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7. Land Contamination

7.1 Environmental Legislation, Plans, Standards, and Guidelines

7.1.1.1 The relevant environmental legislation guideline and standards on land contamination include the following:

- *Annex 19 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), Guidelines for Assessment of Impact On Sites of Cultural Heritage and Other Impacts (Section 3: Potential Contaminated Land Issues), Environment Protection Department (EPD), 2023;*

- *Guidance Manual for Use of Risk-based Remediation Goals (RBRGs) for Contaminated Land Management (Guidance Manual), EPD, Revised in April 2023;*

  Guidance Manual introduces a risk-based approach to land contamination assessment and presents instructions for comparison of soil and groundwater data to the Risk-Based Remediation Goals (RBRGs) for 54 chemicals of concern commonly found in Hong Kong. The RBRGs were derived to suit Hong Kong conditions and follow a risk-based methodology for contaminated land assessment and remediation, designed to protect the health of people who could potentially be exposed to land impacted by chemicals under four broad post-restoration land use categories. The RBRGs also serve as the remediation targets if remediation is necessary.

- *Guidance Note for Contaminated Land Assessment and Remediation (Guidance Note), EPD, Revised in April 2023; and*

  Guidance Note sets out the requirements for proper assessment and management of potentially contaminated sites such as oil installations (e.g., oil depots, petrol filling stations), gas works, power plants, shipyards/boatyards, chemical manufacturing/processing plants, steel mills/metal workshops, car repairing/dismantling workshops and scrap yards. In addition, this *Guidance Note* provides guidelines on how site assessments should be conducted and analyzed and suggests practical remedial measures that can be adopted for the cleanup of contaminated sites.

- *Practice Guide for Investigation and Remediation of Contaminated Land (Practice Guide), EPD, Revised in April 2023.*

  This guide outlines typical investigation methods and remediation strategies for the range of potential contaminants typically encountered in Hong Kong.

7.2 Assessment Area

7.2.1.1 Based on the current design scheme, the proposed study envelope for possible alignment covers Lam Tei area, Tai Lam Country Park and Tuen Mun South area and presented in **Figure 7.1**. The proposed scope of the Project, subject to the outcome of the investigation, comprises the following:

(a) Construction of a road of about 7.5 km long running through Tuen Mun and Tai Lam Country Park, linking the TM-CLKT and the YLH and KSWH;

(b) Construction of tunnel portals and associated facilities at Tuen Mun Area 40 and Lam Tei Quarry;

(c) Construction of viaducts / at-grade roads from the southern tunnel portal to the roads under planning near Lung Mun Road/Mong Fat Street, and TM-CLKT at Tuen Mun Area 40;

(d) Provision of associated ventilation buildings, administration building and other tunnel operation area;

(e) Re-provisioning of facilities affected by the proposed works;

(f) Possible adits and associated connection with existing roads;

(g) Construction of temporary explosive magazines in Lam Tei Quarry, Siu Lam and Pillar Point; and

(h) Associated geotechnical works, ground investigation (GI) works, drainage works, natural terrain hazard mitigation works, sewerage works, traffic aids, directional signs, street lightings, Traffic Control and Surveillance System, Electrical and Mechanical (E&M) works, environmental mitigation measures, landscaping works, and services systems for inspection, maintenance.

7.2.1.2 At grade/ elevated road section of the project alignment and associated Project Elements (i) proposed highway / tunnel operation and maintenance facilities, ii) proposed works area, and iii) proposed slope works have been assessed for this land contamination assessment. The underground tunnel sections involve tunnelling works and the temporary underground adit will be conducted underneath the soil layer, and thus are considered with no land contamination impact to construction workers and future occupants, therefore, have been excluded in the Assessment Area for this land contamination assessment.

7.2.1.3 The project alignment and proposed works area were divided into sub-areas as summarised in **Table 7.1** and relevant locations are presented in **Figure 7.1**.

Table 7.1 Summary of the Sub-areas within Assessment Area

Assessment Area ID	Location	Proposed Works
TMB-N-R	Southwest portion of Lam Tei Quarry	Northern portal of TMB, ventilation building and associated highway / tunnel operation and maintenance facilities
TMB-N-01	Northwest portion of Lam Tei Quarry	Temporary underground magazine shared use with proposed Route 11 (under separate project)
TMB-N-02	Natural Terrain and vegetation at south of Lam Tei Quarry	Slope works
TMB-C-01	Wah Fat Playground	Ventilation building and slope works
TMB-C-02	KW Carpark	Temporary re-provisioning of recreational facilities (basketball courts and public toilet)
TMB-C-03	Parking and planter at Fung On Street	Temporary re-provisioning of facilities (parking area)
TMB-C-04*	Former Girl Guide Association (GGA) Campsite	Building restoration and repair works for site office and other uses
TMB-S-R	TM-CLKT Road and near area and Lung Mun Road	At-grade / elevated road, ventilation building, administration building, associated highway / tunnel operation and maintenance facilities and slope works

Assessment Area ID	Location	Proposed Works
TMB-S-01	Former TM-CLKT Site Office	Temporary works area for (i.e. construction site office, construction material storage etc,) and temporary re-provisioning of EMSD vehicle servicing centre
TMB-S-02	Former TM-CLKT Site Office	Maintenance Compound for tunnel operation and at-grade / elevated road
TMB-S-03	Area near to existing EMSD Tuen Mun Vehicle Servicing Station	At-graded road and slope works
TMB-S-04	Existing EMSD Tuen Mun Vehicle Servicing Station	At-graded road and slope works
TMB-S-05*	Site at Mong Wing Street	Temporary works area for construction site office and carpark
TMB-S-06*	Site at Pillar Point	Temporary aboveground magazine at Pillar Point shared use with proposed Route 11 (under separate project)
TMB-S-07	Along Ho Fuk Street, Ho Yeung Street and Ho Yat Street	Shallow foundation works for the piers of the temporary overhead conveyor belt.
TMB-NL*	TM-CLKT Northern Landfall	Temporary works area for barging point facilities
TMB-SL*	Site at Siu Lam	Temporary aboveground magazine at Siu Lam shared use with proposed Route 11(under separate project)

Note:
* Assessment Area will not involve any excavation and works will not disturb the soil layer.

7.3 Assessment Methodology

7.3.1.1 Land contamination assessment was carried out according to the *EIAO-TM*, *Guidance Note*, the *Practice Guide* and the *Guidance Manual*.

7.3.1.2 Site appraisals, including site walkovers and desktop review, were conducted to identify the potentially contaminating activities that may pose adverse impact to the Project. Site surveys were conducted within the Assessment Area of the Project to review the general site conditions and to identify any sources of land contamination (or 'hot spots'). For the desktop review, the following information was reviewed:

- Selected aerial photographs and topographic maps held by the Lands Department (LandsD); and
- Records on dangerous goods (DGs), chemical wastes and chemical spillage/leakage incidents from Fire Services Department (FSD) and Environmental Protection Department (EPD).

7.3.1.3 Based on the site appraisals, soil and groundwater sampling and testing at the potentially contaminated areas have been proposed. A Contamination Assessment Plan (CAP), detailed findings of the site appraisals and the proposed site investigation (SI) works, was prepared and enclosed in **Appendix 7.1**.

7.3.1.4 As reported in the CAP, all the identified potential contaminated areas within the Assessment Area of the Project are currently in operation and hence accessibility is restricted. The SI works and the subsequent assessment / remediation works are therefore proposed to be carried out after decommissioning but prior to the development works at

the concerned areas. For these concerned areas, review of the contamination, possible remediation methods, potential insurmountable impacts, SI requirements as well as the tentative timeframe for subsequent submissions were presented in the CAP.

7.4 Site Appraisal

7.4.1 General

7.4.1.1 Site appraisals were carried out in the period between August 2022 and April 2023 with site walkovers conducted in August and September 2022 and April 2023. Findings of the site appraisals were detailed in the CAP and are summarized below.

7.4.2 Review of Historical Land Uses

7.4.2.1 To identify any past land uses that may cause potential land contamination issues, the historical land uses of the Assessment Area has been reviewed with the aid of selected historical photographs in the years from 1963 to 2022 available from the LandsD. The details of the historical land use and referenced aerial photographs of Assessment Area are presented in the CAP. The historical land use of the Assessment Area is summarised in **Table 7.2**.

7.4.3 Review of Current Land Uses

7.4.3.1 Site surveys covering the Assessment Area were conducted in August and September 2022 and April 2023 to verify existing land uses and to identify potential sources and signs of contamination. At the time of site surveys, Lam Tei Quarry area (TMB-N-R, TMB-N-01 and TMB-N-02) and TM-CLKT area (TMB-S-R), the former TM-CLKT Site Office (western portion of TMB-S-02) and site at Mong Wing Street (TMB-S-05) were inaccessible and hence only peripheral inspection was carried out.

7.4.3.2 For the accessible Assessment Area except at TMB-S-04 which is the existing EMSD Tuen Mun Vehicle Servicing Station, neither storage/ handling of hazardous chemical and chemical waste nor equipment repair/ maintenance activities were observed within all Assessment Area. Other than TMB-S-04, no evidence of oil stains or chemical leakages/ spillages was observed within all Assessment Area. Besides, no potential land contamination facilities, including underground fuel oil storage tanks, underground oil pipelines, chemical and chemical waste storage areas, dangerous goods stores, wastewater treatment facilities and transformer rooms at all Assessment Area except at TMB-S-04. At all Assessment Area, no signs of obvious/ suspected contamination including abnormal odour and/or distressed vegetation were observed or notified.

7.4.3.3 Details of the site survey observations and the photographs taken during the site walkovers, the site walkover checklists are presented in the CAP. The current land uses of the Assessment Area are summarised in **Table 7.2**.

7.4.4 Information from Government Authorities

7.4.4.1 Both EPD and FSD have been enquired for (i) records on any spillage / leakage of chemicals, (ii) records of DG and (iii) records of Chemical Waste Producer(s) within the Assessment Area.

7.4.4.2 Apart from the responses from EPD, enquiry has been made to the registry of chemical waste producers (CWPs) maintained in the Territorial Control Office of EPD at Wan Chai. According to the nature of business in EPD's CWP record, the CWPs at TMB-S-R, TMB-S-01, TMB-S-02, TMB-S-03 and TMB-S-05 are expected to have chemical waste generated during construction works. Any chemical storage at the area should be handled according to the Waste Disposal (Chemical Waste) (General) Regulation. The CWPs at TMB-N-R / TMB-N-01 and TMB-S-03 are expected to have chemical used during blasting, asphalt and concrete production at Lam Tei Quarry and repair / maintenance of vehicle at the existing EMSD Tuen Mun Vehicle Servicing Station respectively which land contamination issue associated with the CWP records are anticipated.

7.4.4.3 Based on information provided by FSD, three records of DGs licenses were found, those three Dangerous Goods Licenses are granted to Lam Tei Quarry (TMB-N-R and TMB-N-01) for temporary storage of 10,000L / kg Ammonium Nitrate. Potential land contamination issues associated with the DGs records are anticipated.

7.4.4.4 According to replies from FSD, fire incidents including 1 vegetation fire and 1 rubbish fire were recorded within / near the Assessment Area, since the nature of vegetation fire and rubbish fire did not involve chemicals/oil/ fuels. Therefore, land contamination impact on the Project due to these incidents is considered unlikely, no contamination issues associated with the incident is anticipated.

7.4.4.5 Details of the information from government departments and copies of the relevant replies from EPD and FSD and the details of CWPs are presented in the CAP.

7.4.5 Existing Geological Profile

7.4.5.1 A review on the existing geological profile of the Assessment for this Project is presented in the CAP.

7.4.6 Summary of Site Appraisal Findings

7.4.6.1 A summary of the site appraisal findings is shown in **Table 7.2**. The details of site appraisal findings are presented in the CAP.

Table 7.2 Summary of Site Appraisal for Assessment Area

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
TMB-N-R (Southwest portion of Lam Tei Quarry)	1963-1974: Site Formation and Natural Landscape 1986-2021: Lam Tei Quarry	At the time of site survey, site was inaccessible. Based on peripheral inspection, the area is occupied by Lam Tei Quarry.	No (Peripheral Inspection Only)	Yes	Yes (Lam Tei Quarry Area)	Cannot be identified	Metal, PCRs, VOCs, SVOCs	Industrial
TMB-N-01 (Northwest portion Lam Tei Quarry)	1963-1974: Site Formation and Natural Landscape 1986-2021: Lam Tei Quarry	At the time of site surveys, site was inaccessible. Based on peripheral inspection, the area is occupied by Lam Tei Quarry.	No (Peripheral Inspection Only)	Yes	Yes (Lam Tei Quarry Area)	Cannot be identified	Metal, PCRs, VOCs, SVOCs	Industrial
TMB-N-02 (Natural terrain and vegetation at south of Lam Tei Quarry)	1963-2021: Natural Landscape and natural vegetation	At the time of site survey, site was inaccessible. Based on aerial photo the area is natural terrain with natural vegetation.	No (Peripheral Inspection Only)	No	No	N/A	N/A	N/A
TMB-C-01 (Wah Fat Playground)	1964-1986: Village House and Natural Landscape 1990: Site Formation and Natural Landscape 1994-2021: Wah Fat Playground and Natural Landscape	During the site walkover, Wah Fat Playground was observed including basketball court and playground.	Yes	No	No	N/A	N/A	N/A

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
TMB-C-02 (KW Carpark)	1964: Shoreline 1978: Suspected Open Storage 1986: Under Reclamation Works 1990: Site Formation 1994: Suspected Open Storage 1999: Vegetation 2010: Construction Site Office 2016-2021: Car park	During the site surveys, the area was located within a fee-paying car park was observed.	Yes	No	Yes (Previous Suspected Open Storage area)	No	Metal, PCRs, VOCs, SVOCs	Public Park
TMB-C-03 (Parking and planter at Fung On Street)	1964: Open Sea 1978: Under Reclamation Works 1986: Site Formation 1990-2021: Parking Lots and Open Area	During the site walkover, a fee-paying parking lots and planter area were observed.	Yes	No	No	N/A	N/A	N/A

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
TMB-C-04 (Former GGA Campsite)	1950s-1980s: School (building structures were built and developed throughout the period) 1988: Convert into a campsite operation by GGA. (Historical use of the TMB-C-04 can be refer to Section 12)	During the site walkover, the campsite is currently abandoned. The building structures were remained.	Yes	No	No	N/A	N/A	N/A
TMB-S-R (TM-CLKT Road and near area and Lung Mun Road)	1978-1985: Site Formation and Vegetation 1997: Open Storage, Vegetation and Refugee Camp 2002: Site Formation, Vegetation and Refugee Camp 2008-2012: Site Formation, Vegetation and Vacant 2017: Construction Site	At the time of site surveys, site was inaccessible. Based on peripheral inspection, TM-CLKT and associated area were occupied the area and Lung Mun Road was observed.	No (Peripheral Inspection Only)	Yes	No	N/A	N/A	N/A

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
	2021: TM-CLKT and associated area had developed							
TMB-S-01 (Former TM-CLKT Site Office)	1978-1985: Site Formation 1997-2002: Refugee Camp 2008-2012: Open Storage (West Portion), Vacant (East Portion) 2017-2021: TM-CLKT Site Office and Construction Site	During the site survey, site office for Contract No. HY/2021/12 with storage of construction material, no use/ storage of chemical / chemical waste was observed at west portion of the area. During the site survey, vacant land was observed at the east portion of the area.	Yes	Yes	Yes (Previous Open Storage Area at Northwest and Southwest Portions)	No	Metal, PCRs, VOCs, SVOCs	Industrial
TMB-S-02 (Former TM-CLKT Site Office)	1978-1985: Site Formation 1997-2002: Refugee Camp 2008-2012: Open Storage (West Portion), Vacant (East Portion) 2017-2021: TM-CLKT Site Office and Construction Site	At the time of site surveys, site was inaccessible. Based on peripheral inspection, open storage for precast construction material was observed. During the site survey, vacant land was observed at the east portion of the area.	Yes (East Portion) Peripheral inspection for west portion	Yes	Yes (Previous Open Storage Area at Northwest and Southwest Portions)	No	Metal, PCRs, VOCs, SVOCs	Industrial

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
TMB-S-03 (Area near to existing EMSD Tuen Mun Vehicle Servicing Station)	1978-1997: Site Formation 2002-2021: Road, slope and vegetation	During the site walkover, slope, vegetation, pedestrian and vehicle access road were observed.	Yes	Yes	No	N/A	N/A	N/A
TMB-S-04 (Existing EMSD Tuen Mun Vehicle Servicing Station)	1978: Site Formation 1980: Government Depot under construction 1985-1997: Government Depot 2002-2022: Existing EMSD Tuen Mun Vehicle Servicing Station	During the site walkover, the existing EMSD Tuen Mun Vehicle Servicing Station occupied the area. The existing EMSD Tuen Mun Vehicle Servicing Station consists of Car Parking Area, Disused Petrol Refilling Area, Maintenance Workshop Area and Storage Area of New Vehicle Parts. Hotspots were identified including: • Disused Petrol Refiling Station • Underground Petrol and Diesel Tank • Underground waste oil tank	Yes	Yes	Yes (Maintenance workshop area and disused petrol refilling area within the existing EMSD Tuen Mun Vehicle Servicing Station)	Yes	Metal, PCRs, VOCs, SVOCs	Lower of Industrial or Public Park

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
		• Storage of Waste Batteries and Metal Scrap • Storage of Drums of Motor Oil • Waste oil discharge points at inspection pits • Refilling area and chemical waste storage • Storage of Chemical Waste, Automatic Transmission Fluid, Drums of Motor Oil and Oil Drums • Oil stains						
TMB-S-05 (Site at Mong Wing Street)	1978-1985: Site Formation / Vacant 1997: Site Formation 2002: Open storage 2008: Construction Site Office 2012: Open Storage 2017: Open Storage/ Construction Site Office	At the time of site surveys, site was inaccessible. Based on peripheral inspection, storage area for construction trucks and equipment were observed.	No (Peripheral Inspection Only)	Yes	Yes	Cannot be identified	Metal, PCRs, VOCs, SVOCs	Industrial

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
	2021: Vacant Land							
TMB-S-06 (Pillar Point Site)	1978-1980: Natural Landscape 1985-1997: Open Storage 2002-2008: Vacant 2012-2017: Open Storage 2022: Vacant	During the site survey, storage area of construction materials was observed. No chemical, stain, leakage or seepage was observed.	Yes	No	Yes (Pervious Open Storage Area)	No	Metal, PCRs, VOCs, SVOCs	Industrial
TMB-S-07 (Across Lung Mun Road, along Ho Fuk Street, Ho Yeung Street and front section of TM-CLKT Northern Landfall)	Before 1985: Open Sea 1985: Reclamation completed, and site formed for most of the section. 1997: Ho Fuk Street, and Ho Yeung Street already presented and remained unchanged. Sawmill at the TM-CLKT Northern Landfall section. 2014-2020: The TM-CLKT Northern Landfall section was in between	During the site survey, Lung Mun Road, Ho Fuk Street, Ho Yeung Street was observed. A vacant land was observed at the TM-CLKT Northern Landfall section.	Yes	No	No	N/A	N/A	N/A

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
	the sawmill and construction works area. 2021: The sawmill was demolished; a construction works area remained and grassland / plantation was developed.							
TMB-NL (TM-CLKT Northern Landfall)	Before 1980: Open Sea 1985: Reclamation completed, and site formed at the furthest north. Remaining area at open sea. 1988: Sawmill at furthest north. Remaining area at open sea. 2014-2020: Reclamation works under TM-CLKT construction, and used as construction works area. 2021: The sawmill was demolished; a construction works area remained and grassland.	During the site survey, majority area with grassland / plantation and access road were observed and a vacant land noted at the TM-CLKT Northern Landfall and the demolished sawmill area was remained vacant.	Yes	No	No	N/A	N/A	N/A

Assessment Area (6)	Past Land Use (1)	Current Land Use (2)	Site Inspections for this CAP-Accessibility (Yes/No)	Registered Chemical Waste Producers? (Yes/No)	Potentially Contaminated (Yes/No)	Hot Spot Identified in Site Inspection? (Yes / No / N/A) (3)	Potential Contaminants (4), (5)	Selection of RBRG Land Use Scenario (7)
	/ plantation was developed							
TMB-SL (Siu Lam Site)	Before 1986: Natural Landscape 1986: Site Formation and Vacant 1999: Vacant Land 2008: Open Storage 2015: Magazine Site 2021: Vacant Land	During the site survey, vacant land with vegetation was observed.	Yes	No	Yes	No	Metal, PCRs, VOCs, SVOCs	Industrial

Notes:

- N/A = Not Applicable

(1) To identify any past land uses that may cause potential land contamination issues, the historical land uses of the Assessment Area has been reviewed with the aid of selected historical photographs in the years from 1963 to 2022 available from the LandsD. The referenced aerial photographs are attached in Appendix A of the CAP.

(2) The current land use for each identified area is determined based on the site inspection (including the peripheral inspection) and the available information from the internet.

(3) The hot spots that have been identified at this stage are not exhaustive as changes of land use in future may give rise to further hot spots. As such, the site re-appraisal should be conducted to cover the whole Assessment Area to ensure that any additional hot spots are identified once site access is available (e.g., the completion of the land resumption).

(4) Metal, PCRs, VOCs and SVOCs, all-inclusive as listed in Appendix F of the CAP.

(5) The potential contaminants that have been identified at this stage are not exhaustive as changes of land use in future may give rise to further hot spots. As such, the site re-appraisal should be conducted to cover the whole Assessment Area to ensure that any additional potential contaminants are identified once site access is available (e.g., the completion of the land resumption).

(6) At the time of preparation of this CAP, TMB-N-R, TMB-N-01, TMB-N-02, TMB-S-R, western portion of TMB-S-02 and TMB-S-05 were inaccessible during the time of preparation of the CAP, and it was observed that the all the potential contaminated area are in operation and infeasible to conduct site investigation (SI) and sampling works at EIA. Therefore, prior to the development of these areas, site re-appraisal of the whole project should be carried out in order to address any new contamination issues caused by the (i) changes in operation of the identified potentially contaminated site and (ii) changes in land use within the Project Area. The supplementary CAP(s), incorporating the findings of the site re-appraisal and the updated sampling and testing strategy, should be prepared and submitted to EPD for agreement prior to the commencement of SI works.

(7) The RBRGs Land Use Scenario is selected for each Assessment Area with potential contamination by the future land use as summarised in **Table 7.2**.

7.5 Identification of Potential Contaminated Area and Hot Spots

7.5.1.1 According to the *Practice Guide*, based on the findings of the site appraisal presented in **Section 7.4** and detailed in Section 3 of the CAP, the areas, that may have land contamination issues due to the current/past land uses, have been identified.

7.5.1.2 The current/past land uses within potential land contamination activities were observed at the following Assessment Area and are considered as the potential contaminated area:

- Lam Tei Quarry involves the usage of chemicals for blasting, asphalt, and concrete production at TMB-N-R and TMB-N-01;
- Former open storage area at TMB-C-02, TMB-S-01 (Western Portions) and TMB-S-02 (Western Portions), TMB-S-05, TMB-S-06 and TMB-SL (Northern Portion); and
- Maintenance workshop area and disused petrol refilling area of the existing EMSD Tuen Mun Vehicle Servicing Station (TMB-S-04).

7.5.1.3 *Practice Guide* recommends investigating the potential contaminated area in regular grid pattern to have a comprehensive study on the potential land contamination site. Apart from the regular grid pattern, the *Practice Guide* also requires attention should be paid to those locations where potential land contamination could occur. These are regarded as "hot spots" for investigation. The following hot spots are identified at the potential contaminated areas during site walkover.

TMB-S-04

- Disused Petrol Refiling Station
- Underground Petrol and Diesel Tank
- Underground Waste Oil Tank
- Storage of Waste Batteries and Metal Scrap
- Storage of Drums of Motor Oil
- Waste oil discharge points at inspection pits
- Refilling area and chemical waste storage
- Storage of Chemical Waste, Automatic Transmission Fluid, Drums of Motor Oil and Oil Drums
- Oil stains

7.5.1.4 A detailed evaluation of potential contaminated area and hot spots is presented in Section 4 of the CAP. The locations of potential contaminated areas are presented in **Figure 7.2**.

7.6 Site Re-appraisal

7.6.1.1 At the time of site walkovers, TMB-N-R, TMB-N-01, TMB-N-02 and TMB-S-R. the western portion of TMB-S-02 and TMB-S-05 were inaccessible during the time of preparation of the CAP, and it was observed that all the potential contaminated areas are in operation and inaccessible to conduct site investigation (SI) and sampling works at EIA

stage. Therefore, prior to the development of these areas, site re-appraisal of the whole Project Areas should be carried out in order to address any new contamination issues caused by the (i) changes in operation of the identified potentially contaminated site and (ii) changes in land use within the Project Area. The supplementary CAP(s), incorporating the findings of the site re-appraisal and the updated sampling and testing strategy, should be prepared and submitted to EPD for agreement prior to the commencement of SI works.

7.6.1.2 SI works should then be conducted according to the supplementary CAP(s). Contamination Assessment Report(s) (CAR(s)) and Remediation Action Plan(s) (RAP(s)), if contaminated soil and/or groundwater is identified, should be prepared and submitted to EPD for agreement. Any identified contaminated soil and groundwater should be treated according to RAP(s) approved by EPD and Remediation Report(s) (RR(s)) should be submitted to EPD for agreement after the completion of the remediation works. No development works at the contaminated areas shall be commenced prior to EPD's agreement of the RR(s).

7.7 Selection of RBRG Land Use Scenario and Chemical of Concern (COCs)

7.7.1.1 RBRGs criteria are currently used in the land contamination assessment as the remediation target in Hong Kong. Future land use of the areas covered in this Project mainly comprises viaduct / at-grade road, ventilation building, tunnel operation area, reprovision of facilities, barging points and magazine sites etc. Therefore, the RBRGs conceptual site model under, Industrial or Public Park land use scenario and Lower of Industrial or Public Park will be adopted subject to the future land use. The RBRGs criteria is detailed in the CAP.

7.7.1.2 The selection of potential COCs recommended for laboratory analysis (i.e., **Table 7.2**) makes reference to the information collected during the site reconnaissance and the nature of historical and current land uses / activities of each potentially contaminated areas which were accessible / visually accessible for the site inspections, and also the *Guidance Manual* and *Practice Guide*. Since a potentially contaminated area may have different potentially contaminating activities / land uses in the past, more than one land use/ potentially contaminating activity type (i.e., listed in Table 2.3 of the *Practice Guide*) may be applicable. As a conservative approach the key COCs for all potentially contaminating activities / land uses (i.e., Metal, PCRs, VOCs and SVOCs) are selected for testing for the corresponding site.

7.8 Site Investigation Plan

7.8.1.1 Sampling locations are proposed at the potential contaminated areas excavation works and works will disturb the soil layer. The recommended minimum number of sampling locations for each potential contaminated area has taken into consideration the size of the potentially contaminated areas and adopted the regular grid sampling strategy in Section 2.4.1 of the *Practice Guide*. Moreover, as for each hot spots were identified within TMB-S-04, additional hot spots sampling locations are proposed at the potential contaminated areas within TMB-S-04. The proposed site investigation plan for the potential contaminated areas with excavation works and works will touch the soil layer is summarized in **Table 7.3** and **Table 7.4**, all proposed sampling locations are presented in the CAP.

7.8.1.2 The potential contaminated areas are still in operation, there might be change in land use prior to the development. Moreover, TMB-N-R, TMB-N-01, western portion of TMB-S-02 and TMB-S-05 were inaccessible at the time of the preparation of the CAP. Therefore, once the site is available, site re-appraisal should be conducted to identify additional potential contamination sources (or hot spots). The final sampling and testing plan (including the regular grid sampling strategy and any identified hot spots) will be reviewed in the site re-appraisal and reported in the supplementary CAP.

7.8.1.3 The SI and sampling method and laboratory analytical requirements are detailed in Sections 6 and 7 of the CAP.

Table 7.3 Summary of Regular Grid Sampling Locations

Assessment Area	Approximate Potential Contaminated Area (m^2)	Regular Sampling Grid Size (9)	Number of Regular Grid Sampling Locations (9), (11)	Regular Grid SI Location ID	Drilling Depth and Method	Soil		Groundwater	
						Sample Depths (2) , (11)	Parameter to be Analysed (3), (4), (5), (6), (10)	Sample Depths	Parameters to be Analysed (4), (5), (7), (8), (10)
TMB-N-R	1,700	13m x 13m	14	TMB-N-R TP1 to TP14	Trial pit by manual excavation down to 3.0m bgl (10)	Manual excavation of trial pit (0-3.0m bgl): • To manually collect disturbed samples at 0.5m, 1.5m and 3.0m bgl	Metal, PCRs, VOCs, SVOCs	To collect one groundwater sample at static groundwater level (If present)	Mercury, PCRs, VOCs, SVOCs
TMB-N-01	1,550	13m x 13m	12	TMB-N-01 TP1 to TP12					
TMB-C-02	1,200	13m x 13m	8	TMB-C-02 BH1 to BH8	Borehole constructed by rotary drilling to 6.0m-6.5m below ground level (bgl) and 2.0m below ground water level.	Manual excavation of inspection pit (0-1.5m bgl): • To manually collect disturbed samples at 0.5m and 1.5m. Rotary drilling of boreholes: • Continuous drilling from bottom of the inspection pit and collected undisturbed samples at 3.0m and 6.0m bgl.	Metal, PCRs, VOCs, SVOCs	To collect one groundwater sample at static groundwater level	Mercury, PCRs, VOCs, SVOCs
TMB-S-01	11,400	19m x 19m	34	TMB-S-01 BH1 to BH34					
TMB-S-02	6,700	17m x17m	26	TMB-S-02 BH1 to BH26					
TMB-S-04	700	13m x 13m	4	TMB-S-03 BH1 to BH4					

Note:

(1) Exact coordinates to be confirmed by contractor after sub-surface utility scanning and will be provided in the CAR;

(2) Sampling depths may be changed if there is presence of rock/big boulders during rotary drilling. Exact sampling locations shall be subject to the instructions of land contamination specialist during supervision;

(3) Metals for soil samples: Antimony, Arsenic, Barium, Cadmium, Chromium III, Chromium VI, Cobalt Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Tin and Zinc, all-inclusive as listed in Appendix D of the CAP (**Appendix 7.1** refers);

(4) Petroleum Carbon Ranges: C6-C8, C9-C16, C17-C35, all-inclusive as listed in in Appendix F of the CAP;

(5) VOCs: Acetone, Benzene, Bromodichloromethane, 2- Butanone, Chloroform, Ethylbenzene, Methyl tert-Butyl Ether, Methylene Chloride, Styrene, Tetrachloroethene, Toluene, Trichloroethene, and Xylenes (Total);

(6) SVOCs for Soil: Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, bis-(2-Ethylhexyl)phthalate, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Hexachlorobenzene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, Phenol, and Pyrene;
(7) SVOCs for Groundwater: Acenaphthene, Acenaphthylene, Anthracene, Benzo(b)fluoranthene, Chrysene, Fluoranthene, Fluorene, Hexachlorobenzene, Naphthalene, Phenanthrene, and Pyrene; and
(8) Mercury will be analysed for groundwater samples;
(9) Grid size and number of sampling points were determined proportionally from Table 2.1 of the Practice Guide.
(10) TMB-N-R and TMB-N-01 are both within Lam Tei Quarry, Lam Tei Quarry with topsoil less than 3m thick and no groundwater is anticipated, therefore, trial pit method is proposed. Previous ground investigation record at Lam Tei Quarry is presented in Appendix G of the CAP for reference.
(11) Sampling strategic shall be further reviewed based actual site condition. Alternative sampling strategic shall be proposed and agreed with EPD in Supplementary CAP(s).

Table 7.4 Summary of Hot Spot Sampling Locations

Potential Contaminated Area ID	Identified Hot Spot [9]	Hot Spot SI Location ID	Drilling Depth and Method [3], [10]	Soil		Groundwater	
				Sample Depths [2], [10]	Parameter to be Analysed [3], [4], [5], [6]	Sample Depths	Parameters to be Analysed [7], [8]
TMB-S-04	Storage of Drum of Motor Oil	TMB-S-04 BH5	Borehole constructed by rotary drilling to 6.0m to 6.5m below ground level (bgl) and 2.0m below ground water level	Manual excavation of inspection pit (0-1.5m bgl): • To manually collect disturbed samples at 0.5m bgl and 1.5m bgl. for laboratory analysis Rotary drilling of boreholes: • Continuous drilling from bottom of the inspection pit and collected undisturbed samples at 3.0m bgl and at 6.0m bgl.	Metal, PCRs, VOCs, SVOCs	To collect one groundwater sample at static groundwater level	Mercury, PCRs, VOCs, SVOCs
	Oil Stains at Tyre tChanging Machines	TMB-S-04 BH6					
	Chemical Waste Storage	TMB-S-04 BH7					
	Storage of Automatic Transmission Fluid and Equipment	TMB-S-04 BH8					
	Storage of Drums of Motor Oil	TMB-S-04 BH9					
	Chemical Waste Storage	TMB-S-04 BH10					
	Storage of Automatic Transmission Fluid	TMB-S-04 BH11					
	Chemical Waste Storage	TMB-S-04 BH12					
	Refilling Area	TMB-S-04 BH13					
	Storage of Drums of Motor Oil	TMB-S-04 BH16					
	Storage of Metal Scraps	TMB-S-04 BH17					
	Storage of Waste Batteries	TMB-S-03 BH18					

Potential Contaminated Area ID	Identified Hot Spot [9]	Hot Spot SI Location ID	Drilling Depth and Method [3], [10]	Soil		Groundwater	
				Sample Depths [2], [10]	Parameter to be Analysed [3], [4], [5], [6]	Sample Depths	Parameters to be Analysed [7], [8]
	Disused Petrol Refilling Station	TMB-S-03 BH22					
	Waste Oil Discharge Points	TMB-S-03 BH14	Borehole constructed by rotary drilling to 6.0m to 6.5m below the EMSD maintenance inspection pit and 2.0m below ground water level	Rotary drilling of boreholes: • Continuous drilling from bottom of the EMSD maintenance inspection pit and collected undisturbed samples at 0.5m, 1.5m, 3.0m and 6.0m below bottom of maintenance inspection pit.	Metal, PCRs, VOCs, SVOCs	To collect one groundwater sample at static groundwater level	Mercury, PCRs, VOCs, SVOCs
	Waste Oil Discharge Points	TMB-S-04 BH15					
	Underground Waste Oil Tank	TMB-S-04 BH19	Borehole constructed by rotary drilling to 6.0m to 6.5m below underground tank and 2.0m below ground water level	Rotary drilling of boreholes: • Continuous drilling from bottom of underground tank and collected undisturbed samples at 0.5m, 1.5m, 3.0m and 6.0m below bottom of underground tank.	Metal, PCRs, VOCs, SVOCs	To collect one groundwater sample at static groundwater level	Mercury, PCRs, VOCs, SVOCs
	Disused Underground Petrol and Diesel Tank	TMB-S-04 BH20					
	Disused Underground Petrol and Diesel Tank	TMB-S-04 BH21					

Note:

(1) Exact coordinates to be confirmed by contractor after sub-surface utility scanning and will be provided in the CAR;

(2) Sampling depths may be changed if there is presence of rock/big boulders during rotary drilling. Exact sampling locations shall be subject to the instructions of land contamination specialist during supervision;

(3) Metals for soil samples: Antimony, Arsenic, Barium, Cadmium, Chromium III, Chromium VI, Cobalt Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Tin and Zinc, all-inclusive as listed in Appendix F of the CAP;

(4) Petroleum Carbon Ranges: C6-C8, C9-C16, C17-C35, all-inclusive as listed in in Appendix F of the CAP;

(5) VOCs: Acetone, Benzene, Bromodichloromethane, 2- Butanone, Chloroform, Ethylbenzene, Methyl tert-Butyl Ether, Methylene Chloride, Styrene, Tetrachloroethene, Toluene,

Trichloroethene, and Xylenes (Total);

(6) SVOCs for Soil: Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, bis-(2-Ethylhexyl)phthalate, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Hexachlorobenzene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, Phenol, and Pyrene;

(7) SVOCs for Groundwater: Acenaphthene, Acenaphthylene, Anthracene, Benzo(b)fluoranthene, Chrysene, Fluoranthene, Fluorene, Hexachlorobenzene, Naphthalene, Phenanthrene, and Pyrene; and

(8) Mercury will be analysed for groundwater samples;

(9) Sampling strategic shall be further reviewed based actual site condition. Alternative sampling strategic shall be proposed and agreed with EPD in Supplementary CAP(s).

7.9 Evaluation of Environmental Impacts

7.9.1.1 Based on the findings of site appraisals and the evaluation of potential contaminated areas detailed in Section 3 and 4 of the CAP. A total of nine potential contamination areas were identified within the Assessment Area for land contamination assessment of the Project and intrusive SI and sampling works were considered necessary. The potential contaminated areas include, Lam Tei Quarry (TMB-N-R, TMB-N-01), former open storage area (TMB-C-02, western portion of TMB-S-01 western portion of TMB-S-02, TMB-S-05, TMB-S06 and TMB-SL) and maintenance workshop area and disused petrol refilling area of the existing EMSD Tuen Mun Vehicle Servicing Station (TMB-S-04).

7.9.1.2 The land contamination issues in the land use that are identified as potentially contaminated would be considered surmountable to the construction workers during construction phase and future occupants during operation phase, in view that if the recommended actions as outlined in **Section 7.10** were followed and any contaminated soil and groundwater identified should be properly treated using appropriate remediation methods according to EPD's agreed Remediation Action Plan (RAP) prior to the development works at the contaminated area within the Project.

7.10 Mitigation of Adverse Environmental Impact

7.10.1 Recommended Further Works

7.10.1.1 As discussed in **Section 7.6**, prior to the development of these areas, site re-appraisal of the whole Project Areas should be carried out to ascertain the evaluation and recommendation reported and update the corresponding findings (e.g., location of hotspots) and sampling and testing requirements presented in the CAP. The supplementary CAP(s), incorporating the findings of the site re-appraisal and the updated sampling and testing strategy, should be prepared and submitted to EPD for agreement prior to the commencement of SI works.

7.10.1.2 SI works shall be carried out according to the EPD agreed supplementary CAP. Upon the completion of SI works. CAR shall be prepared and submitted to EPD for agreement. If land contamination is identified based on SI results, a combined CAR-RAP shall also be submitted to the EPD for agreement to formulate necessary remedial measures.

7.10.1.3 Soil and/or groundwater remediation works shall be carried out according to the EPD agreed CAR-RAP if land contamination is confirmed. Upon the completion of remediation works, Remediation Report (RR)s shall be submitted to the EPD for agreement to confirm that the necessary remediation works has been completed.

7.10.2 Possible Remediation Measures

7.10.2.1 The actual remediation methods should be confirmed after completion of the site re-appraisal and the approved CAR and RAP at the later stage of the project before construction. The RAP will provide details of the remedial actions for any identified contaminated soil and groundwater.

7.10.2.2 For soil, there are several technologies commercially available to tackle these contaminants. Technologies that are commonly used in Hong Kong are biopiling and cement solidification/ stabilization. These ex-situ methods have been proven to be effective in treating the target COCs (cement solidification/stabilization on metals and biopiling on hydrocarbons).

7.10.2.3 For groundwater, some examples of remediation techniques of contaminated groundwater (e.g., air sparging, recovery trenches / wells, in-ground containment/capping and permeable reactive barriers) are shown in the *Practice Guide* from EPD.

7.10.3 Mitigation Measures for Remediation Works

7.10.3.1 Mitigation measures for the remediation works would depend on the nature / extent of contamination and the method of treatment. The mitigation measures will be recommended in the RAP and would typically include the following:

- Excavation profiles must be properly designed and executed with attention to the relevant requirements for environment, health and safety;
- Excavation shall be carried out during dry season as far as possible to minimise contaminated runoff from contaminated soils;
- Supply of suitable clean backfill material (or treated soil) after excavation;
- Stockpiling site(s) shall be lined with impermeable sheeting and bunded. Stockpiles shall be fully covered by impermeable sheeting to reduce dust emission;
- Vehicles containing any excavated materials shall be suitably covered to limit potential dust emissions or contaminated wastewater run-off, and truck bodies and tailgates shall be sealed to prevent any discharge during transport or during wet conditions;
- Speed control for the trucks carrying contaminated materials shall be enforced;
- Vehicle wheel and body washing facilities at the site's exit points shall be established and used; and
- Pollution control measures for air emissions (e.g. from biopile blower and handling of cement), noise emissions (e.g. from blower or earthmoving equipment), and water discharges (e.g. runoff control from treatment facility) shall be implemented and complied with relevant regulations and guidelines.

7.11 Evaluation of Residual Environmental Impacts

7.11.1.1 Recommended further works for the proposed works area with excavation / site formation works would need to follow EPD's *Guidance Manual*, *Guidance Note* and *Practice Guide*, and any soil / groundwater contamination would be identified and properly treated prior to the development works at the contaminated area. Land contamination impacts are therefore considered surmountable to the construction workers during construction phase and future occupants during operation phase if the recommended actions as outlined in **Section 7.10** were followed and contaminated soil and groundwater (if any) were properly treated using appropriate remediation methods and according to EPD's approved RAP.

7.12 Conclusion

7.12.1.1 Site appraisals, in the form of desktop review and site walkovers, were conducted in 2022 and 2023 to identify any current / historical potentially contaminating and uses within the Project Area. Based on the findings of site appraisals, potential contaminated areas were identified.

7.12.1.2 A SI, sampling and laboratory analysis plan, targeting the potential contamination area and hotspots identified within the Assessment Area is recommended in the CAP. At the time of preparation of this CAP, Lam Tei Quarry (TMB-N-R, TMB-N-01, TMB-N-02), TM-CLKT Area (TMB-S-R) and former TM-CLKT Site Office (western portion of TMB-S-02) and site at Mong Wing Street (TMB-S-05) were inaccessible during the time of preparation of the CAP. It was also observed that all the potential contaminated area are in operation and infeasible to conduct site investigation (SI) and sampling works at EIA stage. Therefore, prior to the development of these areas, site re-appraisal of the whole Project Areas should be carried out in order to address any new contamination issues caused by the (i) changes in operation of the identified potentially contaminated site and (ii) changes in land use within the Project Area. The supplementary CAP(s), incorporating the findings of the site re-appraisal and the updated sampling and testing strategy, should be prepared and submitted to EPD for agreement prior to the commencement of SI works.

7.12.1.3 SI works should then be conducted according to the supplementary CAP(s). Upon the completion of SI works. CAR shall be prepared and submitted to EPD for agreement. If land contamination is identified based on SI results, a combined CAR-RAP shall also be submitted to the EPD for agreement to formulate necessary remedial measures. Any identified contaminated soil and groundwater should be treated according to RAP(s) approved by EPD and Remediation Report(s) (RR(s)) should be submitted to EPD for agreement after the completion of the remediation works. No development works at the contaminated areas shall be commenced prior to EPD's agreement of the RR(s).