures safety proposed, including limited duration for the restoration capping system remain opened and exposed to the environment to minimise the LFG emission, etc. Thus, adverse environmental impact to the surround is unlikely.

Road Works and Utilities Installation

- 3.8.1.19 Roadworks and utilities installation are only 1m below the finished ground level and will not affect the capping layer of the restored landfill, there should be no adverse impact due to the roadworks and utilities installation.

Civil and E&M Works for Buildings and Ancillary Facilities

- 3.8.1.20 The buildings and ancillary facilities such as carpark and plant rooms are all outside the waste boundary without excavating the waste mass, and no adverse impact on gaseous emission and leakage of leachate is anticipated. Nevertheless, protection measures including gas detection system and gas barriers will be provided during construction stage and for long term operation stage.

Temporary Site Office

- 3.8.1.21 Similarly, the temporary site office will be provided outside the waste boundary as far as practicable, no adverse impact on gaseous emission and leakage of leachate is anticipated. Protection measure includes raising the temporary site office clear of ground and regular gas detection as mentioned in **Section 3.7.1.19** will be implemented during construction stage.

Overall Mitigation Strategy

- 3.8.1.22 A Design Plan has been prepared according to Condition 2.20 of the EP with details on the interfacing works including all demolition, relocation, reprovision and modification works of the existing landfill restoration facilities. Further, a Works Plan required under Condition 2.21 of the EP has been prepared by the Specialist Contractor providing details for implementing the interfacing works, and measures described in the approved Works Plan will be fully implemented during construction phase of the Project.

4. Conclusion

- 4.1.1.1 The results of this updated qualitative risk assessment for LFG hazards indicate the risk level from the Project during the construction phase is **Medium**. With the implementation of appropriate protective and precautionary measures according to LFG Hazard Assessment Guidance Note, adverse impacts on the targets are mitigated to acceptable level.
- 4.1.1.2 In addition, potential impacts from construction activities on existing landfill restoration facilities have been assessed. These include soil erosion arising from tree felling, site formation (include excavation and filling), relocation, modification, re-provision and demolition of existing landfill restoration facilities, road works and utilities installation, civil, electrical and mechanical works for buildings and ancillary facilities and provision of temporary site offices. With proper mitigation measures adopted, adverse impacts on the landfill restoration facilities are not anticipated.

Appendix 1.1

Figure 1 in FEP-571/2019/C



Legend 圖例

- Project Location
工程項目位置
- 1.2 ha Core Roosting Area
1.2 公頃核心夜間棲息地
- Aquilaria sinensis*
土沉香

| | |
|--------------------------------|---|
| Project Title 工程項目名稱 | Shuen Wan Golf Course 船灣高爾夫球場 |
| Figure 1 圖一 | Project Location and Conceptual Layout Plan 工程項目位置及概念佈局圖 [This figure was prepared based on Figure 2.1 of EIA Report (Register No.: AEIAR-221/2019)] [本圖是根據環境影響評估報告 (登記冊編號: AEIAR-221/2019) 圖 2.1 編制] |

Environmental Permit No.:
環境許可證編號：
FEP-01/571/2019/C



Appendix 2.1

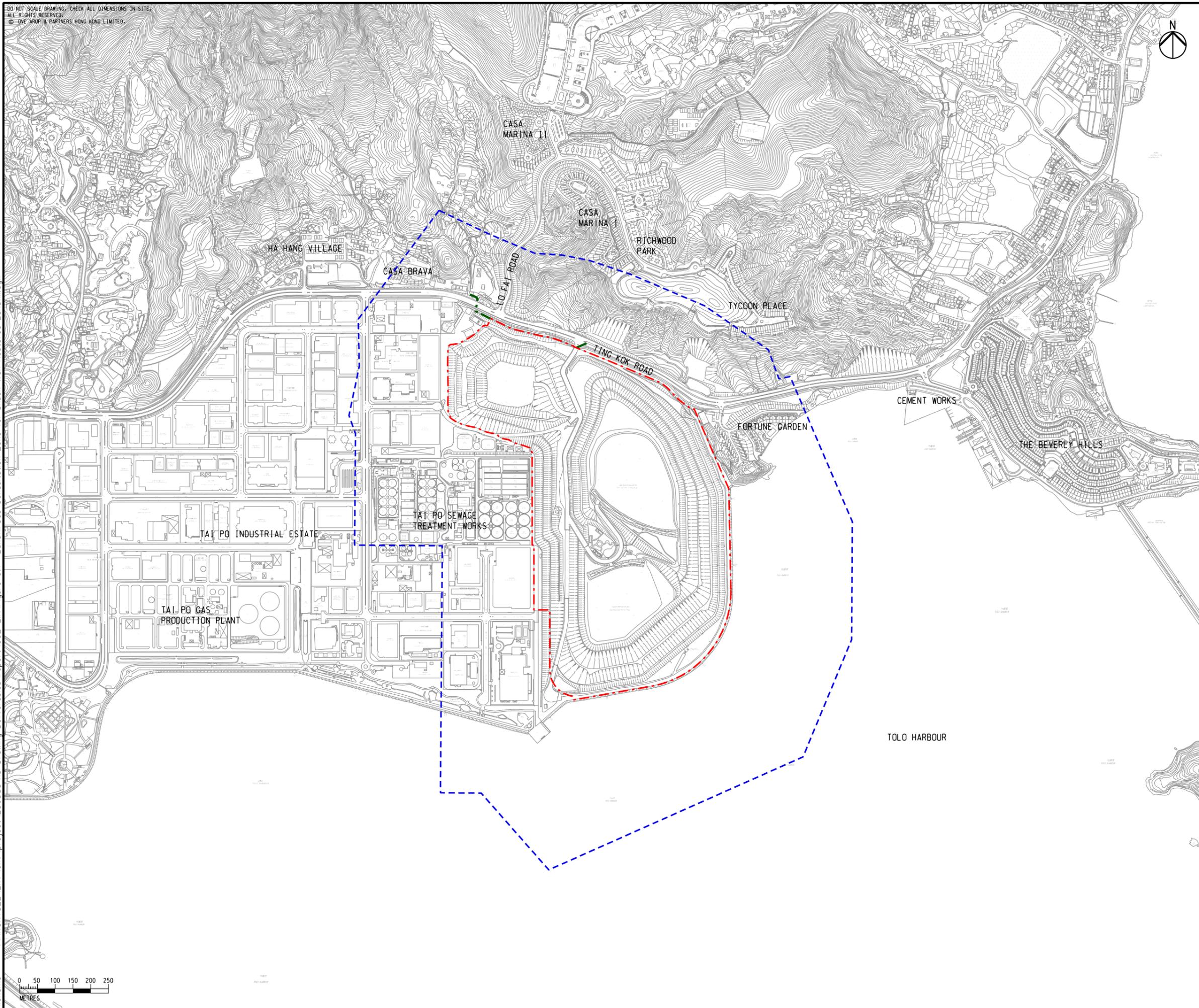
Figure 9.1 of the approved EIA Report

DO NOT SCALE DRAWING. CHECK ALL DIMENSIONS ON-SITE.
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- LEGEND**
- PROJECT BOUNDARY
 - PROPOSED DRAINAGE / SEWERAGE / WATERWORKS OUTSIDE SITE BOUNDARY
 - CONSULTATION ZONE

Printed by : 7/13/2018
 Filename : \\HKGNTS22\env\project\256383\13 Drawing Deliverables\report\002 EIA\Figure 9.1 - Landfill Gas Consultation Zone for Shuen Wan Restored Landfill.dgn



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|--|--------------|---------|----------|
| | | | |
| B | SECOND ISSUE | GL | 07/18 |
| A | FIRST ISSUE | GL | 04/18 |
| Rev | Description | By | Date |
| Consultant | | | |
| ARUP | | | |
| Contract No. and Title | | | |
| SHUEN WAN GOLF COURSE | | | |
| Drawing title | | | |
| LANDFILL GAS CONSULTATION ZONE FOR SHUEN WAN RESTORED LANDFILL | | | |
| Drawing no. | | | Rev. |
| FIGURE 9.1 | | | B |
| Drawn | Date | Checked | Approved |
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Appendix 3.1

Implementation Schedule of Precautionary and Protective Measure for Landfill Gas Hazard

**Precautionary and Protective Measures for Landfill Gas Hazard Implementation Schedule
Shuen Wan Golf Course**

| Updated CPLFGHA Ref. | EM&A Log Ref | Recommended Precautionary and Protective Measures | Objectives of the Recommended Measures & Main Concerns to address | Implementation Agent | Location / Timing | Implementation Stage |
|--|--------------|---|---|----------------------|-------------------|----------------------|
| <i>Landfill Gas Hazards (Construction Phase)</i> | | | | | | |
| S3.7 | LFG1 | <p><u>General Site Safety</u></p> <ul style="list-style-type: none"> Appointment of Safety Officer, who has been trained in use of gas detection equipment and LFG related hazards, should be present on site throughout the ground works phase. The Safety Officer should be provided with an intrinsically safe portable instrument appropriately calibrated and capable of measuring the following gases: <ul style="list-style-type: none"> CH₄: 0-100% LEL and 0-100% v/v; CO₂: 0-100% v/v; and O₂: 0-100% v/v. Those staff who work in, or have responsibility for “at risk” areas, including all excavation workers, supervisors and engineers working within the Consultation Zone, should receive appropriate training on working in areas susceptible to LFG, fire and explosion hazards. An excavation procedure or code of practice to minimise LFG related risk should be devised and carried out by the Safety Officer. No worker should be allowed to work alone at any time in or near to any excavation. At least one other worker should be available to assist with a rescue if needed. Smoking, naked flames and other source of ignition should be prohibited within 15m of any excavation or ground-level confined space. “No Smoking”, “No Naked Flame” and “Potential Hazard of Landfill Gas” notices in Chinese and English should be posted prominently around the Project Site. Welding, flame-cutting or other hot works may only be carried out in trenches or confined spaces when | Minimise the risk of LFG hazards to personnel in landfill site | Contractor | The Project Site | Construction stage |

**Precautionary and Protective Measures for Landfill Gas Hazard Implementation Schedule
Shuen Wan Golf Course**

| Updated CPLFGHA Ref. | EM&A Log Ref | Recommended Precautionary and Protective Measures | Objectives of the Recommended Measures & Main Concerns to address | Implementation Agent | Location / Timing | Implementation Stage |
|--|--------------|---|---|----------------------|-------------------|----------------------|
| <i>Landfill Gas Hazards (Construction Phase)</i> | | | | | | |
| | | <p>controlled by a “permit to work” procedure, properly authorised by Safety Officer.</p> <ul style="list-style-type: none"> • Ground level construction plant should be fitted with vertical exhausts at least 0.6m above ground level and with spark arrestors. • Any electrical equipment, such as motors and extension cords, should be intrinsically safe. • During piping assembly or conduiting construction, all valves/seals should be closed immediately after installation. As construction progresses, all valves/seals should be closed as installed to prevent the migration of gases through the pipeline/conduit. All piping/conduiting should be capped at the end of each working day. • Frequency and location of LFG monitoring within excavation area should be determined prior to commencement of works. LFG monitoring in excavations should be conducted at no more than 10mm from exposed ground surface. • Temporary facilities such as mobile site offices, equipment stores, mess rooms etc. should be raised clear of the ground and provided with regular gas detection by appropriately calibrated portable gas detection equipment, which should be properly maintained and kept in a good condition. If buildings are raised clear of the ground, a minimum, clear separation distance (as measured from the highest point on the ground surface to the underside of the lowest floor joist) should be 500mm. • Adequate fire extinguishing equipment, fire-resistant clothing and breathing apparatus sets, should be made available with appropriate training given in their use, | | | | |

**Precautionary and Protective Measures for Landfill Gas Hazard Implementation Schedule
Shuen Wan Golf Course**

| Updated CPLFGHA Ref. | EM&A Log Ref | Recommended Precautionary and Protective Measures | Objectives of the Recommended Measures & Main Concerns to address | Implementation Agent | Location / Timing | Implementation Stage |
|--|--------------|---|---|----------------------|-------------------|----------------------|
| <i>Landfill Gas Hazards (Construction Phase)</i> | | | | | | |
| | | <p>which should be properly maintained and kept in good condition.</p> <ul style="list-style-type: none"> • Fire drills should be organised at not less than six months intervals. | | | | |